Development of the Methodology of Applying Multimedia Means for Distance Courseware Design, Development and Implementation

Dr. S. Kudriavtseva;
Dr. V. Kolos; Glushkov Institute of Cybernetics
Dr. P. Kommers; University of Twente

PROJECT NUMBER
PL 961125

PROJECT ACRONYM
MATEN

PROJECT FULL TITLE
Multimedia Applications for Educational Telematics Network

PROJECT CO-ORDINATOR
University of Twente
Faculty of Educational Science and Technology

TELEMATICS APPLICATIONS PROGRAMME
(EDUCATIONAL SECTOR)

Contents

Content ..............................................................................................................................................................................................1
1. Introduction ..................................................................................................................................................................................2
2. Main Objectives of Multimedia Use in Telematics-Based Learning .................................................................................2
3. Classification of Educational Multimedia. .............................................................................................................................4
4. Development of the methodology for telematic-based multimedia courseware creation. .............................................4
   4.1. Pre-production ....................................................................................................................................................................5
   4.2. Design ...................................................................................................................................................................................8
   4.3. Implementation ..................................................................................................................................................................15
5. Copyrights ..................................................................................................................................................................................16
6. References .................................................................................................................................................................................28
1. Introduction

At present time we see two main directions of information technology progress:
- high level of telecommunication development;
- multi-functionality of equipment.

This situation has created the favourable conditions for new media use in telematic-based education. Over the last fifteen years communication mediated by computers has grown in volume and variety. New technologies have continued to develop apace providing richer sources of information in imaged and sound in addition to text-based E-mail, telephone conversation and broadcast TV. Video and audio information use open new possibilities for teleteaching implementation (B. Somekh and N. Davis, 1997; N. Davis, 1996). Multimedia resources are used to improve quality of education in particular in the case when telecommunications is the means of access (N. Davis at al., 1996; N. Davis, 1995).

2. Main Objectives of Multimedia Use in Telematics-Based Learning

Each multimedia fragment that is included in the course or multimedia tool that is proposed for the learners has to be selected in respect to goals, objectives and content of the learning. The general approach in using multimedia asks for the following points in respect to distance learning process (see Fig. 1):

- **Content presentation**
  - learning material presentation;
  - tests implementation;
  - activities implementation.
- **Friendly interface creation**:
  - screen development;
  - interaction providing;
  - navigation organization.
- **Intercommunication implementation**:
  - discussion organization;
  - informal communication providing.
Main objectives of multimedia use in telematic-based learning

- Content presentation
- Tests implementation
- Activities implementation

Course presentation

Friendly interface creation
- Screen development
- Interaction development

Intercommunication implementation
- Discussion organisation
- Informal communication providing

Navigation development

Fig. 1. Main objectives of multimedia use in telematic-based learning.
3. Classification of Educational Multimedia.

Educational media are the communicative resources for those who offer and support education and those who are participating in educational activities (“ISM-1” – course, 1997). Classification of multimedia that are used in telematic-based learning may be made from different point of view:

- on the base of communication mode (see Fig 2.);
- on the base of multimedia communication technologies (see Fig 3).


The process of creating multimedia educational software, as any development process, can be broken down into a series of basic steps covering both interface/architecture development and content development. We can summarize these steps as follows:

- Pre-production
- Design
- Implementation
In further consideration we shall dwell on specific features of each step concerning to multimedia involving in courseware.

4.1. Pre-production.

Pre-production can be tedious, but it’s critical to any multimedia project. Planning your project before starting it ensures that you can deliver a cohesive product to your audience. Developing realistic goals and schedules is the best way to get a project finished and into its final form sometime near its deadline. Preproduction stage includes:
- conceptual design development,
- target audience analysis,
- specification creation,

4.1.1. Conceptual design development.

The first stage in any software development is plainly that of concepts when the idea for the courseware emerges. At the start of a courseware project it is always better to be ambitious than conservative with regard to application features simply because it is easier to prune down an over-bold wish-list during the development process than to add features to a conservative software specification, particularly after development has commenced. The content provider should draw up an ambitious list of desirable application features with relatively little consideration of technical problems.

Needs

The first question to be asked is “Do we need this courseware?” That is, will the courseware perform any one or more of the following functions:
- improve teaching quality
- improve teaching productivity
- gain a higher profile for the institution and thus help to raise funding
- make money for the institution

This question will be particularly pointed if the costs of development are to be borne by the institution itself rather than external funding bodies, as opportunity costs will need to be considered – the cost of the courseware could be used, say, to employ a lecturer for a year.

Resources

The second question to be asked is “Do we have the resources to develop this courseware?” The resources in question are, of course, money, time, and people, no one of which is sufficient.
Fig. 3. Educational multimedia classification on the base of telecommunication technologies.
Pedagogy

Related to the question of needs, and just as important, is the question: “Will the courseware improve the quality of teaching?” In other words, to use a commercial term, does the courseware that will be developed improve the pedagogical aspects in comparison to currently used teaching methods?

Some instructional approaches (Kearsly Gregg, 1998) take into account the use of different media to increase the effect of learning and provide certain outcomes. The following learning theories apply to multimedia use:

- Anchored Instruction Theory had been developed by the Cognition & Technology Group at Vanderbilt under the leadership of John Bransford. The main focus of the work is on the development of interactive video materials, that make it possible for students to easily explore the content.

- Cognitive Flexibility Theory, which had been developed by R.Spiro, P.Feltovich and R.Coulson, is especially formulated to support use of interactive technology (videodisk, hypertext).

- R.Mager’s Criterion Referenced Instruction Theory. Training programs developed in Criterion Referenced Instruction format tend to be self-paced courses involving a variety of different media.

- Gragne’s Conditions of Learning Theory. Gragne identifies five major categories of learning: Verbal information, intellectual skills, cognitive strategies, motor skills and attitudes. Different conditions are necessary for each type of learning; so in each particular case appropriate media have been used.

- A.Paivio’s Dual Coding Theory. The main principle of theory is that recall/recognition is enhanced by presenting information in both visual and verbal forms.

Other instructional approaches consider individual differences. For example, the H.Gardner’s Multiple Intelligence Theory suggests that there are a number of distinct forms of intelligence that each individual possesses in varying degrees:

- linguistic,
- musical,
- logical-mathematical,
- spatial,
- body-kinesthetic,
- intrapersonal (e.g. insight metacognition),
- interpersonal (e.g. social skills).

This theory shares some common ideas with other theories of individual differences such as Aptitude-Treatment Interaction Theory of L.Cronbach and R.Snow – the concept that some instructional strategies are more or less effective for particular individuals depending upon their specific abilities. So, different forms of learning material presentation and different media have to be involved in learning process.

The G.Salomon’s Symbol Systems Theory are closely connected with both groups of instructional approaches mentioned above This theory is intended to explain the effects of media on learning. One of the critical concepts of Salomon’s theory is that the effectiveness of a medium depends upon its match with the learner, the context...
and the task. There is a reciprocal relationship between media and learner; each can influence the other.

Bandura’s Social Learning Theory and J.Lave’s Situated Learning Theory consider the role of interaction and social interaction in particular in learning process.

Thus the different media use in instructional systems can considerably increase the effect of learning by the
- use of different forms of presentation that provides attention, creativity, mental models, imagery, memorizing, and intelligence;
- individualizing of learning that provides different learning styles and enhance memorizing and mental models creation;
- different interactions and collaboration that provides attitudes, feedback and mental models.

4.1.2. Target Audience Analysis

The courseware should be aimed at a particular population of users. The important point, at this stage in the development process, is that the target audience should be accurately identified by the development team. Similarly, it is important that the delivery platform for the courseware should be defined at this stage, as this is a criterion in defining the target audience. The lower the delivery platform specification the greater the potential audience, although of course the application functionality may be reduced.

4.1.3. Specification creation

The content provider and developer together need to produce a wish-list of desirable application features from which the eventual application will be produced. The developer needs to be involved in order to advise the content provider on what is, and is not, technically possible to achieve.

Once the first document has been drawn up it has to be refined into a document detailing the functional requirements of the courseware that the developer can use as a basis for implementing the software.

4.2. Design

Design stage includes:
- Delivery platform selection
- Media selection
- Selection of tools
- Budget planning
- Outlining and prototyping

4.2.1. Selection of the delivery platform

A point that should be considered at the software design stage is how the application will be distributed. As is well known, multimedia applications, particularly those using digital video, can consume tens of megabytes of disk space. The most popular
ways of multimedia application distribution are: CD-ROM and WWW. Interactive multimedia stands a much better chance of success if the WEB is used as learning environment rather than a number of isolated PCs with or without CD-ROM. Network distribution has a number of significant advantages over disk distribution:

- **Speed.** Delivery time to the user can be measured in minutes, assuming a broadband (megabits per second line speeds) connection and moderate network traffic.

- **Ease of distribution.** Disk-based distribution requires time-consuming disk copying and envelope stuffing, and runs the risk of loss or disk corruption in the post.

- **Substantially reduced distribution costs.** No physical media, no delivery charges, and a network free for users, reduce distribution costs to the cost of server disk space and the time required to mount the application.

- **Flexible upgrading and patching.** Upgrades and bug fixes can be placed on a server as and when required and users informed via email.

Some of the disadvantages are:

- **Network connections** that may be unreliable.

- **Payment.** Unless the courseware is to be made freely available a system of user authorisation and invoicing needs to be created which may require a high level of skill on the part of the server administrator.

- **Security.** Exposing a host computer to a publicly-accessible network runs the risk of it being hacked into, and of course ordering and payment systems need to be secure.

- **Documentation.** Users often prefer hard copy manuals to online documentation, so these may have to be sent out in the post, incurring some distribution costs.

As the number of Internet connections grows, courseware distribution via the Internet will become more cost-effective.

Bellow we’ll consider the characteristics of WWW as distance education delivery platform.

**Using WWW technology for delivery distance course.**

WWW is a collection of protocols and standards to access the information on the Internet. These standards and protocols defined a particular kind of information.

Reading rooms will increasingly be transformed into rooms with ordinary WEB browsers or cheap network computers. Lecture notes, books and sheets are more and more consulted through a PC or networked computers and printed if necessary. In the latter case we are dealing with a form of ‘printing on demand’. Universities and colleges are thus able to provide up-to-date information and instruction materials while keeping the cost of printing to a minimum. Lecturers like to put all sorts of information on the WEB. All parties involved in education benefit from it. This means that every actor on the work floor is motivated to use it. Studying in digital learning environment and organising higher education for ‘knowledge society’ is about computer supported education in general. In particular it is about learning
environments such as computer based simulations in the form of interactive ‘dynamic
graphics’ on the WEB (Min Rik, 1998).

Using WWW servers as delivery platform allows to:
- present learning material as Hypertext material (curricula and courses information,
etc.),
- distribute of learning material, e.g. books (in various formats like postscript, word
  processor, etc.), programs, applications needing a specific interpreter/language for
  the client;
- use embedded multi-media,
- provide interactivity during on-line learning process,
- provide collaboration;
- combine multimedia and tutorials

Example.

WWW - based distance course on the Communication and Information Technologies
(CIT course) was developed according to Copernicus project "Flexible and Distance
Learning through Telematics Networks - A Case for teaching English and
Communication and Information Technologies" (participants: the Netherlands,
Twente University - co-ordinator, United Kingdom, Bulgaria, Lithuania, Ukraine).
The Web-server used for the CIT course delivery has the next main functions:
- integration educational texts and multimedia
- hypertext support of local and remote links to distributed educational materials
- interface with some kinds of remote programs for student access to educational
  materials (GOPHER, TELNET and other) and tutor (e-mail)
- feedback and interaction within course delivery (CHAT, on-line tests, E-mail)

Experience shows that WWW can be used in education and training in different ways
and levels: from additional resource bank in face-to-face learning activities to
carefully designed virtual classroom.

The advert of Java the programming language and other WEB techniques that are
available to all provide the designers of learning environment with unlimited
possibilities. With the help of Java software designers can make loose components for
teachers (‘building stones’) for example bare computer-based simulations. It does not
matter on what platform something is developed: the applications (‘applets’) are
platform independent. Building stones made in Java can be included in any WEB
page. Applets are found on a WEB page and they are usually interactive, visual and
dynamic. That particular form is for education the one with the most possibilities.
These days an increasing amount of valuable applications in applet form is appearing.
Java-applets have solved two problems: it is an easy and natural way of spreading
software all over the world and a way to be platform independent.

WWW as learning tool.

Let’s consider some basic moments about WWW media:
<table>
<thead>
<tr>
<th>Location of the students</th>
<th>Different place and different time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>complicate</td>
</tr>
<tr>
<td>Way to present information</td>
<td>nonlinear</td>
</tr>
<tr>
<td>Elements of the information</td>
<td>text, color, audio, graphic, animation, video</td>
</tr>
<tr>
<td>Learning strategy</td>
<td>student oriented</td>
</tr>
<tr>
<td>Model of interaction</td>
<td>branching</td>
</tr>
<tr>
<td>Time of interaction</td>
<td>short delay</td>
</tr>
<tr>
<td>Way of interaction</td>
<td>text, visual</td>
</tr>
<tr>
<td>Strategy of interaction</td>
<td>material oriented, oriented,</td>
</tr>
<tr>
<td>Object of interaction in student's point of view</td>
<td>study material</td>
</tr>
<tr>
<td>Teacher's possibility to control the interaction</td>
<td>low</td>
</tr>
<tr>
<td>Costs of the production</td>
<td>low software costs, high labor costs</td>
</tr>
<tr>
<td>Costs to use</td>
<td>cheap to use</td>
</tr>
<tr>
<td>Costs of the updating</td>
<td>cheap to update</td>
</tr>
<tr>
<td>Costs dependent on the number of students</td>
<td>fixed</td>
</tr>
<tr>
<td>Speed</td>
<td>slow material production, quick material delivery</td>
</tr>
<tr>
<td>Updating</td>
<td>complex, quick redelivery</td>
</tr>
</tbody>
</table>

What are benefits from WWW use in educators activity?

- Students would be able to study the course from anywhere in the world, thus overcoming the restrictions imposed by the traditional delivery mechanism that requires a postal service.
- We are interested in the possibilities afforded through hyper-textualizing. The materials and the greater flexibility of navigation which this would provide.
- We recognized that a hypermedia version of the course would allow for a tighter integration of the various media employed in courses (such as text, video, interactive activities and so on) and increase interactivity. In traditional distance education, the various media are deliberately not tightly integrated so that the student has more opportunity to be flexible in when and where she or he studies. Whilst this has some benefits, it also means that the material has to be chunked into larger components. The tighter integration and increased interactivity offered by a hypermedia presentation may have important pedagogical benefits because it allows the student to go directly to any of the components for the information required.

The most basic element of using the Web as a pedagogical instrument is found in its ability to present information clearly, attractively and practically.

From a curricular point of view, the Web can be used to design tutorials and on-line lessons for a variety of subjects. For example, you can create online tutorial on basic chapters of your subject. Students are introduced to basic notions by reading a
hypertext version of learning material. The hypertext version contains links to a dictionary of terms, as well as annotated comments from other readers that can be added to by any user. In a sense, an automatic tutor is already built into the Web site; discussion and questions are presented as they would be in a live introduction to your course, yet because the coursework is built into the Web, each student may dissect the subject (and thus progress her comprehension of it) at her own rate.

There are many benefits accruing from the decision to maintain a WWW site as a central integrative environment for a course. Some of these are generic to any central electronic site but are made particularly flexible through the WWW hyperlinked organisation:

- students can access the environment at any time, from a variety of locations (this is useful not only for students already enrolled in a course but also those considering taking the course, to help them in decision making about course). For example, there is no need for either the instructor or students to be inconvenienced if students did not get a copy of a particular handout; they can simply download it or print it out from the WWW site.
- the material can be continually updated, although some procedure to help students identify what has been changed or added is important. Updating relates not only to procedural aspects of a course, but also to lecture notes to new resources that the tutor and the students, identify as useful to the course, and to student work itself.
- the tutor has an efficient way to communicate and disseminate information and resources to the students, avoiding the need to have to bring photocopied piles of handouts to class. The tutor can offer a broad range of course-resource possibilities to students, which the students in turn can choose to retain or not.
- there is a capacity that a learner or teacher can visit a site, study the resources there, and at the same time communicate with the author of the site, even if that author is in another side of the world.

Use of the WWW allows students to design and build hypermedia documents as part of the curriculum, lectures or theses.

We would like to note that HTML standards dictate how WWW site is to be interpreted by WWW browser, so when one converts a text document into WWW document, its appearance as a user-friendly HTML document can be predicted with ease. Additionally, one can use hypertext to organise enormous amounts of data in a relatively lucid fashion, using menus, key word searches, even clickable graphics as a means to link the user to more and more information.

Problems of WWW use.

Unfortunately, trying to develop stable courses using evolving technologies is itself a major problem as different students have different facilities. In addition to the pedagogical considerations, developing at the leading edge of high technology will exclude some students, while adopting a “lowest common denominator” approach lacks real innovation.

There isn’t unified, common acceptable hypermedia design guidelines that are generally applicable as to how to organise instructional material, because the decisions are so depend on the course material. Some authors (Benyon, 1997)
comments that a challenge to hypertext authors is to put just enough information on a node – not too much and not too little. Though in WEB-based implementation where students will be using different sizes of screen, controlling the screen layout is impossible.

Other difficult design issues concern the dividing up of WWW-pages into separate files. Such design decisions have to be taken bearing in mind that many students will be studying the material from home and may wish to download large section, whereas other students may wish to study on-line.

So, why use the Web for Open & Distance Learning?

• User-friendly
• Availability of content-rich materials
• Customizable by tutor
• Integration of text, graphics, sounds, video, animation and communication into a single tool
• A minimal learning curve to use tool
• Students study at own pace
• Continuously accessible
• Cheap to prepare
• Low cost

4.2.2. Media selection

To start selection of educational multimedia that will be used in the course tutor has to clear up the course needs and learners’ abilities concerning to multimedia access and establish a balance between these two items. Distance tutor can use these criteria during media choice for your distance course (D. Rowntree, 1996):

1. Do any of the learning objectives dictate certain media?
2. Which media will be physically available to the learners?
3. Which media will be most convenient for the learners to use?
4. Are any media likely to be particularly helpful in motivating learners?
5. Are you under pressure from the organisation to use/avoid certain media?
6. Which media will you (the teacher) be most comfortable with?
7. For which media will learners already have the necessary skills to use?
8. For which media do you (the teacher) have the necessary skills to use?
9. Which media will you be able to afford to use?
10. Which media will the learners be able to afford to use?
11. Which media might you call on to back up the main media and/or to ensure adequate variety?

Answering all these questions, distance course developer can select the most suitable multimedia for concrete course, taking into account costs and the speed of data transmission.

The concept presentation form relates to the way in which information is presented to the learner’s senses, normally by sight or by sound (“ISM-1” – course, 1997).
The presentation form helps us to distinguish content from the way that the content is organized and presented. For many subject areas, the type of content lends itself to certain types of presentation forms more than to others. In law, for example, much use is made of text as the presentation form for the content; in mathematics, use is made of combinations of text, symbols, and graphics; in the medical world, use is made of text but also of images, photographs, and sketches.

A good analysis of the message one wants to communicate in a lesson, plus a good understanding of the most appropriate presentation form to use for that subject area are needed before the designer can turn to the layout of the information to be presented. What medium finally gets chosen depends on the instructional context and the chosen sort of learning activity.

4.2.3. Selection of tools

A crucial decision to be made is which development tool to use. Among the criteria that can be used are:

- expertise of the developer;
- suitability;
- ease of interface design;
- cost;
- runtime licensing;
- future of the environment;
- technical support.

Additional software for multimedia courseware incorporates images, sound and video, may include:

- graphic packages;
- wave audio editors;
- digital video editors;
- file format conversion utilities;
- on-line help editors
- data-base package;
- etc.

4.2.4. Budget planning

Beside the developers’ salaries and other expenses for any software production, the developing multimedia telematic-based courseware needs the specific budget articles. This are

- correspondence telecommunication payment;
- licenses and copyrights payment for some multimedia educational materials;
- software and hardware to produce multimedia fragments:
  - microphone,
  - recorder,
  - video-camera,
  - photo-camera,
  - video-conference and/or audio-conference,
  - etc.
• software and hardware to digitize some content materials:
  ✔ capture card,
  ✔ sound card,
  ✔ scanner,
  ✔ etc.

Necessity of each item will be considered in further consideration.

4.2.5. Outlining and prototyping

The core element of the multimedia production is usually a detailed outline. This contains all the text used in the production and specifies the images needed. It mentions when important sound is required and focuses on the messages and how it can be presented to the audience. This is where the content is polished and delivery style determined.

The outline can then be used to determine actual budgets for time and is the guide for the programmer who will integrate all the multimedia elements.

Once you have created a detailed outline, you may wish to create a prototype to try out your ideas, layout, and interface to see if they work. Interactivity is one of the hardest areas to visualize. A flowchart is the most effective way to visualize how a learner can progress from one screen of the courseware to another.

Modern software development tools - programming languages and authoring systems - allow for the rapid creation of working models and mock-ups. This undoubtedly gives the developer considerable freedom to experiment. It also allows the developer to prototype at all stages of development, from the moment the first code is written, or object is drawn, right up to the last version. This is not only a considerable help when it comes to program testing but it can also enhance and facilitate the dialogue between content provider and developer.

At all stages of the software lifecycle the developer should produce prototypes both for internal testing and to demonstrate to the content provider. Prototyping is a major part of the developer-content provider dialogue for many reasons. Amongst these are:

• misunderstandings are identified by showing on screen what was previously on paper;
• the content provider can test modules from their viewpoint and ask for amendments if necessary;
• possibilities can be demonstrated to the content provider who will sometimes need to be shown what is possible before s/he can formulate requirements;
• the feasibility of application features may be assessed particularly from the viewpoint of 'user-friendliness'.

4.3. Implementation

The process of creating multimedia educational software can be broken down into a series of basic steps. With respect to main objectives multimedia use in distance courseware we can summarize these steps as follows:
• Content development
• Interface development
• Intercommunication development

4.3.1. Content development

By definition, it is the responsibility of the content provider to supply the educational content of the courseware by putting together source materials – texts, audio clips, images, etc. - and organising them coherently. It is of crucial importance that most of the content is in place before the implementation of the courseware begins, for two reasons:
• the content will, to a great extent, dictate the structure of the courseware;
• development requires content to advance application.

Starting the content development for telematic-based courseware developer has taken into account two factors that are very important for telelearning:
• the speed of data transmission, because audio and video materials usually are presented by the large files and
• cost of channels, in particular for video-conferencing use for lectures and presentations that are expensive.

There are basically two ways to create multimedia content material: produce it yourself or get it elsewhere.

5 Copyrights

This is a serious issue for all multimedia courseware developers. The law of copyright applies to software as they do to books, music or any other media, the use of any materials requires the permission of the copyright holders. This may not always be easy to obtain. There may be multiple copyright holders. The holders may be difficult to track down, or they may not reply to permission requests. The multimedia courseware developer has to operate very carefully and should avoid using copyrighted material except where absolutely necessary, and instead create material or find copyright-free material in the public domain.

Sources of public domain materials

There is a considerable amount of usable material in digital form in the public domain that the courseware developer can profitably use or adapt. Such material includes:
• texts,
• clip art,
• photographs, such as stock libraries on CD-ROM,
• audio clips,
• video clips.

It is, however, erroneous to assume that because material is in the public domain that it is necessarily copyright-free. If any documentation is present with the material, whether electronic or hard copy, it should be scrutinised carefully for conditions of use. Similarly, material available on the Internet is covered by copyright laws,
although there is an understanding amongst Internet users that material placed in the public domain, not accompanied by details of use restriction, can be used freely for personal and non-commercial purposes as long as it is attributed.

Methodological aspects of audio use for telematic-based courseware

Sound may be central to the courseware focus, for example, for music history or foreign language learning or can enhance navigation or fill access period. We can use our voices as powerful instruments, to capture attention, to send a message, to soothe or set a mood.

When thinking about audio, we can distinguish between audio by itself as a carrier of a message, and audio as part of a more-complex system (i.e., audio used for feedback within a computer-based tutorial or an interactive WWW site) (“ISM-1” –course, 1997).

Audio consists of three different forms:
- sound effects;
- music fragments;
- spoken text.

Audio that is presented in real-time (synchronously), such as a radio broadcast, a telephone communication or a lecture, has the disadvantage of being gone as soon as the sound finishes. The audience must find a way to remember what was heard. There is only one chance to hear the message, and no way to reproduce the message so that others, at different times and places, can also hear it. Thus it is not surprising that we pay a great deal of attention to ways to store audio, so that it can be heard asynchronously, when, where, and as many times as we want it.

Here are some of the many reasons for audio use in learning-related situations (“ISM-1” –course, 1997):
- Presenting audio source materials
- Putting new emphasis and interest into ideas that are presented already in another way (usually text)
- Help learners by talking to them during a task, perhaps via an audio-tape
- Make some aspects of printed or print-based study materials more human and interesting
- Communicating in ways that do not show up in printed text, such as by inflections in the speaker's voice
- Add audio to stimulate and motivate attention
- Audio can influence feelings (especially music)
- It can be interesting to hear the voices of others, including distant students and distant experts
- Audio might be useful for explaining some course materials to students who do not learn well from reading text
- For students who are at a distance from one another, communicating via audio communication technology can be an important way to help them to work together on projects, to help each other with the learning materials, and to ask questions
• Voice mail can allow an easier way of communicating than having to type in all of one's questions or ideas.

The following audio production variables need to be considered when producing stored audio products:
• Where and how will you get your source material? Are there copyright issues? How will you capture and digitise the audio material if it is to be used via a computer?
• If you plan to use human voice components, you must carefully pay attention to the script, to what the voices will be saying, to the choice of voices, to the blend and distinction between voices if there is more than one voice, and to good expression in the voices
• You must be concerned with the quality of the audio, for example, keeping a stable volume and eliminating distracting noises
• You must be very careful that any audio that is synchronized with text or images is synchronized very well

Here are some design guidelines for audio used:

1. Use clearly spoken comments.
2. Design the script for listening, not for reading.
3. Avoid complicated sentences and use familiar words.
4. Use short phrases and appropriate pauses, so that the audience has time to comprehend and synthesize the message.
5. Use sound effects and music to increase interest and realism, but not to compete with spoken text.
6. The delivery rate, the voice of the narrator, and the inflection used by the narrator must be appropriate for the audience. If more than one voice is used, there must be a clear distinction between the voices.
7. Use sound effects and music to add realism and interest, but not to compete with the narration or with the message being communicated visually.
8. Encourage an active intellectual engagement by the listener by asking questions and posing problems.

Methodological aspects of graphics use for telematic-based courseware

Graphics may be used, for example, to facilitate the navigation system or demonstrate some processes within simulation (“ISM-1” – course, 1997). There are three general categories of pictures (Heinrich, Molenda, Russell, & Smaldino, 1996):
• Realistic image, that show the object being visualised in a way that looks realistic. Examples are photographs, realistic drawings, and certain technical drawings.
• Analogous image, that present an analogy of the real thing, such as a cartoon or a schematic drawing of the rings around an atom.
• Schematic image, that focus on the relationships among elements in an overall system, such as a flowchart, a map, or a topological chart.

Just as Heinrich, Molenda, Russell, and Smaldino (1996) describe three sorts of pictures, they also describe three main functions of graphics:
• To attract attention, to stir emotion, to motivate.
• To reinforce, by giving more than one form of information, for example to combine a visual symbol of a stop sign with the word Stop.
• To serve as a tool for thinking or analysis, such as a graphic that shows a representation of how electrical current flows through various resistors.

We can also classify the ways that graphics are used to accompany text (“ISM-1” – course, 1997):
• To clarify an explanation that is being primarily given in words, for example, when the sketch of the electric current flowing through a circuit as mentioned above accompanies an explanation of electric currents in a textbook.
• To break up and bring emphasis in text, to call attention by highlighting, such as the use of the little picture of the purple ball in all your study materials.
• To carry the main task of instruction, such as a flow chart of steps to follow in a procedure. In this case, words may be added as clarification of the visualisation.
• To tell a complete story, such as a cartoon that doesn't need words to get its message across.

The audio in an image-based material may be very useful. Often it is what clarifies the information line of the presentation. Also, it can add very much to the interest line, especially when good use is made of sound effects and music.

Animation is often the best tool for explaining advanced concepts. If you need to describe how certain mechanical parts work in conjunction, or how a particular machine is assembled, animation will often be the perfect solution. One of the greatest benefits of animation is that you can alter the material to suit your needs. If your presentation requires that you explain the movement of planets in the solar system over a fifty-year period, you can easily create a short segment that gets the point across clearly. This is obviously a case in which video or still images are not as appropriate as a custom-designed animation.

Animation is mostly used for:
• educational material explanation;
• a providing friendly interface;
• a facilitation of navigation;
• improving distance course design.

Animated images may be implemented by:
• Java applets;
• animated gif-files;
• etc.

Now we will summarize the most important points of graphics use in telematic-based courseware (“ISM-1” – course, 1997):
1. **Finding a balance.** Look critically at the balance between efficiency and effectiveness when using visualizations. It is not always so that more is better in terms of learning effect or even motivational appeal. So do not spend considerable time making a complicated drawing if a simple one may be just as effective.
2. *The use of color in visualizations.* When color is more difficult or costly to use than black and white, consider carefully if color brings enough added value to justify the effort. However, in computer-based visualizations, color is not more difficult or costly than black and white, so this concern is less and less important. Color can heighten and stimulate the appeal of a visualization but should not be overdone. The use of color should be appropriate to the target group and the message being communicated.

3. *The amount of realism in visualizations.* Here, again, more is not necessarily better. Too much realism or too little can both affect learning. Collis & Stanchev argued that for beginners learning a new concept, a rich visual representation is useful, to stimulate attention and to connect the new idea to familiar ideas. But when the learning goal relates to focusing on relationships, then too much realism is not good.

4. *The use of cueing techniques.* Cueing is the process of calling a person's attention to specific aspects of a picture so that they are discriminated from the overall picture. In a realistic picture, there may be thousands of distracting items that will capture the attention of the learner and distract him from what he is supposed to be focusing upon. The learner is not likely to remember the key points without some form of cueing within the picture. Here are some valuable cueing strategies for visualizations:
   - Lines and arrows that point to the important aspect of the picture
   - The use of contrast, different colors, composition, and size to make a certain aspect of a picture stand out
   - Labels added to the picture explain the meaning of the key elements

   There is research which shows that the viewer's eyes (in cultures when reading is from left to right and top to bottom) go automatically to the top left-hand corner of a picture, and in addition, tend to go to elements along the invisible lines that divide a picture in thirds. Thus the location of elements in a visualization can affect their cueing value.

5. *The placement of images and text.* There is also research that indicates that it is important to place visualizations as close as possible to the text they are associated with, when both text and images appear on a page or poster. Poor readers look back and forth frequently, while good readers look at the image first, quickly, and then focus upon the text. In either case, it is important that the text and image are close together on the page.

   Also, textual and visual elements must be arranged in layouts so that the attention of the reader is led to the important aspects.

Methodological aspects of video use for telematic-based courseware

Video is certainly the best visualization tool available and is often the only way to truly communicate your message. For example, if you are trying to demonstrate the effects of weather conditions on certain coastal regions, video footage of storms pounding the coast will have much more effect than an artist’s diagram, diagrams, or animation. If you want to show the dance steps used in different cultures, video will be easier and more effective than to use than any graphic or animation.
However, video requires extremely large quantities of memory and therefore places significant technological demands on your system. The nature of your project will determine your approach.

From an interface and design point of view, the decision to include video is not so much a question of aesthetic choice as an issue of content. Although video can be very powerful, you must use it judiciously, based upon your desires and the capacities of your media and playback system. When a beautiful full-screen graphic or animation will suffice, you may want to consider using it instead. Short video sequences can also make dramatic points or punctuation to deliver quick message. For a longer instructional video that tells a complete story, you can use a lower resolution, smaller windowed video, but avoid it in other situations. Video is the most demanding resource you can have in a multimedia project.

There are many reasons for the use of video in telematics-based education. Sometimes moving images are very much part of the content that one wishes to communicate, is in the case with describing how birds fly or helping people to visualise a complicated process involving moving parts. Sometimes video is chosen so as to most effectively and efficiently help people to picture what life was like in another place and or another time. Video can

• give the viewer a glimpse of feelings or complexity that perhaps could not be so well communicated even with thousands of words;
• be used as a cognitive tool, to help a person think more clearly about a certain process or situation;
• be used to demonstrate skills and tasks that involve motor activities;
• be a tool for capturing a complex situation and making it available for review at a later time, and with pauses;
• be used to give persons the opportunity to see and hear exceptional persons and to be emotionally as well as factually involved about human events;
• be engaging, and can be a powerful way to teach those who do not learn well by reading or who might not be motivated to read about a certain topic;
• capture attention, and can be viewed by a broad audience.

When a designer decides to use video, there can be many starting points for this decision. Several of these are:

• Where text is the starting point: How can a video supplement a book or printed study material?
• Where the desire to visualise is the starting point: How can we help people to picture what we want to communicate?
• Where redundancy of information is the starting point: If we present the same information in both text and via a video, perhaps the two forms will reinforce each other, so that better learning occur?
• Where the desire to perform is the starting point: How can drama and performances be used for impact?
• Where the desire to have a multimedia collection of information is the starting point: How can we develop a multimedia database or WWW site so that people can find interesting video and audio materials later, when they want or need them?
• Where engagement is the starting point: How can we stimulate a viewer to be more active, more involved, and can we use video for this?
But like any medium, video is not the best medium for all situations. Some of the reasons that are often mentioned as limitations of video, such as cost and complexity of production, are certainly constraints, but becoming less so with advances in technology. Other constraints of video, such as the sense that it is a linear medium where the viewer has no control over sequence or pace, are much less relevant now that video can be stored, replayed, fast-forwarded, digitised, reused in small pieces or in pieces of the viewer's choosing in digital environments. Video can be watched by entire groups or on one's own monitor; once made, video can be very inexpensive to reproduce. But video still requires more equipment to view and handle than is the case with print materials. All of us can read in the train, but few of us can view video, especially video of one's own choice. The choice of video or not video is a complicated one. To help make this choice, it is important to be aware of a variety of forms of programming for video products.

Digitizing the content

The majority of the courseware ingredients initially exist in an analogue rather than digital form: printed images, audio-tape, video-tape, and photographic slides and negatives. Nowadays, though, any analogue source of multimedia data can be digitised using suitable hardware. The vast majority of PCs require additional hardware to enable digitisation of analogue sources. This extra hardware, in the form of expansion boards or external devices, that may also- directly or indirectly – create a need for additional software, naturally adds to the cost of the computer to be used to develop multimedia courseware.

Sound is the easiest, and cheapest, analogue medium to digitise. Many PC have build-in facilities for the recording and playback of high-quality audio. PCs require slot-in sound cards that are increasingly being supplied as standard accessories. Essentially audio digitisers are simple analogue-to digital converters, that take an audio waveform as input and sample the wave – record the numerical value of its amplitude – so many times a second (the sampling frequency). Each sample is stored as a binary number that the computer can process like any other data. Playback of digitised, computer-generated, sound is accomplished by the reverse process using a digital-to-analogue converter.

Images in hard copy, whether that be paper, negative, or slide, are digitised by scanners of one form or another. A scanner will shine light on (paper) or through (film) a hard copy images and record the value of a dot (pixel) on that image as a number. With a monochrome scanner the number will be either 0 or 1. Color scanners, however, will record the pixel value as a number triplet denoting the red, green, and blue components of the pixel, and the greater the number of bits allocated to this value the greater the number of colors visible in the resulting scanner image (its color depth). The other major determinant of scan quality is the resolution of the scanner, or the number of dots per inch (dpi) it can resolve on the hard copy – the higher the resolution the higher the quality. Scanners vary considerably in price, the major determinant, of course, being scan quality (resolution and color depth).

Digitising video can be problematic and is certainly the most expensive form of content digitisation. Developers and content providers should think long and hard
before deciding to incorporate video fragments within courseware. Whilst video can undoubtedly aid the learning process, because our visual perception is highly attuned to movement, the pedagogical value added by video in courseware must be balanced against the technical complications and costs that it incurs. These include:

- cost of the capture card;
- high speed of data transmission;
- disk space.

Inclusion of video-fragments in telematic-based courseware can limit its target audience to those with sufficiently capable hardware and even then the replay may not be of an acceptable quality.

4.3.2. Multimedia use in interface implementation for telematic-based learning.

The interface is an extremely critical facet of a multimedia telematic-based courseware, so screen design must be well thought-out from the perspectives of good graphic design; user-friendliness; and appropriateness to the learning content. Interface is the focal point and control center of any courseware. It brings the multimedia components (text, graphics, sound, animation, and videos) together into a cohesive whole; and it’s the all-critical graphic environment through which a user interacts with them. Interface implementation includes:

- Screen development
- Interaction providing
- Navigation organisation

By today’s standards, a user interface should be extremely intuitive, eliminating the need for written instructions. Proper use of icons, good screen design, logical ordering of content, and a consistent structure are all important concerns when planning a user interface.

Be conscious of whether or not your project feels consistent. All the screens should have the same basic elements, with all the key buttons always in the same location.

You should also make sure you have enough room to include graphics or text on any given screen. An interface should make sense at a first glance to any user. It should also be intuitive in regard to design sense, button placement, and logical data flow.

It’s important that you offer learners an unfettered path through your courseware. They should be able to intuitively locate whatever it is that interests them without having to go through each screen or button. They should also be able to navigate through a variety of interactive level and still find their way back to where they began.

Where possible, you should create extra guidance. For example, some programs will provide dialogue and/or message boxes with information on alternate path or approaches to information. Some project include interactive maps that show the levels and sub-levels of the learning material structure, allowing learners to change location by referring to the map and clicking on the area they wish to visit.
It’s also nice to build in reward for learners. If they’ve completed an entire section of course, it’s useful to create an animated segue to the next screen.

An ergonomically designed interface will offer a logical flow between different functions. It should not force learners to look all over the place for information and buttons, but maintain consistency in the placement of text, graphics and navigation tools.

Glowing and pulsing buttons can heighten the visual impact of your interface. Sound effects that reinforce various choices and actions can make a courseware more stimulating. If there are questions in learning material, sound effects for “yes” and “no” answers are a great means of livening up the presentation, and they make it easier to understand as well.

Make sure you don’t include too much dynamic media, as it can lead to other problems. If your interface is to heavily laden with animation and video, it will tend to slow down, regardless of the system you are working on.

The layout of the screen should read easily and be able to be browsed quickly. Background should have an interesting design with good color composition, but they should never overpower foreground elements.

A term that is used in many ways with respect to educational media is interactivity. We use it to distinguish a media product where the designer plans the entire sequence and pace of a presentation in advance and the user cannot alter this sequence unless he stops the presentation (such as with a movie or linear multimedia presentation). A media product where the designer builds in choices for the user as to what the user wants to see, in what order the user wants to move around in a product, and even where the user can decide for himself when he is finished with a product. A WWW site is an example of this second type of product, which we call an interactive multimedia product. But there are also other ways to think about interactivity with respect to educational media:

• In the broadest sense of the word, there should always be some interactivity when a learner is using educational media, because he should be mentally active as he watches a movie or listens to an educational radio broadcast or reads a textbook. Even as he only watches a linear multimedia production, for example, the learner should be trying to extract the message, and consider the information from different perspectives. Thus he should be mentally interacting with the learning material.

• Sometimes the interaction can be tactile, such as when a learner works with a model, or figurative such as when a learner is mentally interact, reflecting on what he has seen in a film or heard and seen in a college or read in a book or from a screen. There is also some disagreement as to whether turning the pages of a book is interactivity; it is, in the sense that the reader can determine which page he goes to and how fast he reads. But it is a limited form of interactivity compared to a WWW site for example, because the material is typically meant to be read in the order in which it is presented.
• The most specific meaning of interactivity with respect to educational media relates to computer-based materials that are programmed to respond in different ways, depending on what the user chooses or answers.

Information flow is important as well; so it might be a good idea to chart project out on paper, showing the various areas where learners can reach out and find data that they might not otherwise encounter. Keep in the mind that unlike most viewable media, such as television or films, interactive multimedia is nonlinear. Therefore, “interactive” means that learners don’t necessary have to proceed through it in a straight, linear fashion from the first screen to the last. If they need one piece of information before proceeding to the next, than plan your project accordingly, making sure that the button to reach item two can only be clicked after going through item one.

4.3.3. Multimedia use for intercommunication implementation in telematic-based learning.

Intercommunications in telematic-based courseware may be used for
• Discussion organisation
• Informal communication providing

_Synchronous communication_ occurs when persons are communicating with each other at the same time, via various forms of communication technologies. Usually this means that the persons are not at the same location. Here are some examples, all very important in some forms of tele-learning (Collis, 1996):

_Audio conferences:_

Via a technical bridge supplied by the telephone company, more than two persons can talk with each other at the same time on the telephone. This is often used to support a group discussion when participants are at a distance from each other. There is no stored instructional material involved; the technology (or media) is used as a channel or a tool and the people themselves have to supply the organisation and meaningfulness of the experience.

Audio-conferencing can be audio-only or supported by enhanced image or data transmission – audio-graphic conference. Audio-only conference typically utilises the public telephone system to link together people at two or more locations.

Audio-graphic conference combines technologies for voice communications with image or data transmission. While voice remains the principal communication medium, audio-graphic peripherals provide a visual component. Audio-graphic peripheral devices include the electronic blackboard, still video technology and the personal computer.

Advantages of audio-conferencing:
• Audio-conference is comparatively inexpensive to install, operate, and maintain.
• It uses available telephone technology and can therefore reach many students.
• It is a generally familiar technology to teachers and students and is relatively easy to use.
• It is an interactive medium, allowing direct student and instructor participation. Students have many opportunities for give and take with other students, the instructor, and outside experts.
• It can be very effective when used in combination with other media including print, video, and computers.

Limitations of audio-conference:
• May encounter initial resistance until users become familiar with the equipment and know how to use it effectively.
• Can be impersonal because it eliminates non-verbal cues and body language such as smiles, frowns, arm and hand movements, etc.
• Places restrictions on the type of content that can be delivered in an oral format.

Groupware

The shared workspace software we described earlier is one example of groupware. Groupware is a general term to describe any computer software that can be used by all members of a group to help them in various ways to carry out their group tasks. Sometimes groupware can be used by participants at the same time, either when they are in the same place or at a distance from one another. Other times groupware is more useful when group members can access it whenever they want, and not just synchronously.

Audiographic tools

Earlier, this was a way for persons not at the same location to see the same materials on their computer screens via networking while also talking to each other over the telephone. As technology has advanced, people tend to do this via a single groupware application and even over the WWW. The software program NetMeeting is a free WWW site that allows people in different places to see and hear each other at the same time as they work simultaneously on the same document, as long as they all are using the NetMeeting site at the same time.

Videoconferencing

Videoconferencing is a rather old technique as far as technology goes, but like everything else with technology, is improving all the time. In videoconferencing a person or persons in one location can see and hear persons in another location, and vice versa. Sometimes this is done via a large screen, so that a whole group can see a speaker who is in another location; other times a small group of persons in one location see and talk to a small group in another location. Videoconferencing is now available over the WWW if all locations who wish to communicate with each other have a video camera attached to their computer, software to compress the digital video signal so that it is small enough to send through the network, software to decompress the signal once it is received at the other location, a microphone to capture the voices, and software that digitizes and transmits the audio so that it arrives at the other computer or computers at the same time as the video signal. Although this can now be done over an ordinary Internet connection because compression techniques are improving all the time, the quality of the video and audio is much improved the higher the speed of the network. Usually ISDN connections at least are
preferred. Videoconferencing can be combined with tools so that the participants can not only see and hear each other, but can work simultaneously on the same document or look simultaneously at the same file. Then this becomes a form of groupware that we call desktop videoconferencing. If you pick up any computer magazine, you will probably read about these sorts of systems. They are not educational media in themselves, because no instructional materials are built in, but tools to help people when they are working and/or learning together.

In an educational environment, videoconferencing may be used for teacher led distance education initiatives. However, many other scenarios may occur, from "one on one" teacher/student dialogue, to "many on many" student led discussions. This creates new and previously unforeseen problems, that are unique to the teaching domain, and in many cases go beyond the designers’ original remit for the technology (Kies Jonatan K., 1998).

These education specific characteristics of video conferencing equate to a set of skills and knowledge, which have not been necessary before. If video conferencing is to enhance education, then it must be used appropriately and within context (McMillan B., 1994). It is necessary not only to examine the areas where video conferencing can be used effectively, but also to highlight its inefficient usage.

Typical scenarios include desktop conferencing between two sites where each site may have one or more active participants, where both sites are actively involved in dialogue or discussions.

Chat

Chat gives the possibility for student groups to get together on-line in real time. Once or twice a week a special one-hour chat session may be held. These sessions may have a moderator who would answer questions about appropriately defined theme or be a free conversation among students and other course participants. Chat is also useful for the student groups to meet and discuss their assignments.

Asynchronous communication is communication via a network where the message is written at a different time from when it is read. There are three main types of software environments that support asynchronous communication:

- **E-mail** and sending attachments by e-mail
- **Computer conferencing and WWW-Board** environments, where messages sent in the form of a group discussion are saved and made available to everyone in a group
- **WWW sites**, which can contain both of the above forms of communication support as well as other forms, such as the fill-in. These fill-in forms are called CGI scripts.

5. Summary

The general outline of multimedia telematic-based courseware development process is presented on Fig. 4.
Fig. 4. Outline of multimedia telematic-based courseware development process.

6. References.


Davis N., Superhighways for Teachers AND Teachers for Superhighways. 1996.


Min Rik (1998). The WEB as working- doing- and learning-environment and the strength of applets. Faculty of Education Science and Technology, University of Twente (URL: http://www.to.utwente.nl/prj/min/papers/JavaWeb).


B. Somekh and N. Davis (Eds.) Using IT effectively in teaching and learning. 1997.