POLLEN

Guide for the design of educational multimedia applications based on concept mapping

ET 1016	D 4.3
Version	final
Date	20.06.97

POLLEN DELIVERABLE

PROJECT NUMBER	**ET 1016**
PROJECT TITLE	**POLLEN**
DELIVERABLE TYPE	**PU**

DELIVERABLE NUMBER	**D 4.3**
CONTRACTUAL TIME OF DELIVERY	**30.06.97**
ACTUAL TIME OF DELIVERY	**20.06.97**
TITLE OF DELIVERABLE	**Guide for the design of educational multimedia applications based on concept mapping**
WORK-PACKAGE CONTRIBUTING TO THE DELIVERABLE	**WP4**
NATURE OF THE DELIVERABLE	**PU**
AUTHORS	**KLETT, LDES, OCCAM**

Type: PU-public; LI-limited; RP-restricted;
Nature: PR-prototype; RE-report; SP-specification; TO-tool; OT-other;

ABSTRACT:

This handbook brings a basic understanding of professional multimedia design and development techniques to editorial departments of publishing companies. The focus is on detailing necessary skills and techniques when designing a successful multimedia program from the publisher's point of view. This report has five main sections. First an introduction section which gives a global overview on actors, phasing, methods and costs, second a theoretical part which starts the conception phase and prepares the development, third the realisation of the conception, fourth the designing of an application within the specification phase and fifth how Pollen uses the concept mapping design method as a tool in different contexts.

KEYWORD LIST:

handbook, user analysis, technical analysis, accompanying services, legal issues, investment strategies, architecture, functional specification, storyboarding, quality criteria pedagogy, user centred design, knowledge representation, graphical representation, concept map, actors, definition phase, conception phase, specification phase.

TELEMATICS APPLICATIONS FOR EDUCATION AND TRAINING

POLLEN
ET 1016

Deliverable 4.3
Final - June 1997

Guide for the design of educational multimedia applications based on concept mapping

Authors
Jörg Boy (KLETT)
Hervé Platteaux (Université de Genève, LDES)
René Rickenmann (Université de Genève, LDES)
Serge Pouts-Lajus (OCCAM)

Summary: This handbook brings a basic understanding of professional multimedia design and development techniques to editorial departments of publishing companies. The focus is on detailing necessary skills and techniques when designing a successful multimedia program from the publisher's point of view. This report has five main sections. First an introduction section which gives a global overview on actors, phasing, methods and costs, second a theoretical part which starts the conception phase and prepares the development, third the realisation of the conception, fourth the designing of an application within the specification phase and fifth how Pollen uses the concept mapping design method as a tool in different contexts.

Keywords: handbook, user analysis, technical analysis, accompanying services, legal issues, investment strategies, architecture, functional specification, storyboarding, quality criteria pedagogy, user centred design, knowledge representation, graphical representation, concept map, actors, definition phase, conception phase, specification phase.

Executive Summary

Guide for the design of educational multimedia applications based on concept mapping:
a handbook for multimedia producers and publishers.

The goal of this handbook is to bring a basic understanding of professional multimedia production techniques to editorial departments of publishing companies. The focus is on detailing necessary skills and techniques when producing a successful multimedia program from the publisher's point of view.

This report has five main parts.

1. **The introduction** section describes the main actors involved in the multimedia design process, the main phases of this process, the contribution of concept mapping techniques for designing the contents and negotiating within the production team, and last but not least, an overview of the financial means needed for designing and producing a multimedia educational application.

2. **The definition phase** section describes the main issues that publishers should address before launching any project of production of an educational multimedia application: how to estimate the targeted audience, the content of the product, how to recruit the authors, how to pay them, which technological support to use, which are legal issues to be known, and last but not least, what are the chance to obtain a return on the investment?

3. **The conception phase** section has two parts. The first concerns the more theoretical side of this phase as opposed to the second which deals practically with the issues raised in the first phase. At the first stage of the conception phase the handbook describes the publisher's investigations concerning target group and topic of the application. The publisher is supported by technicians and authors and his decisions are framed by the clarification of legal issues and investment strategies. The starting of the conception phase describes the preparation of the development.

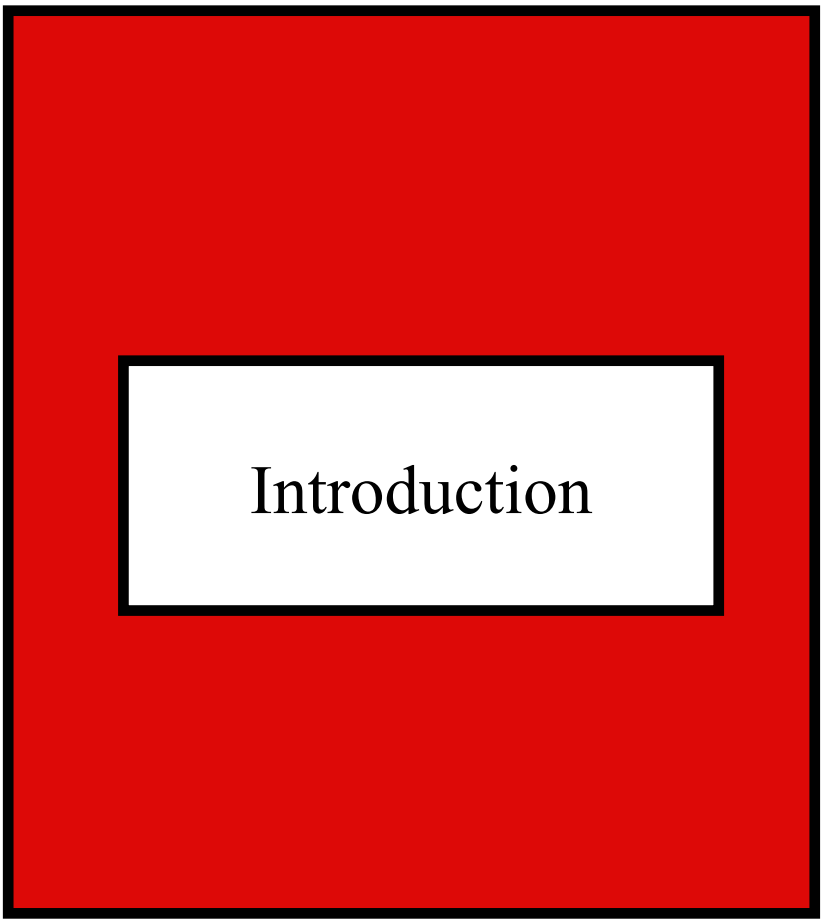
4. **The specification phase** is the last phase before implementation and exploitation. These last production phases not analysed in this guide as they used generic techniques and tools

out of the scope of the POLLEN project. Publisher, developer and the author are involved in the specification phase. The main critical factors are analysed in this chapter, in particular those concerned with the communication between people at the different stages of the process.

5. The last section of the document summarises the principles of **Interactive Concept Maps** as they have been created and described in previous phases of the project, taking into account the experience of applying these principles for the design of two prototypes. In particular, the role of Interactive Concept Mapping is analysed as an interface and a tool for collaborative work between among four categories of actors: authors, editors, developers and users.

This handbook addresses the main issues when dealing with multimedia development. The actual design implementation and its exploitation are not part of this handbook.

Table of contents



1.1 THE ACTORS

REGROUPING THE ACTORS IN PRODUCTION TEAMS

1. Actors, competences and production teams

Actors Competences	
Publisher/ editor:	Management, marketing, finance expertise, publishing, advertising and product distribution.
Developer:	Hardware and software expertise, hypermedia market expertise
Author/ Educationalist:	Domain expertise, multimedia sources mediation
Scientist:	User preconceptions expertise (topics and computer), learning contexts, product evaluation

Three Production Teams

- Management
- Conception and design
- Implementation

User as a virtual actor

Actors Responsibilities	
Publisher/ editor:	Production process general coordination, communication and product exploitation,
Developer:	Interactivity and ergonomy, product implementation (hardware, digitalizing data, programming), product test, manufacturing, design
Author/ Educationalist:	Storyboard writer, content and multimedia source provider
Scientist:	Product evaluation

1.1 THE ACTORS
COMMENTS AND REFERENCES

Ad1. The need of multiple competence domains
The hypermedia application production can be compared with the film production. It implies the need of multiple competence domains (in fact five, cf. 2.3). The hypermedia production teams are thus regrouping heterogeneous and multidisciplinary work teams.

The actors recruitment is therefore based on the product definition which makes precise its general objectives and topics (design and development), its market characteristics (technological level, socio-cultural particularities) and its end users.

One can distinguish four generic terms to identify the actors: Editor, Authors, Pedagogues (or Mediator), Developers. Each one of these terms is regrouping many competencies or persons.

Five competence domains
The five competence domains of a collaborative hypermedia production process (management, content, didactic, design, technology) form three production multidisciplinary teams having precise tasks:

- Management team: Editor (the co-ordinator), eventually with the Software Developer;
- Conception and authoring team: Author/ Educationalist, Scientist, Developer, Editor;
- Implementation team: Developer, Author/ Educationalist, Scientist, Editor.

These competence domains often require many members for a single domain (cf. note p. 20). But there is no need that all the members of one domain together join the production team into each meeting session. Each competence domain can be represented by one member. The Editor assumes the general co-ordination of the production process.

A virtual actor: the end user
For the production of educational hypermedia products, the end user plays a central role into their structuring in particular for two aspects:

- marketing: socio-economical and socio-cultural profiles of the end user;
- learning or training: end user preconception study on the topic and the computer media use.

Taking into account the results of previously done surveys about the end user preconceptions is crucial. The Pedagogue can have some available but, if not, a representative sample of the end users can be tested. It must be underlined that this sort of survey is no study on the user satisfaction level. The aim is not to better know about what the user likes. Instead it is to use his/ her pre-competencies and pre-knowledge for introducing new items (product, services, knowledge).

1.2 PHASING

THE THREE PHASES OF THE DESIGN PROCESS

1. Overview on the phasing of the design process

Conception Phase

Project definition

- Target group
- Investment strategie
- Product definition:
  - topic(s)
  - legal issues, copyrights
  - technological

Management strategy

- Identification of the production team actors
- Phasing identification
- Production method
- Communication

Putting the Conception Phase Into Practice

Design

- User analysis
- Learning strategie
- Form of the product

Technical analysis

- On/off-line delivery
- On-line services
- Development tools

Specification Phase

Implementation Phase*

Exploitation Phase*

* The implementation and exploitation phase are using state of the art methods which are not explicitly part of this handbook

1.2 PHASING
COMMENTS AND REFERENCES

Ad 1. Production process phases: networked competencies
The production process of an educational hypermedia product develops along five phases (cf. table on the left page): Definition Phase, Putting Conception Phase Into Practice, Specification Phase, Implementation Phase, Exploitation Phase.

The three first ones correspond to the Design Process of an hypermedia product and are further developed into this Guide. A good strategy is based on networking the competencies. It allows to integrate the feedbacks of each competence domain within each phase.

Building a software allowing the end user to learn by himself
Three approach types of the learning strategy to be implemented into an educational software were identified: free access/browsing, instructional and constructivist. The most generalised is the last one and is founded on a basic principle: the learner himself is the main actor of his knowledge construction! His knowledge construction is based on his preconceptions (previous knowledge and experience) and on his activities.

Basing the software design on this pedagogical principle, originally coming from Piaget's work, implies this central idea always has to be kept in mind along the different phases of the design process.

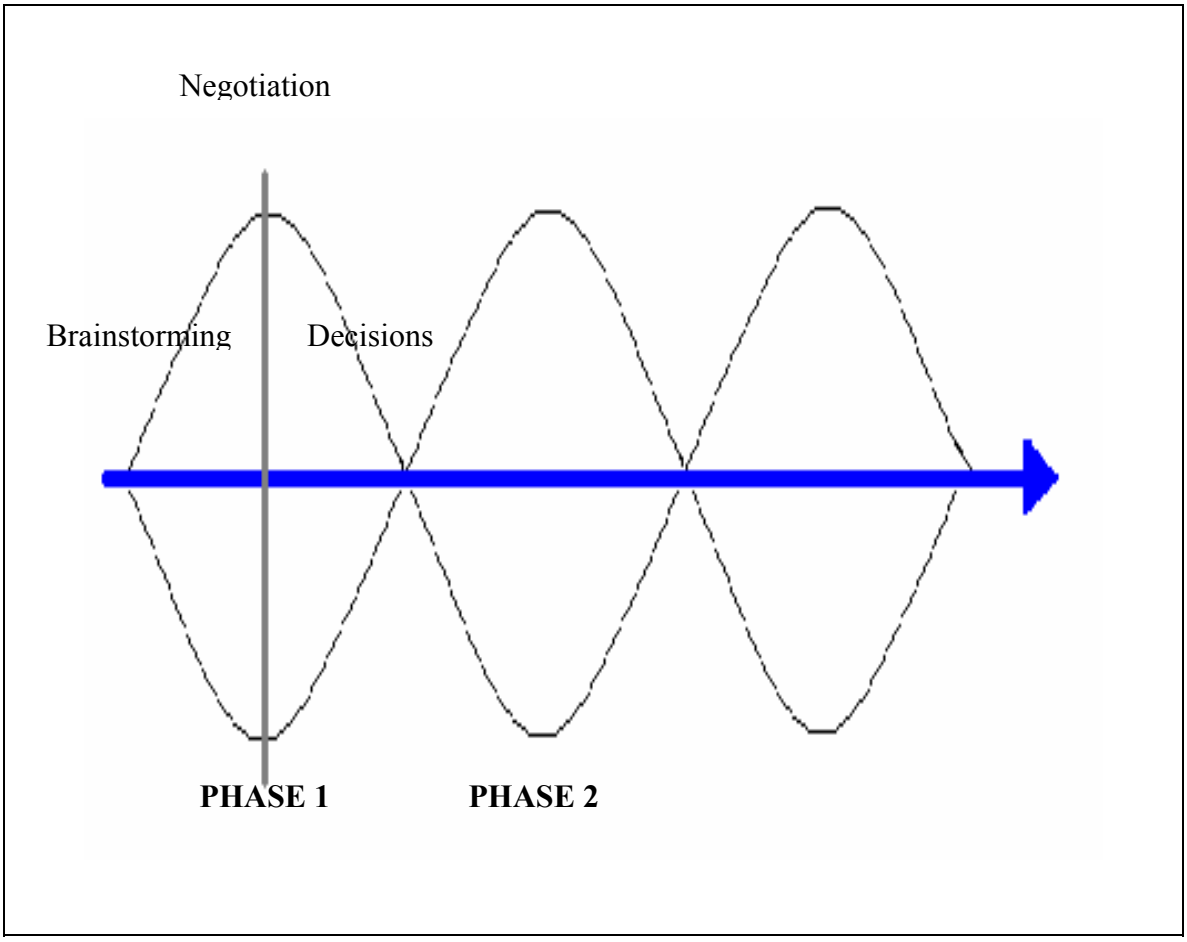
The general way to follow for applying this idea is to define a software architecture where the end user and his activities are placed in the centre. It largely depends on three functional domains (corresponding to important tasks to be achieved by the conception and authoring teams):
- the content structuring;
- the ergonomy and the interactive functions building;
- the application shaping.

Furthermore, looking for implementing a user centred learning strategy implies to do parallel choices for the three tasks:
- the content structuring has to take into account the user preconceptions about the topic and the multimedia usage;
- the interactive functions must favour both an efficient navigation and the user activities;
- the application shaping must create a familiar environment to the user.

For further and detailed information see section 5.

1.3 METHODS
A COLLABORATIVE STRATEGY

1. Interaction between the actors of the design process



2. The negotiation function of a concept map

> *Concept maps serve as a useful vehicle for discussion between students and between students and instructors. Since the concept maps prepared by any two individuals will show at least some differences in structure, they create the opportunity for negotiating meanings between students and between students and instructors.*
>
> **J. Novak, 1995**

Replacing the words "Students" and "Instructors" by "Authors", "Editor", "Developer" and "Pedagogue" let appear the negotiation function a concept map can play into the design process of educational hypermedia products.

1.3 METHODS
COMMENTS AND REFERENCES

Ad1. A need for interactions of competencies
The challenge offered in developing an educational hypermedia product, by heterogeneous production teams, is reinforced by a strong hierarchical structure. Indeed the specific competencies of the various actors are necessary all along the process because the product is not developing thanks to a simple comparison of the necessary competencies but thanks to complex interactions of those competencies.

A collaborative strategy, into a multidisciplinary working group (Management, Conception and Design, Implementation) is more efficient for the different tasks to be done: Co-ordination, Product definition, Information circulation, Auto-regulation of the production process. The main reason of this argument is that the continuous presence of all the actors implies every one of them can keep a global idea of the product evolution.

This strategy articulate around principles:
- multimedia is a complex knowledge support;
- the product is built and defined while the different phases develop;
- in each work group there is a preponderant competence domain.

Ad 2. Collaborative work: a diverging and converging process
One can say all the different phases, of the design process, globally have a similar shape when considering the communication that have to grow up among the team members. They are constituted of a three step sequence:
- a brainstorming step must first happen so to let appear the ideas. During this step the co-ordinator must emulate an inflation of ideas and make a list of them;
- a negotiation step happens just after with the aim of discussing further about the ideas that have emerged;
- a decision step comes then to end one phase and must be dedicated to select the ideas that has to be kept for feeding the next phase.

The co-ordinator can use the schema presented on the left page to explain the team about this global process shape to be followed. Indeed this drawing is representing well the succession of the three steps and their main characteristic: there first must exist a divergence period which has to be followed by a converging one.

The concept map methodological tool, can serve in two ways along the different design phases so to favour the horizontal communication process described above:
- it is a knowledge representation tool to be used for defining the content structure;
- it is a negotiation tool (cf. citation on the left page) to be used for discussing about the ideas that emerge in relation with the product software architecture.

1.4 COSTS

WHAT ARE THE COSTS FOR PRODUCING AN EDUCATIONAL MULTIMEDIA PRODUCT?

1. Initial production costs for a CD-ROM

The following chart summarises a possible distribution of costs according with different categories of expenditures. In the context chosen for this example, the producer is a pure financing operator, subcontracting all the work to specialists, like in the movie industry. The prices are those who are currently practised in countries like France, Germany or the UK. The different categories of expenses are:

- *Labour* in the form of subcontracting to independent free-lancers or specialised companies. The prices include taxes and insurance contribution.
- *Technical costs* and *External services* include specific multimedia works apart from programming.
- Internal expenses represent the costs for managing the financial and administrative tasks of the production, considering that the project management itself is subcontracted to a project manager (see Labour).

	N° Unit	Unit cost (Ecu)	Cost (Ecu)
Labour			
Author-scenarist	Fix		12 500
Document research	30 Days	700	21 000
Project manager	90 Days	500	45 000
Assistant	40 Days	200	8 000
Producer	10 Days	800	8 000
Production assistant	10 Days	300	3 000
Lawyer	2 Days	1 500	3 000
Technical management	30 Days	750	22 500
Developers	50 Days	700	35 000
Data entry	400 Articles	6	2 400
Art Direction	10 Days	800	8 000
Graphist/Designer	20 Days	800	16 000
Infography	20 Days	750	15 000
Musician	Fix		2 000
Speaker	4 Days	550	2 200

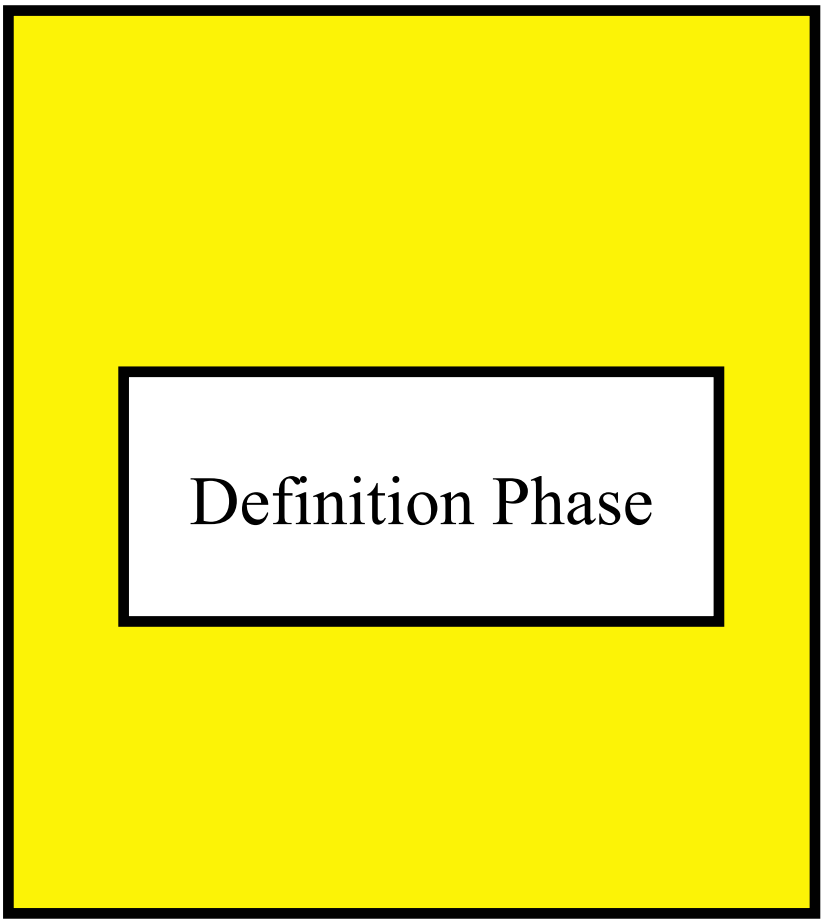
1.4 COSTS

WHAT ARE THE COSTS FOR PRODUCING AN EDUCATIONAL MULTIMEDIA PRODUCT?

Sound Engineer	4 Days	400	1 600
Translation	20 Days	550	11 000
Total Labour			*216 200*
Technical costs			
Sound studio	8 Days	950	7 600
Develop. station (hard and soft)	Fix		10 000
Mastering	Fix		4 000
Miscellaneous	Fix		2 000
Total Technical costs			*23 600*
External services			
Photo Lab.	Fix		4 000
Digitalisation	1500 Images	10	15 000
Total External services			*19 000*
Internal expenses			
Management expenses	Fix		3 000
Administration	Fix		1 000
Total Internal expenses			*4 000*
Total			**243 800 Ecus**

Conclusion

- Costs for developing sophisticated multimedia CD-ROM are very high. Producers who expect return on their investments can explore two ways. First, to reduce the production costs by applying innovative production methods; second to enlarge their product market either geographically or technically (see below 2.7).



2.1 PUBLISHER

THE EUROPEAN PUBLISHERS OF MULTIMEDIA EDUCATIONAL SOFTWARE, THEIR MARKET AND THEIR STRATEGY

1. The European Publishers of Educational Materials

European publishers operating in the Educational sector form an experimented and powerful industrial sector. The products they offer are numerous, various, generally of high quality and cover most of the learning needs in all languages of the European Union. Most of the production is in a paper format (books). Since 1980's, many publishers have developed educational materials using modern media, first audio-visual, then electronic media. But the market for such innovative products has not yet succeeded to develop significantly. It remains marginal compared with the traditional books production sector.

Pollen Project, 1995

2. Educational CD-ROMs producers

The majority of European production of multimedia educational software comes from very large number of micro-enterprises, offshoots of the technological publishing and sometimes educational sectors, distributed throughout the territory of Europe, and largely dependent on the quality of their local environment. Many of them are specialised publishers or developers operating in the educational institutional market or various niches in the vocational training market. Other specialise in the linguistic and cultural adaptation of multimedia products, most of which are still of American origin, to the various national markets. It often happens that these small producers are bought up by large groups -not only European but also American -looking to establish a foothold in the marketplace or strengthen their market positions.

Educational Multimedia Task Force - Intermediate report, 1995

3. On-line production and delivery

The production and delivery of learning materials through telecommunication networks oblige the publishers to face new constraints and to create new internal competences in terms of editorial policy, authors management and delivery of materials. In order to answer this new challenge, co-operation between different European publishers having similar policies is perceived as an appropriate strategy for exploring potentialities of this emerging market. In this exploratory phase, publishers are expecting to acquire methods and tools that will allow them to exploit future "information highways" for the delivery of learning materials they will produce.

Pollen Project, 1995

2.1 PUBLISHER
COMMENT AND REFERENCES

Definition phase
The publisher starts the definition phase of the design process by analysing the target group, identification of authors plus responsible people for the technical support staff, choosing the content of the topics, the assessing legal issues and the investment strategy.

Ad 1. Publishers in the Pollen partnership
Five of the POLLEN partners are educational publishers corresponding with the definition and the description given in the opposite box.

- ***Ernst Klett Verlag*** is amongst the leading educational publishers in Germany, producing an extensive range of teaching aids for all subjects taught in general and vocational training, in adult education and for the open learning market.
- ***Helicon*** is a well-known independent reference publisher in UK, editor of the famous Hutchinson Encyclopedia, available on paper format, on CD-ROM (since 1994) and from March 1995, on-line through Compuserve.
- ***Hachette*** is one of the major publishing group in France and in Europe, with a leading position on the French market of education, both for schools and families. *Hachette Livre* has already produced multimedia encyclopedia on CD-ROM (Axis) and on CDI.
- ***Gyldendal*** and ***LIBER*** (*Wolters Kluwer* subsidiary) are among the major publishers in their country, Denmark and Sweden. Both ambition to take leading positions in the market of multimedia products for education.

Ad 2. Multimedia publishers in Europe and the US
Most of the differences that can be observed between the supply sides of the market in Europe and the US reflect directly the difference of the two demand sides. But the major difference seems intrinsic:

- **In the US**, the leading educational multimedia publishers are multimedia publishers with a special educational line of products (the top ten are: Broderbund, Microsoft, Davidson, The Learning Company, Knowledge Adventure, Sierra, Mindscape, MECC, Edmark, Soft Key).
- **In Europe**, the leading educational multimedia publishers are most often subsidiaries or departments of large book publishers operating on their national markets (Bertelsman in Germany, Hachette and CEP in France, Anaya in Spain, Rizzoli in Italy), with the exception of the UK where the situation is similar as the one of the US (Dorling Kindersley, Virgin).

The European situation presents some advantages and many handicaps for the concerned publishers in the competition have to face with the US providers.

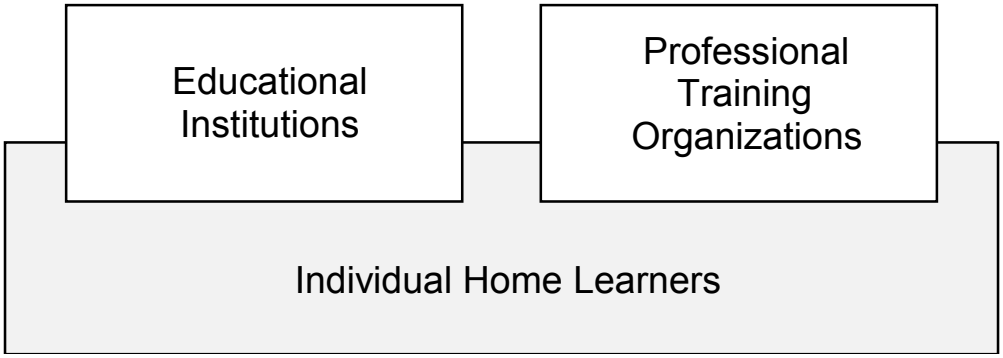
Ad 3. Is there a room for publishers on the net?

Publishers want to explore opportunities for a commercial exploitation of on-line publishing even if they consider the are at a very exploratory stage. This is one of the objectives of the Pollen project, first to analyse the implication of on-line publishing in production and educational terms, second to identify the requirements for international co-operation.

2.2 TARGET GROUPS

SEGMENTATION OF THE AUDIENCE FOR EDUCATIONAL MULTIMEDIA PRODUCTS AND SERVICES

1. Overview on the market



Educational Institutions *are schools, colleges and universities at primary, secondary and tertiary level.*
Professional Training organisations *are specialised training services providers and internal professional departments of large enterprises and administration.*
Individual home learners *are households composed of children and adults.*

2. Focus on the education market segments

Level	***Age***	***Educational Institutions***	***Home market***
Nursery	3-5		
Elementary	5-7		
Primary	7-11		
Secondary	11-16		
Tertiary	16-20		

Dynamism of market segments for the commercial off-the-shelf multimedia producers.

low	
medium	
high	

2.2 TARGET GROUPS
COMMENTS AND REFERENCES

Ad 1. Education vs. Training

The difference between the Education and the Training sector is the following,

- the **Education** sector is composed of children and young adults who are not yet on the employment market
- the **Training** sector is composed of employed and unemployed adults.

Individual vs. Institutional

An important difference in the market is represented by the segment of the market made of institutions and the segment of market consisting of individuals.

- Institutional market is composed of educational and training institutions and of enterprises and administrations: the product is not bought by the end-user but by a trainer or a teacher who is an intermediate agent; the product is paid by the institution.
- Individual market is composed of households and people: the product is bought by the end-user (adults) or by the parent with his/her own money.

Opposite marketing approaches address Education and Training segments and Institutional and Individual segments.

Ad 2. Synergy

Generally the publishers are not the same on the Education and Training markets. But often, the same publisher can operate both on the institutional and individual markets, with the same or most often with different products. For reasons of productivity, publishers look for developing synergy between the different market segments they address. Many educational publishers benefit from their reputation and their image on the educational institutional market through prescription of teachers as a token of quality, to support and promote products developed for the home market.

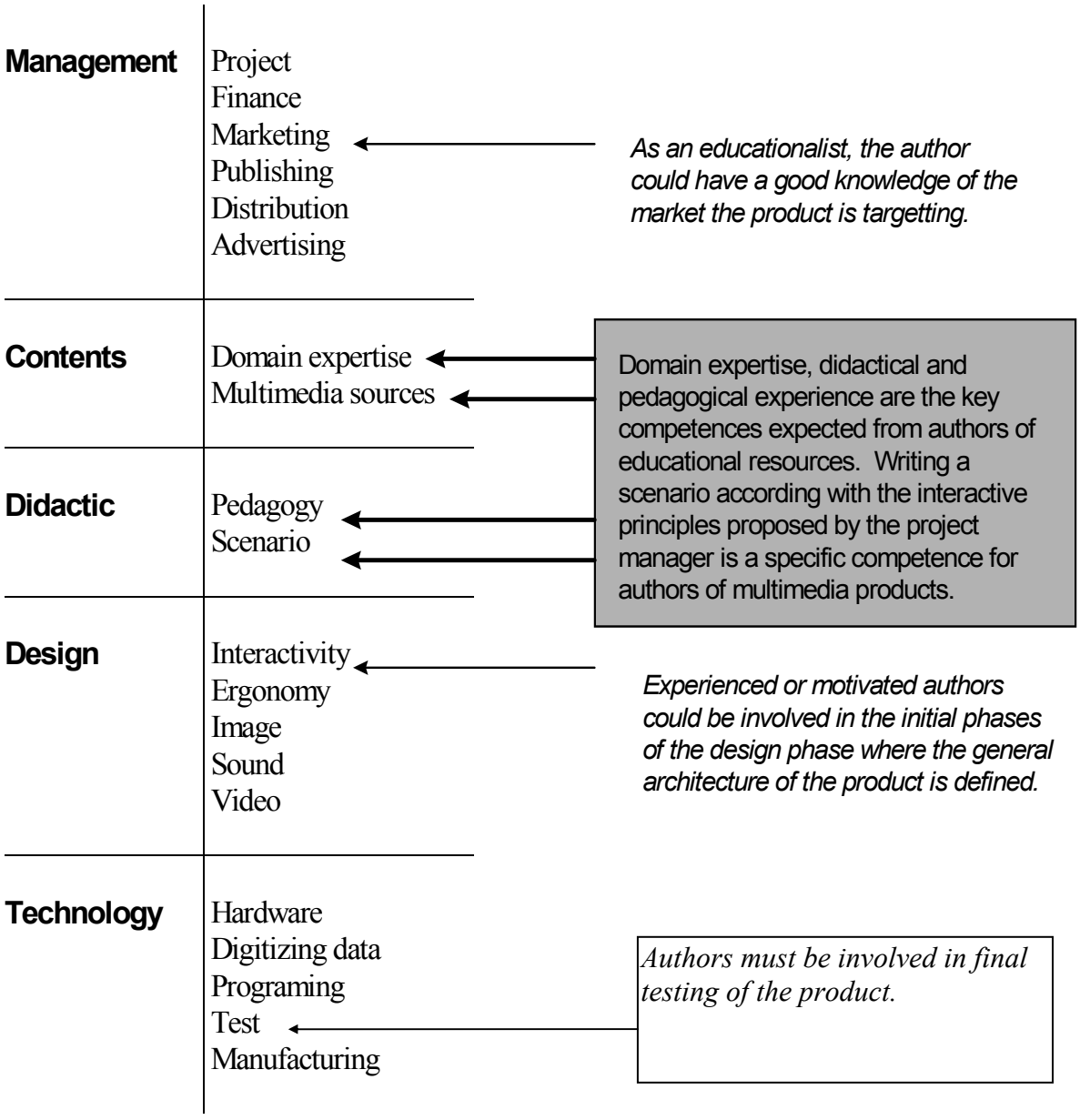
Ad 3. Market Niches

The opposite chart shows a segmentation of the Education market in five layers according with the age of the learners. The dynamism of the demand on each layer is empirically estimated. It is reflected by the offer of the publishers. Lower levels (3-5 y.o.) are the most dynamic on the home market for several reasons: kids are not yet at school, their needs are basic and homogeneous, linguistic and cultural constraints are low, parents are more and more aware of their children development. The institutional segment is quite dynamic at the primary and secondary levels. But its dynamic decreases progressively because of the growing segmentation of educational contents.

2.3 THE AUTHORS

HOW TO IDENTIFY, RECRUIT, TRAIN AND HOW TO PAY THE AUTHORS

1. Overview of the competences required for the production of educational multimedia products: which ones for the author?



2.3 THE AUTHORS
COMMENTS AND REFERENCES

Ad 1. Authoring Competences
Competences required for the design, production and distribution of educational multimedia materials are very numerous. The opposite diagram displays a possible segmentation of these competences. Other solutions for grouping and listing elementary competences are possible.

Who are the authors?
All the people participating in the design and production process could be theoretically considered as co-authors of the product. All of them, whatever the volume of their participation and their status (independent, free-lance, employed) should be mentioned in the credits of the product, printed on the package or displayed on a product screen. But only some of the co-authors could receive copying rights which indicate that they are intellectual owners of a part of the product.

How are the authors paid?
One must distinguish between authors of pre-existing multimedia sources like photographs, musicians, movie makers and the authors of original materials in the form of an image, a music, a text, a scenario. All of them can be paid by royalties, whether in the form of fixed price or a percentage of sales. The co-creators who have participated in the production process as employees of a publisher of a software house cannot usually claim for royalties.

The main author
Among the numerous participants involved in the production of a multimedia educational resource, one (or two, or three, but generally not more) is considered as the author of the product. He/she is the person at the origin of the idea; he/she has conceived and selected most of the contents; he/she has written most of the original text; he/she has written most of the scenario of the product.

The traditional author
This situation of authors in the multimedia publishing industry inherits from the practice in traditional printed publishing: the author is the intellectual creator of the product, even if this status is less clear as it is in the book industry. This situation could be compared with what happened in the cinema industry: it took a long time before the Director was considered as the author of a film.

Authors of educational materials are Teachers
Almost always, authors of educational materials, multimedia or traditional materials, are active teachers, teaching at the level and in the domain targeted by the product. This position guarantees that the author masters the domain expertise and the didactic experience which constitute the core competences to be mastered by the authors. Traditional book publishers use to identify among their book authors those who are familiar and motivated with multimedia technology. The identification of authors and their mobilisation in the production process which is always more long and complex

that planned is one of the main difficulty in the production process. In the future, only experience could allow the publishers and their authors to overcome this difficulty.

2.4 TECHNICAL SUPPORT

THE TECHNOLOGY FOR DISSEMINATION. CD FOR OFF-LINE, INTERNET FOR ON-LINE

1. Comparative advantages and disadvantages of off-line and on-line dissemination for publishers

	Off - line dissemination	**On** - line dissemination
Technology *Existing*	- CD-ROM	- Internet - WWW
Technology *Emerging*	- DVD	- Cable - ISDN
Advantages for Publishers	- Low costs for manufacturing - No piracy - Traditional distribution channels	- World access - Contents up-dating - User feed-back - Low production costs
Handicaps for Publishers	- Rapid obsolescence - Narrow market - Prices too high - Hard competition	- Accompanying services to be provided - Payments systems difficult

	Off-line	**On-line**
Hybrid Distribution	Basic multimedia data and programs on CD	Up-dated complementary information, user support services

2.4 TECHNICAL SUPPORT
COMMENTS AND REFERENCES

Ad 1. Off-line dissemination channels

Publishers are familiar with off-line distribution of products. Between the publisher and the end-user, there are at least two intermediary stages: wholesalers and retailers. The distribution channels used for books are progressively adapted to incorporate educational and cultural products to new media like video and CDs. But for the traditional book publishers as well as for specialised new media publishers, complementary channels are to be taken into account. Most of educational and cultural CD-ROMs are sold through specialised high-tech stores where clients could find at the same place the computers and every types of applications, professional, games, education and culture. Another possibility which is more explored by publishers is to sell through specialised or generalist mail-order catalogues. For publishers, off-line products distribution is nothing more than diversifying the distribution channels.

On-line dissemination channels

On-line dissemination represents a big challenge and a deep change in publishing practices. There are four main comparative advantages in on-line distribution. First, a product put on net is immediately world-wide accessible. Second, the contents of the products can be permanently up-dated and the mistakes corrected. Third, feed-back from users inform about the product usability and the users satisfaction. Fourth, the production costs are low, compared with off-line products which are usually more sophisticated in terms of interactivity. But these advantages are negatively balanced by two enormous handicaps. First, on-line distribution assumes that accompanying services are provided to the users on a permanent daily bases. Publishers are totally inexperienced and unprepared for providing such services for technical, economical and cultural reasons. Secondly, there are today no stable and secure solution for the publishers to be paid by the clients. This is of course a prohibitive obstacle for commercial operators.

Hybrid on-line / off-line distribution

One possible solution for publishers is to explore hybrid and intermediary solutions to overcome the two above mentioned disadvantages of on-line dissemination. There are surely several ways to do so. One of them is explored in the context of the Pollen project. As indicated in the opposite chart, the basic principles for hybrid distribution, as it is already practised by some encyclopedia publishers like Helicon, consists in delivering most of a product on a CD-ROM and through an Internet connection to deliver up-dated information as well as complementary tutoring and communication facilities.

2.5 TOPICS

SCIENCE, LANGUAGE, TECHNOLOGY, ART, WHICH TOPIC FOR WHICH MARKET SEGMENT

1. Categories of products and market segments.

	Definition	Home market	Schools market
Drill and Practice	Series of multiple choice questions for controlling acquisition of knowledge.		
Games	Educational software based on video games architecture (adventure, race, etc.)		
Simulation	Representation of a situation through a model and parameters the user can modify to explore the situation		
Encyclopedia	Data Base of multimedia documents in a specified domain.		
Tools	Generic software tools for the production of multimedia documents.		

Very demanded *Poorly demanded*

2. Topics, types of applications and market segments

	Home Market	School Market
Art	Topical Encyclopedias	-
Science	-	Simulations Tools
English Language	Drill and Practice	
Reading and Counting	Drill and Practice Games	
History & Geography	Topical Encyclopedias	
Technology	-	Simulations Tools

2.5 TOPICS
COMMENTS AND REFERENCES

Ad 1. Categories of products and segments of market

In the opposite box, five well-known categories of educational products are proposed with a brief definition: *Drill and Practice*, *Games*, *Simulation*, *Encyclopedia*, *Tools*. Such categorisation cannot be consensually accepted and different categories could be proposed but the following statements would be probably widely accepted:

Most of educational multimedia applications are hybrid products made of several components of different types (questions, simulations, games, data base, tool, etc.).

For instance, Pollen applications can be defined as topical encyclopedia including questionnaires and communication facilities between users.

Different levels of attractiveness are proposed, as an hypothesis for discussion, for each category of product and each of the two market segments (home, schools): drill and practice products for instance are said very demanded by home market but less by the schools market; the opposite for simulations. According with this hypothesis, the encyclopedia type appears as the only type of products to be equally demanded on the two market segments. It is certainly not by accident if *Microsoft*, leader in software industry, has chosen to address the educational market with a general encyclopedia (Encarta) which took a leading position in most of the European countries, both on home and school market.

Ad 2. Products styles, contents and markets

The second chart on the opposite is another hypothesis, based on the know-how of the Pollen project participants, which aims at representing the type of products with which publishers tend to address home and school markets. In the last year, topical encyclopaedias in the field of Art (painters, museums, musicians, etc.) have had a great success on home market. Such products have also been successfully exported in the US and Japan. Availability in the domain of Science is limited as opposed to the English language learning (it must be underlined that the offer and demand for foreign language learning is dramatically dominated by English) and in basic know-how for very young (3-5). The chart reflects more the offer from publishers than the demand which is, as usual, partly unknown and partly unexpressed. Publishing is always a risk. Pollen partners believe that the domain of science, could meet a demand if addressed in an attractive and innovative form: topical subjects in an encyclopaedic approach with additional on-line services.

2.6 LEGAL ISSUES

THE BASIC RULES OF MULTIMEDIA COPYRIGHT TO BE KNOWN BY COMMERCIAL PUBLISHERS

1. Four types of contracts

The creation, production and distribution of a multimedia educational product implies the writing and signature of contracts with participants. Four types of such contracts can be distinguished

	Signatory	Contents
COPRODUCTION	People and organisations who have participated in the production financing.	- object of the production - sharing of financial contribution of coproducers - sharing of responsibilities among coproducers - sharing of copyright among coproducers
AUTHOR (and rights assignment)	Producers, authors of original works, authors or right owners of pre-existing works.	- object of the right assignment - payment of the author (fix or sales percentage) - conditions of exploitation (geographical coverage, duration of the contract, diffusion support, subsidiary exploitation, etc.).
EXTERNAL SERVICE	Producers and external service providers.	Command letter describing the task to be performed (specification), the condition for performing (duration, delivery, etc.), the price and the ownership of the final product.
DISTRIBUTION	Producers owners of the distribution rights and external organisation.	- duration - geographical coverage - payment of the producer by the distributor

2.6 LEGAL ISSUES
COMMENTS AND REFERENCES

Ad 1.
Legal issues concerning the production and commercial diffusion of multimedia products, distributed in different countries with different legislation pose questions of not easy solution. On-line channels make the matter all the more complicated. Only some concrete and practical remarks are proposed.

The responsibility of knowing, taking into account and applying legal issues in the form of contracts is taken in charge by the coproducers, a group of people and organisation (generally led by one of them who took the initiative of the product) who will financially participate in the production. Four types of contracts (see opposite page) are to be signed in the context of a multimedia production: coproduction contract, author and right assignment contract, service contract and distribution contract. In each case, there are several tricky question that could appear, hopefully before the contract is signed, but unfortunately they appear later on.

One of the most difficult question is the one of moral right protecting authors creation. The international legislation is not harmonised on this question as indicated by the text below from the European Commission. This is a major difficulty in the context of international coproduction as it will be more and more the case in multimedia production.

"Moral rights protect the personal link between the author and his creation. They give authors the inalienable right to claim authorship of the work and to object to any distortion, mutilation of, or other derogatory action in relation to his creation which could be detrimental to his honour or reputation. Moral rights are thus complements to the author's economic rights, protecting the paternity and integrity of his work.[…]

The exact shape of moral rights stipulated in the copyright laws of the Member States differs widely within the Community. Those countries with a civil law approach have all included provisions in their copyright legislation on moral rights for authors. These provisions are usually rather strong. Some Members States' laws accord moral rights in ad vitam. The laws with an Anglo-Saxon tradition have accorded authors certain prerogatives, not always through the relevant copyright law, but partly in legislative acts serving other objectives (such as consumer protection). Neighbouring rightholders, and in particular performers, enjoy moral rights only in some Member States' legislation.

Moral rights have not been the subject of any harmonisation at Community level."

FOLLOW-UP TO THE GREEN PAPER ON COPYRIGHT AND RELATED RIGHTS IN THE INFORMATION SOCIETY - COMMUNICATION FROM THE COMMISSION COM(96) 586 - 20.11.1996

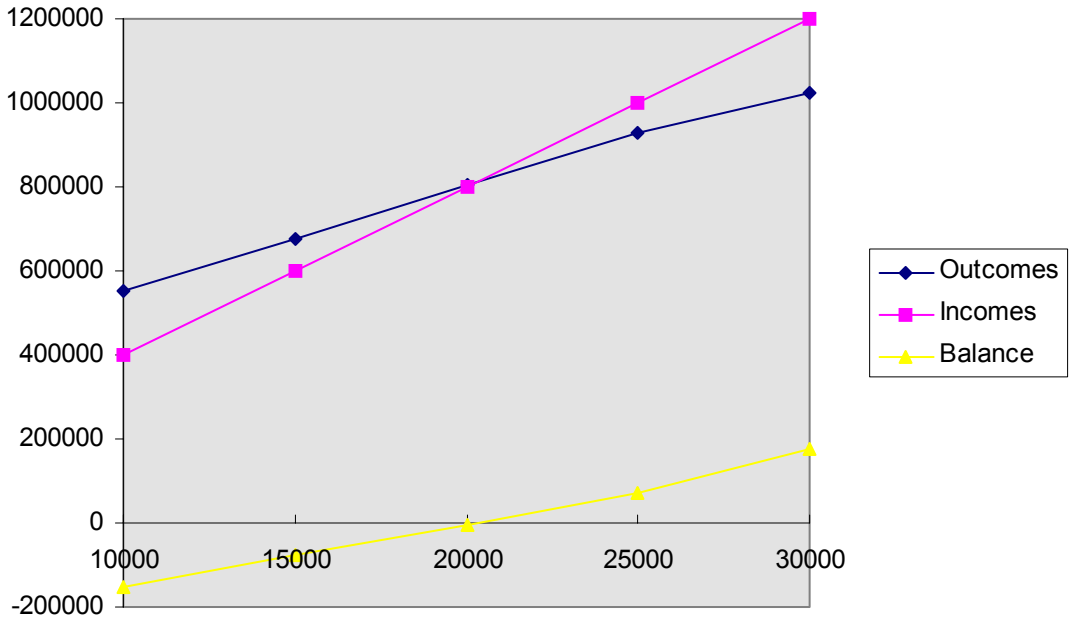
2.7 INVESTMENT STRATEGIES

IS IT POSSIBLE TO MAKE MONEY IN THE FIELD OF MULTIMEDIA INDUSTRY?

1. Computing the break-even point

Fixed expenses	300 000 Ecus
Initial production costs	250 000 Ecus
Copyright	50 000 Ecus
Variable expenses	
Manufacturing	4 Ecus/copy
Authors rights	8 % of price
Distribution	45 % of price
Public price (without taxes)	40 Ecus

Fixed expenses are mostly composed of the initial production costs (250 000 Ecus as presented in 1. Costs) and fixed copyright to be paid for the pre-existing multimedia materials used (estimated at 50 000 Ecus). Variable expenses are made of three components (manufacturing, author rights, distribution) which are proportional with the number of sold copies, that is with the incomes. The public price VAT excluded has been fixed, as a working hypothesis for computing the break-even point at 40 Ecus.



Comparison between incomes (public price x number of sold copies) and outcomes (fixes + variable expenses) shows that the break-even point, that is the number of copies to be sold for the producer to make benefit is about 20 000 copies.

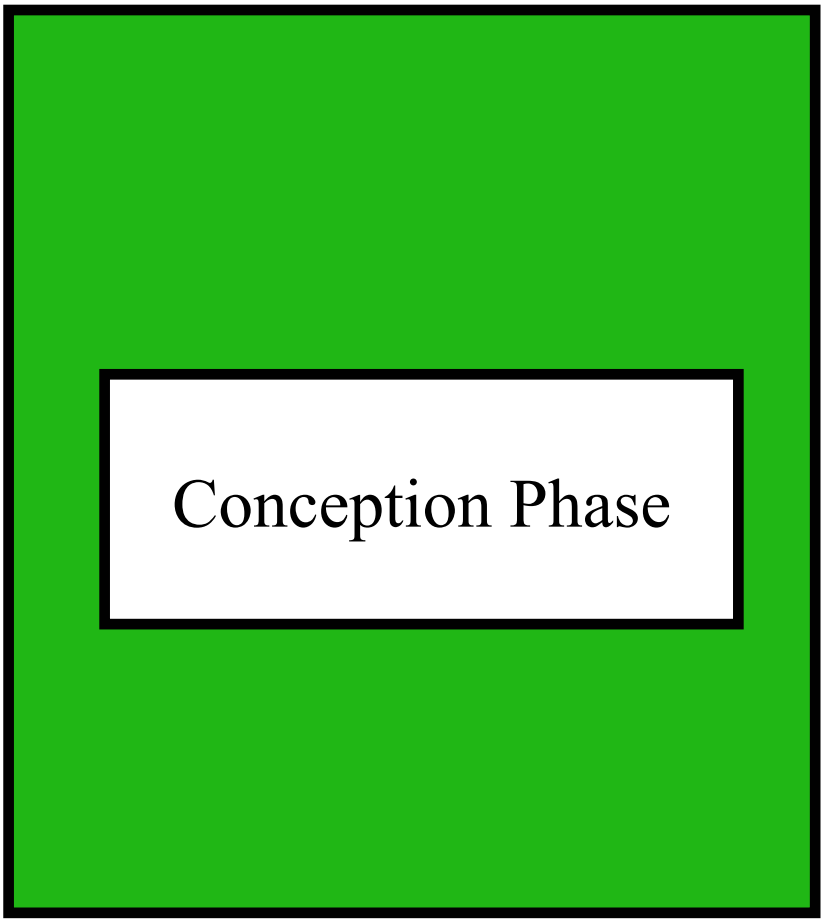
2.7 INVESTMENT STRATEGIES
COMMENTS AND REFERENCES

Ad 1. Off-line market is difficult
The market of educational and cultural CD-ROMs is difficult for private publishers and producers. The main reason to explain this situation lies in the comparison between the production costs which are high and the market which is narrow (due to the low rate of households and educational institutions equipped) and segmented (due to the characteristics of the educational and cultural demand). Moreover, for European publishers, the competition with products coming from the US, in terms of price and quality, is very hard.

In the opposite charts, a typical break-even point analysis, shows that the high production costs (300 000 Ecus is an average price) and the high distribution rate (45% of public price) leads to a break-even point of 20 000 copies, very difficult to reach for educational products in a single country, and impossible with small countries.

On-line market is not profitable
Internet is considered as the market place of the future. But until now, the commercial distribution of educational applications on Internet cannot be envisaged by publishers and this situation will surely be unchanged for years. The conclusion is not that making money through Internet is not possible. Publishers can use Internet to promote and sell their off-line products, books or CD-ROMs. Advertising on WWW is often considered as a source of financing but in the sector of education, the potential is smaller than in other domains. But the biggest potential for specialised educational publishers is to move progressively towards an offer of integrated off-line and on-line services that educational institutions and households could pay through yearly or monthly subscription.

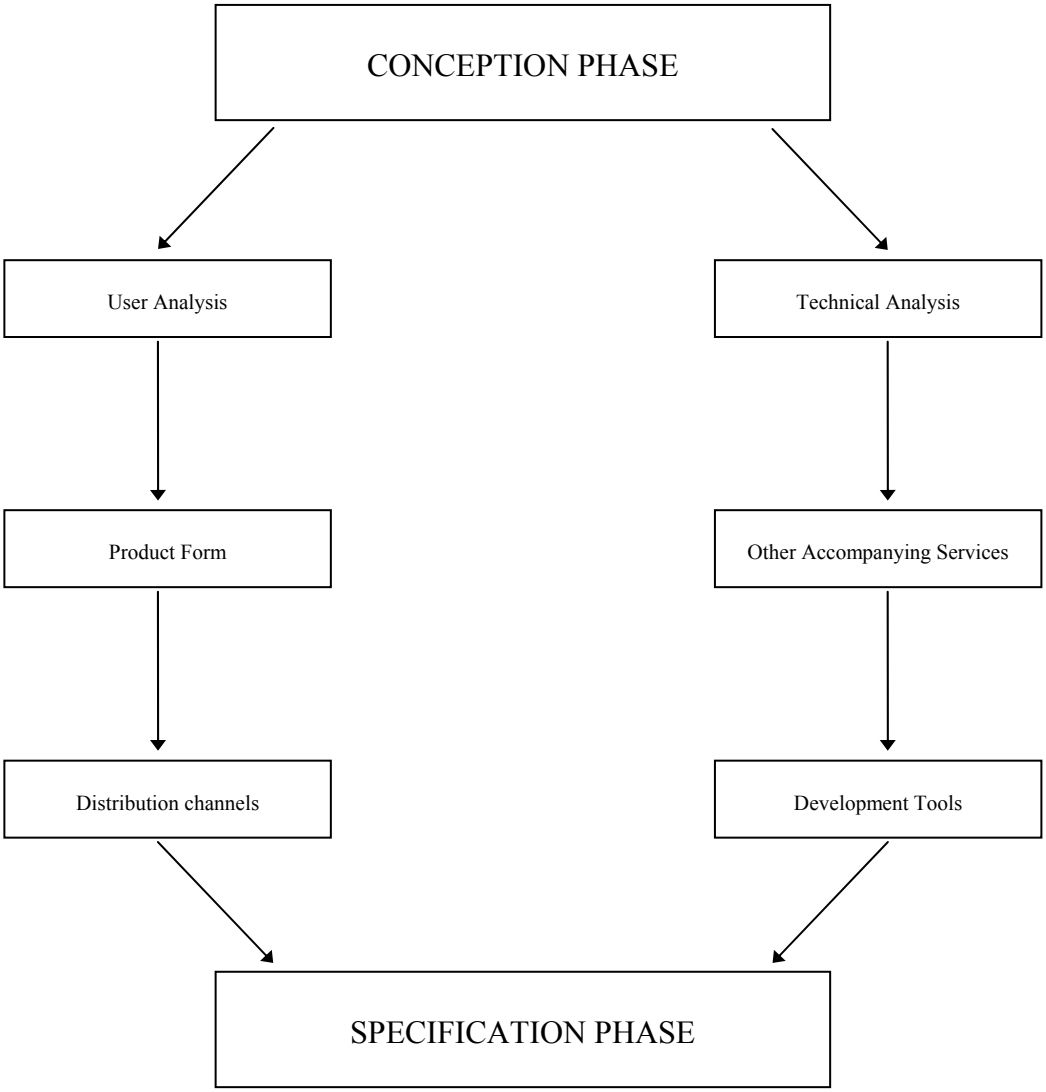
Solutions: reduce production costs and enlarge the market
The future of a profitable educational multimedia production should be envisaged in the perspective of a strong synergy between off-line and on-line distribution and consuming channels. The second condition is to enlarge the market by addressing systematically the international market and especially the European market for European publishers. The third condition is to reduce the initial costs production by diversifying the type of products the publishers will put on the market. The demand of households and educational institutions for educational materials is deeply evolving and the role of Internet in this evolution is already very important and will continue to grow. Providers of educational materials must orientate their offer towards individualised services to teachers and learners, support for exchanges, up-dating of information about sources of information. This is typically the way Pollen partners are exploring.



3.1 PUTTING THE CONCEPTION PHASE INTO PRACTICE

DEFINITION OF WORK PHASES

1. ***Conception phase***
   We identified two main aspects in the conception phase: theoretical discussed by .... and practical carried out as shown in the diagram below. As you notice the diagram is divided into user's issues (left hand side) and technical issues (right hand side).



Tip:
- Of course it is possible to start from any of the phases but it would be like walking backwards. If we aim to have a user-oriented quality product firstly we need to define who it is for (user) and the platform that better adresses the target group (user).

3.1 PUTTING THE CONCEPTION PHASE INTO PRACTICE

COMMENTS AND REFERENCES

It is obvious that educational publishers have a specific interest in multimedia production and have to brush up their current production skills. Mainly concerned by this interest is the editor in a multimedia department of an educational publisher, i.e. he/ she requires to learn about multimedia. The following pages of this handbook focus on the different stages of the design process to enable an editor to manage a project that has a deadline in the future.

The design process starts with the conception of the application. Multimedia production is 40% conception, 30% implementation, 20% revising, and 10% testing. Conception is the largest chunk which starts with the identification of a profitable market and choosing an authoring and developing team (refer to section 2). Putting the conception phase into practice means writing a functional specification document and a storyboard of everything that will happen in the multimedia product (refer to 4.4, 4.5).

Ad 1. Conception phase
Within the conception phase the editor contacts a software company to receive professional support from developers[*] while defining the outlines of the evolving application.

The success of the design process of an educational application with or without web-based performance depends on fulfilment of all steps of the design process, from conception to implementation and evaluation. It is at this initial stage that the developer and editor decide the outlines of the application.

The conception phase consists of six interdependent sub-phases:
1. a user analysis which reflects about user expectations and takes through in the further steps to determine the general form of the application.
   Tip:
   - After the definition of the user expectations the user analysis should be precise by a the consideration if obstacles for an harmonised development of an international version of the application exist. Obstacles could be a national curriculum or cultural and linguistic constraints.

2. definition of the target platform of the application,
3. definition of the distribution of the application,
4. definition of the other accompanying services,
5. definition of the product form and
6. definition of the development tools which the developers use

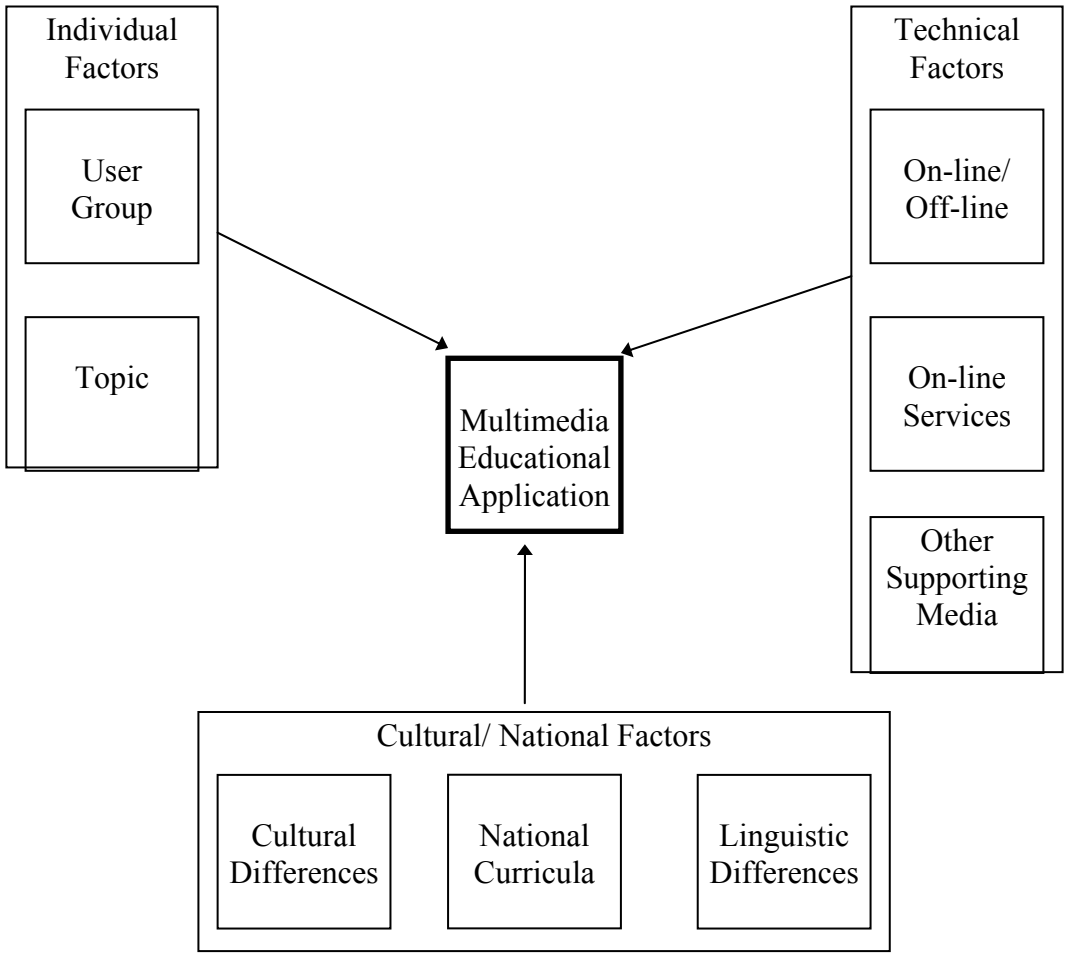
Responsibility: project manager/ editor, developers

[*] Developer is a generic term for all employees of a software company involved in the production of the multimedia application. Part of this group are e.g. programmers, graphicists, screen designers, etc.

3.2 USER ANALYSIS

AS A RESULT OF INTENSE USER CONTACT, THE USER ANALYSIS DELINEATES USERS NEEDS AND OUTCOMES THAT SATISFY THOSE NEEDS

1. Aspects of the user analysis to be taken into consideration in an international market



The above are the most important factors to be taken into consideration when producing multimedia for an international market such as the European market.

2. The linguistic and cultural constraints

„The prototypes are exploited in France and Germany and the translation in any other European language should be possible. The contents of the prototypes are not directly linked with national curriculum. They are of general interest, accessible by any student at the level of the secondary education, with a minimum of pre-requisite in mathematics and scientific modelisation."

Pollen, 1995

3.2 USER ANALYSIS
COMMENTS AND REFERENCES

Ad 1. User analysis

The user analysis is carried out by the editor and if required scientists (e.g. a market researcher). The user analysis identifies the target audience which is influenced by individual, cultural and technical factors.

The individual factors (user group):

- Who is the user group, i.e. social group and profession of the user?
- What is the age range of the user group?
- What is the educational level of the users?
- What is the pre-knowledge of the users?
- What are the range of existing computer skills of the users?
- What is the motivation of the users?
- What are the user's goals and expectations?

The technical factors:

- What are the computer facilities available to the users?
- What is the computer educational level in each individual country?
- Which types of connections are available?
- What are the costs involved for hardware, software and connections?

The cultural/ national factors:

- How can a different cultural attitude, e.g. towards technology, influence learning?
- How computer availability in a country will influence the attitude towards software products and consequently effect their market?
- Is the application an extension or part of the national curricula?
  - What are the learning goals?
  - What exactly does the user/learner need to know to learn the content?
- National curricula in some countries will emphasise some subject more than others. How is this going to effect both the user and the market?

Further cultural issues worthy to be taken into considerations when analysing the user group in an international market are:

- linguistic and translation issues,
- the dominance of different jargons, e.g. the English computer jargon,
- metaphors may not have the same meaning,
- sense of humour

Obstacles when producing for an international market:

- language, topic, cultural protection, cultural differences, national curriculum, copyrights.

All the above factors although they are separated into three distinct categories they are closely interrelated with one another as the individual interests and motivations by and large depend on their environment, culture and education.

3.3 TECHNICAL ANALYSIS

DEFINITION OF BASELINE TECHNICAL CAPABILITIES OF THE END USER PLATFORM

1. Off-line PC/ MAC

A PC/ MAC meets a certain minimum specification for multimedia delivery within an MS-Windows/ MAC-OS environment.

Processor:	*486DX-33 or MAC LC III or higher/ 128 - 256K mem cache*		
RAM:	*8 Mb (16 Mb recommended)*		
Hard drive:	*400 Mb (or more)*		
CD-ROM:	*Single or double speed,*		
Monitor:	*VGA/ resolution 640 *480, 14 inch*		
Sound:	*Not included*	*Video:*	*Not included*
Modem:	*Not included*	*Network:*	*Not included*

2. On-line Multimedia PC/ MAC

A on-line multimedia PC/ MAC meets a certain minimum specification for multimedia delivery within an MS-Windows/ MAC-OS environment with internet/ network connection.

Processor:	*Pentium 90 or MAC PowerPC 6800 or higher/ 256 - 512K mem cache*
RAM:	*16 Mb (32 Mb recommended)*
Hard drive:	*800 Mb (or more)*
CD-ROM:	*Quatro speed, or higher*
Monitor:	*S-VGA/ resolution 800 * 600, 15-17 inch*
Sound:	*Sound card 8-bit / 16-bit*
Video:	*Video card - DVI, MPEG or software only - VfW, Quicktime*
Modem/ISDN:	*28.8 kbit/s - 64 kbit/s*
Network:	*Not included/ 16-bit Ethernet*

3. TV-set with a CDi-playstation

An alternative way to reach a target audience is given by CD-systems. Within this configuration the end user platform is the TV-set which is connected to a playstation. The navigation is based on the remote control of the CDi-player

4. Web-PC

The term Web PC is used to describe a new generation of low cost networked computers that are effectively internet terminals. A huge market will be achieved by discarding the large operating systems and the monolithic platform-dependent applications that are currently in use. Instead of using large applications small component programs will be downloaded as they are needed directly from the network.

3.3 TECHNICAL ANALYSIS
COMMENTS AND REFERENCES

Technical analysis
A multitude of manufacturers produce components, add-ons and peripherals galore, which they combine in countless different ways to produce a PC or MAC. So the potential for incompatibility between some component of the user's system and the application which is added is enormous, particularly when it comes to multimedia machines.

The purpose of the technical analysis is to establish the baseline technical capabilities of the target audience. Most appropriate is to define a baseline projected into the time of implementation and including capabilities added expressly for the developed application.

Questions of the technical analysis are:
- Which is the target platform?
- Which are the hardware and software standards of the selected platform?
    - Which display screen should be used?
      For multimedia, this is a 14" super-VGA (SVGA) colour monitor. If you plan to make a lot of use of resolutions above 640 x 480 pixels, however, you should seriously target a user with 15-17 inch monitors.
    - Which graphics cards should be used?
      Multimedia needs colour (for optimal performance). For multimedia, a graphics card capable of supporting at least 32,000 colours at screen resolutions of 640 x 480 and 800 x 600 is recommended. Make sure that your target group's monitor, graphics card and drivers match.
- Which kind and standard of assets can be realised on the selected platform?
- Which form of delivery is desired, on-line or off-line?
- Which influences has the delivery on:
    - the standards for the software configuration,
    - the speed,
    - the multimedia assets
    - the functionalities and
    - the features of the application

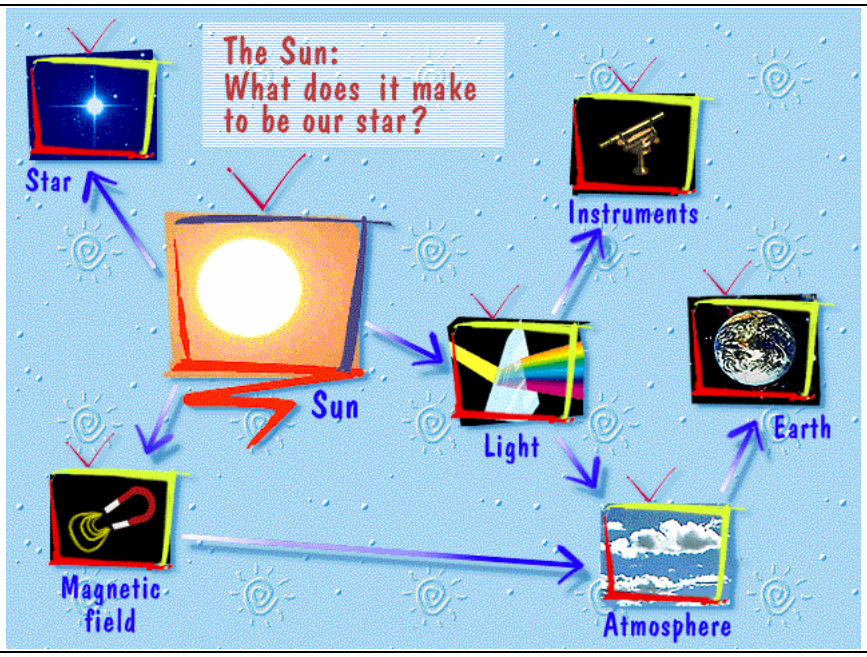
Outcome of the technical analysis:
- standards of the end user platform
- standards for software configuration

Responsibility: project manager/ editor, developer

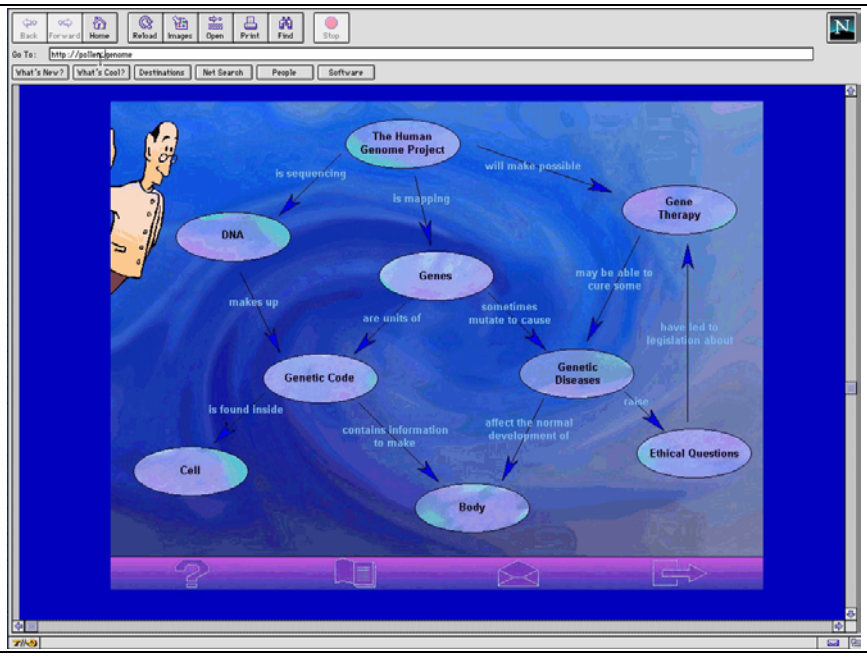
3.4 FORM OF THE PRODUCT

DEFINITION OF PRODUCT TYPE

1. Pollen Sun CD-ROM-application:



2. Pollen Genome World Wide Web-application:



3.4 FORM OF THE PRODUCT

COMMENTS AND REFERENCES

Which kind of product?

At this stage of the conception phase the editor decides about form(s) of the application. Usually there are three options, but only two of them are suitable to reach a huge target audience, the CD-ROM and the World Wide Web.

CD-ROM: CD-ROM programs can be used by either Macintosh or Windows based PC systems.. A CD-ROM has a limitation of playing QuickTime or video for windows at 15 frames per second unless an MPEG-1 video card like the "Reel Magic" is added and then video can play full motion, full screen. The program and all of the video, audio, animation, and graphics components typically reside on the disk. CD-ROMs are not sensitive in the way data is laid out on a CD-ROM, the only advantage is access time.

Trend: **DVD** (Digital Versatile Disk) technology is emerging
The new storage medium DVD is launched in 1997. DVDs hold ten times more data than conventional CD-ROMs and can store full-motion pictures.

World Wide Web: on-line applications or on-line supported applications on CD-ROM can be used by either Web-PCs, Macintosh or Windows based PC systems. How much of the program and all of the video, audio, animation, and graphics components typically reside on the CD-ROM or on the server depends on the transmission rate of the internet connection between the learner's PC/ MAC and the content server.

Tips:

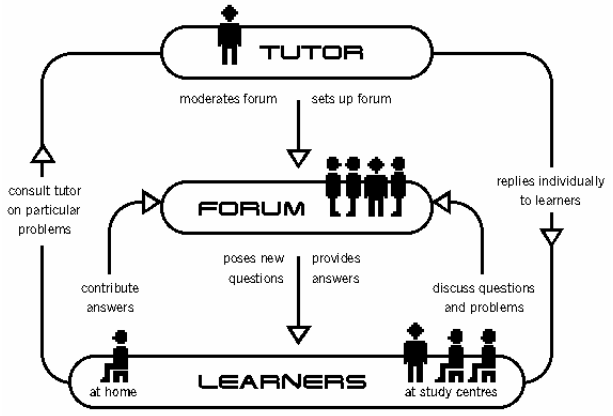
- Web server administration
  Once the files of the multimedia educational application are placed on the server, someone has to configure the server for the types of files used, monitor courseware/performance system usage, maintain user accounts or access privileges, maintain supporting databases, and monitor and update external hyperlinks.
  Responsibility: editor contacts the technically responsible (webmaster) of the Web-server
- Common gateway interface scripting
  Server-side applications may be needed for creating dynamic documents, performance tracking, student record keeping, and security measures. Documents that include dynamic information offer rich, timely information to the learner. Additionally, an evaluation may need to log usage and track student performance. A programmer can write common gateway interface scripts that perform these and other tasks.
  Responsibility: developer

CD-i: CD-i programs must be played in a dedicated CD-i player. The CD-i player can be used the same as the laser disc program with the exception of a large storage capacity for volatile data. The small memory that is used with a CD-i system is normally reserved for high scores for video games but it can be used to keep student scores. The memory of each player is comparable to 1 MB of ram. A CD-i player must have a video playback card to watch full screen, full motion video. The video is encoded MPEG-1.

3.5 ACCOMPANYING SERVICES

DEFINITION OF SERVICES AROUND THE EDUCATIONAL APPLICATION

1. On-line communication



MULTIMEDIA CHANGES LEARNING AND TEACHING

2. Home-learners, self-learners and educational tele-services

The number of "pure" home-learners, that is people who learn exclusively at home, is small. There are no reasons to think that it will grow dramatically in the coming years. On the contrary, the number of "part-time" home-learners, that is learners realising a part of learning at home (opposed to school, training centre or working place), is expected to grow rapidly. Pupils and students are traditionally part-time home-learners (home work). The group of home-learners will include more and more adults involved in continuing training: companies tend to encourage their employees to share the training time between work-time and leisure-time. Consequently, the number of home-learners of different categories will increase and will offer greater opportunities for educational products and services providers.

This trend has been analysed in different DELTA projects (BEACON) and concerns initial education as well as continuing training. It has been demonstrated that telecommunication networks have great potentialities for supporting home-learning. Tutoring and monitoring facilities have been experimented in several DELTA projects (MTS, JITOL, JANUS, ECOLE, etc.). These experiments have shown that the problem of support to distant-learners is complex and cannot be solved with a unique technological tool.

Pollen, 1995

3. Video Conferencing - A new world opens for distance education and training

"The big news is that video conferencing has become more affordable and user-friendly. It's a communications medium that people only talked about, but is now quickly becoming a desktop reality. It's destined to arise as a major technology in 1997, impacting the worlds of distance education, training and corporate communications. Major distributors such as Ingram Micro, Merisel and Tech Data are already seeing year to year growth rates of 80%."

Top Ten Multimedia Trends by Bruce and Jai Cole, MULTIMEDIA 97 Trade Show

3.5 ACCOMPANYING SERVICES
COMMENTS AND REFERENCES

Which kind of accompanying services?
At this stage the project manager/ editor should decide which kind of on-line services are implemented in the application and which communication tools are necessary to realise the desired form of communication.

Ad 1.
In the context of educational multimedia products exist several different fields for the implementation of on-line services. They can be distinguished by the form of communication between tutors/ teachers and learners or the communication between publishing house and learner. In both cases the communication can be synchronous or asynchronous and each communication partner can be part of a collective or single (synchronous or asynchronous) communication. Asynchronous communication tools are a sub-set of the synchronous communication tools

	Synchronous (real time)	Asynchronous (delayed)
Teacher/ tutor	teaches in an virtual classroom (at home or in school) connected to the learners via video conferencing and chatting groups	answers directly questions of homelearners via e-mail or updates newsgroups/ forums
Learner	learns in an virtual classroom (at home or in school) connected to the teacher/ tutor and learners via video conferencing and chatting groups	learns individually at home connected to the teacher/ tutor via e-mail and newsgroups/ forums
Publishing house	supports the virtual classes with course materials and sets up chatting groups, e.g. for German as a foreign language	on-line support, e.g. with updates on the course materials.

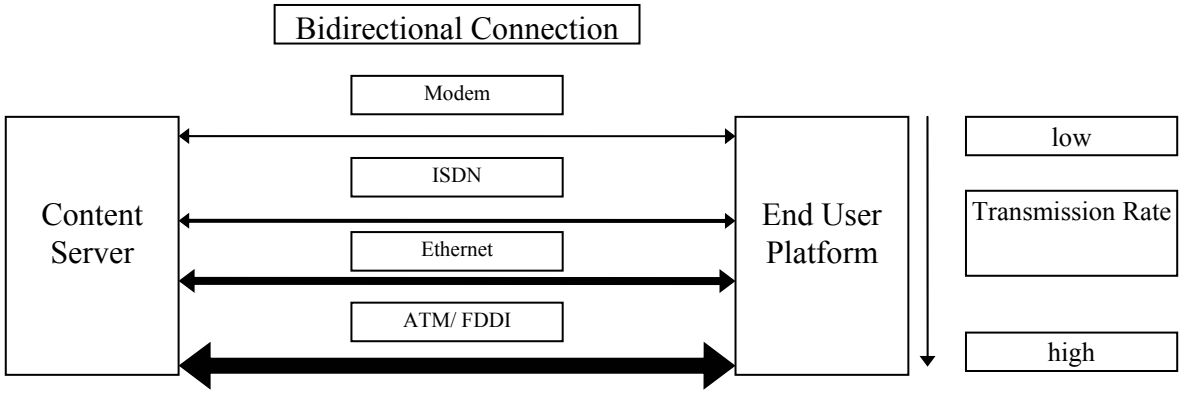
Ad 2.
Distance learning is a term encompassing all learning that takes place at locations remote from the point of instruction. Distance learning may take the form of an instructor-led course delivered via satellite to multiple remote locations. Distance learning may also be training applications delivered via computer networks to students at any network node. Web-based distance applications reside on a Web server while students may use the training from any location that can access this server. The virtual classroom is a way how to tailor specific functionality to allow a group of teachers/ tutors and learners to carry out the learning process in an electronic virtual environment that is meant to replace the physical class environment.

Ad 3.
The sophistication and flexibility of software structures for supporting distance education vary widely, from simple electronic mail systems to Conferencing systems that have been specially enhanced to support classroom-like experiences, particularly group discussions and joint projects. Currently, a large number of colleges in the US offer remote courses utilising various forms of Computer Mediated Communications.

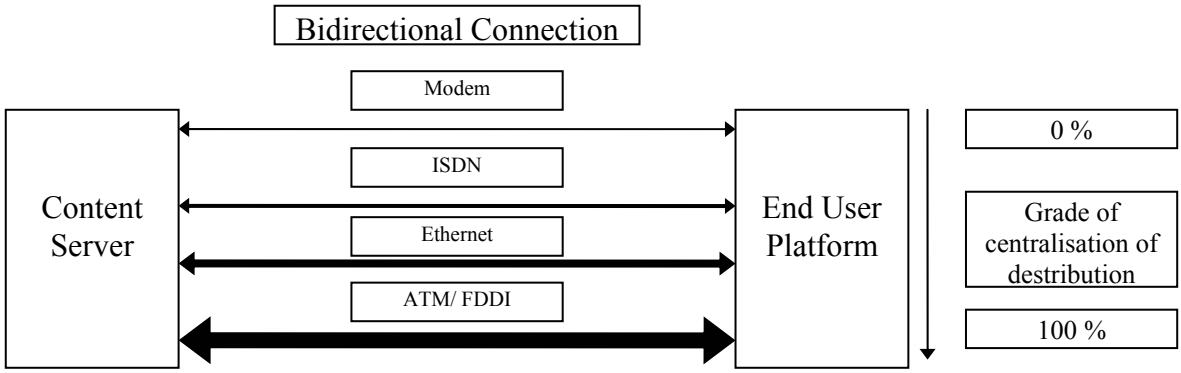
3.6 DISTRIBUTION CHANNELS

DEFINITION OF DISTRIBUTION OF THE APPLICATION

1. Transmission rates of different internet connections



2. On-line delivery of educational applications



3. Multimedia Trends

1. Security on the Net - Practising safe surfing
„A big issue for 1997 is the growing fear that confidential information on the net might be used and abused by every computer geek from here to Helsinki. Firewalls, which PC Week predicts will experience a 66% compound annual growth rate from now until 1999, will be heavily used to prevent unwanted entry into private sites. And Net marketers will rally to boost consumer confidence in the safety of giving credit card numbers on-line."

2. Video on the Net
"Sophisticated net delivery systems like QuickTime VR and VXTreme are ensuring that 1997 is the year that video comes of age on the Internet."

Top Ten Multimedia Trends by Bruce and Jai Cole, MULTIMEDIA 97 Trade Show

4. Publishers and on-line delivery

Publishers assume *that by 2000, the number of households and Education and Training organisations connected on information highways in experimental sites will reach a level that will open a profitable market for them.“*

Pollen, 1995

3.6 DISTRIBUTION CHANNELS
COMMENTS AND REFERENCES

Ad 1.
At this stage the project manager/ editor should decide in which form the application will be delivered to the user with respect to the end user platform and the transmission rate of the user's internet connection.

There are three options from which the editor can choose:
- off-line, e.g. on CD-ROM/ DVD
- off-line, e.g. on CD-ROM/ DVD with on-line support (refer to 3.5) or
- on-line via the World Wide Web

Ad 2.
Using the Web for educational applications is an attractive proposition for a number of reasons. First of all it enables you to reach each multimedia platform with a connection to the World Wide Web. Second it is likely there is a lot of software readily available to distance learners. Third the World Wide Web already contains a vast wealth of information which enriches the learning environment.

However one of the most attractive features of the Web, as far as large organisations such as universities or schools are concerned, is that they are likely to be much easier and cheaper to maintain and administer than stand alone computers. Moving all software maintenance to servers is an attractive proposition to most support personnel. The expensive cycle of software and hardware upgrades would also be slowed by this strategy. Conventionally as monolithic applications get bigger and include more features they require a higher specification of machine. The widespread use of such machines encourages developers to create applications that are even bigger and need more resources. The modular software architecture of Web applications could slow the development of huge applications by breaking programs up into small manageable components that are only loaded when they are needed (e.g. in future the spell checker of a text editor could be downloaded).

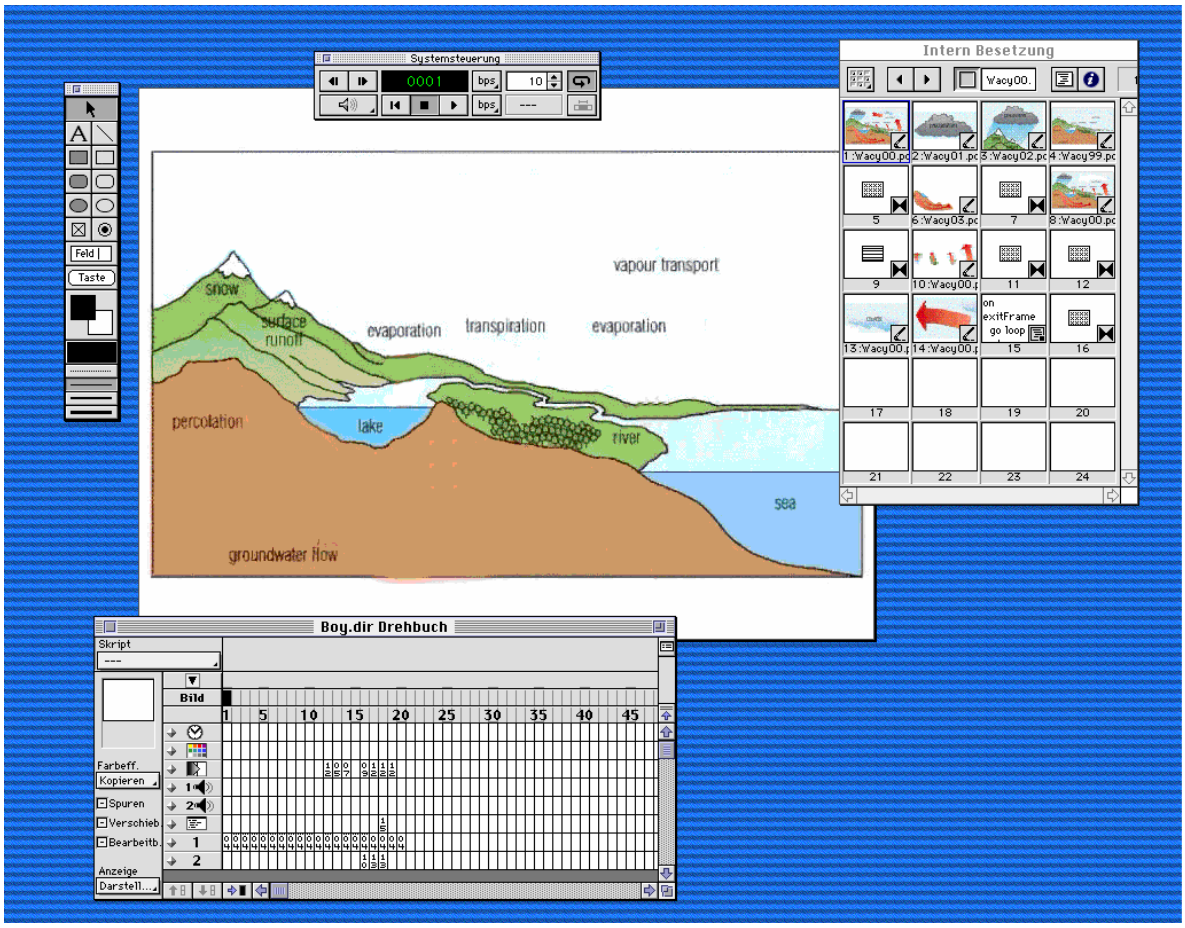
Ad 3.
The progress of the Internet/ Web-technology is very fast, initial problems like security in the net or time consuming video transmission will be removed in the near future.

Ad 4.
It is at the moment impossible to judge what impact the World Wide Web and server based applications will have upon education - it may not have any if negative attitude towards Web-applications cannot be overcome. However they may have a very substantial impact if the Web-connection is cheap and popular enough to become really ubiquitous. This can be achieved by placing emphasis on Web-applications as opposed to PC/ MAC installed applications.

3.7 DEVELOPMENT TOOLS

SELECTION OF SUITABLE PROGRAMS

1. Example: Screenshot Macromedia Director



2. Selection of development tools

„The technological tools used are chosen among existing tools, accessible on the free market. The selection and utilisation of tools and methods was based on a pragmatic rule: utilisation of an innovative tool, and more generally any change in the production process, has to be justified in terms of cost-effectiveness. A perfect solution for this requirement is the Asymetrix Toolbook II application, the design tool used for programming the prototypes.“

Pollen, 1997

3.7 DEVELOPMENT TOOLS
COMMENTS AND REFERENCES

Based on the decisions which are the hardware and software standards of the end user platform and which form(s) of delivery is (are) envisaged, the development tools are selected by the developers.

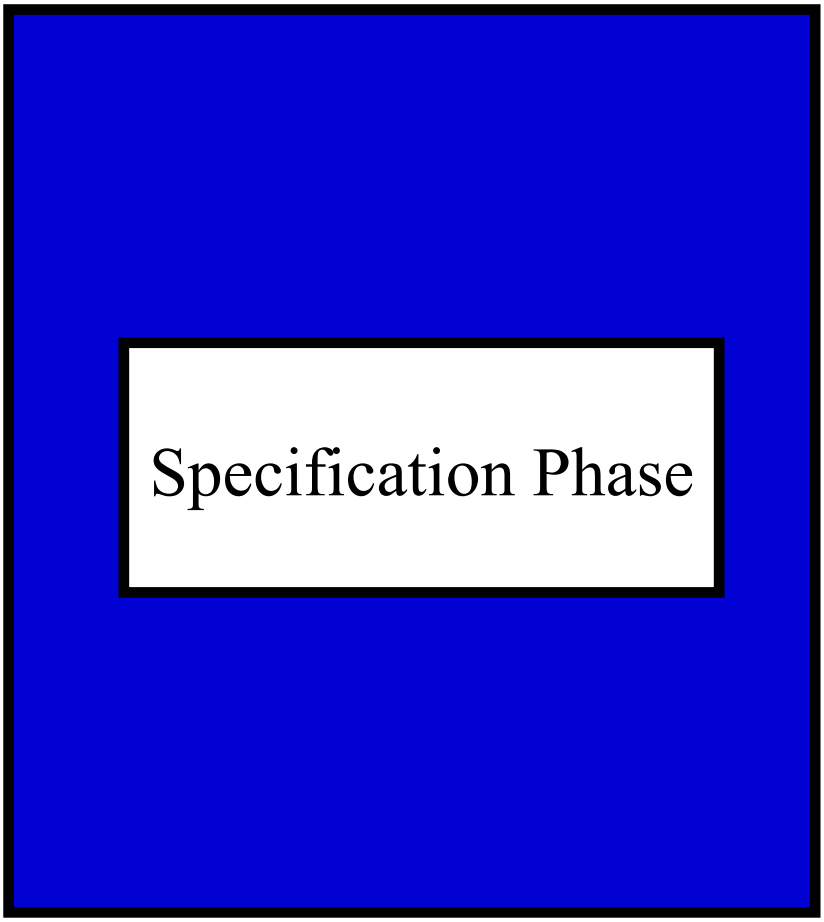
Ad 1. Development of off-line products:
In the past it was only in the realm of computer engineers to create multimedia programs. Because of the type of skills required for programming, all multimedia programs were created by someone who had years of computer training. As times have changed programs have been created which enable non programmers to produce multimedia titles, the multimedia programs have been made simpler thus there is a deskillization of the developers.

As computer and video technology merge, there is a new breed of computer users called multimedia producers. These people use authoring systems that can generate their own code as far as programming goes and offers a plethora of options and features. An authoring system can be very basic, allowing a simple jump to different pages or it can be complex using digitised video, digital audio, and even access to such devices like, laser disk players, and touch screens. Some authoring languages are: Toolbook, Director, and Visual Basic. The only cross platform program out of these is Director which allows you to produce for PC and MAC
Responsibility: developer

Development of on-line products:
a. The Toolbook II and the Director allow the diffusion and use of an Toolbook/ Director application on Internet by using the Neuron/ Shockwave internet plug-in which can be installed on the learner's PC, MAC or Web-PC. It is of crucial importance to meet the specification of a net based implementation, this is because the HTTP based on-line version of Toolbook/ Director (Neuron/ Shockwave) has restrictions that are not present in the usual developers' kit for Toolbook/ Director, i.e. a sub-set of the Toolbook/ Director features has to be used to develop equal on-line and off-line prototypes.
Responsibility: developer

Java coding/ Plug-ins content
b. Should the application call for sophisticated interactions, graphic simulations or self-contained applications ("applets") transparently embedded in the Web pages, Java coding becomes necessary. In some cases Java script or some other scripting technology will be adequate and appropriate. In other cases, Shockwave-, Neuron- or other plug-ins content will suffice or be quicker to develop. Nonetheless, this step, if required, is strictly the realm of the developer.
Responsibility: developer

Ad 2.
It is extremely difficult to predict which development tool will survive to become the new standard, and the precise implications of these developments for current high level authoring projects are equally difficult to discern. Of one thing only we can be certain: that nothing in this lively area will remain static. Don't forget that the computer market changes very rapidly.



4.1 SPECIFICATION PHASE

DEFINITION OF WORK STRUCTURE BETWEEN EDITOR, DEVELOPER AND AUTHOR

1. Functional specification of the design of the Pollen prototypes:

The functional specification of the Pollen prototypes contains seven sub-sections that are organised as follow:

1. Overview on the two prototypes
   - content description,
   - target group & diffusion and
   - participants of the development process

2. Architecture of the prototypes
   - modular design

3. Technical specification of the sun prototype
   - user interfaces - screen designs and
   - navigation functions

4. Technical specification of the Genome prototype
   - user interfaces - screen designs and
   - navigation functions

5. Content delivery
   - storyboard design and
   - resource file standards

6. Technical specification of the verification sites
   - requirements for the implementation
   - requirements for the evaluation

7. Specification of the development tool
   - requirements for the on-line and off-line delivery of the prototype and
   - log-file record

Pollen Project Functional Specification, 1997

4.1 SPECIFICATION PHASE
COMMENTS AND REFERENCES

Specification phase
The specification phase of the multimedia design process starts with the definition of the application's architecture (refer to 4.3). The editor resumes supported by the implementation team (consisting out of the editor, developer and author) the decisions from the last steps of the definition and conception phase and prepare a graphical representation by allocating all important modules of the application (e.g. communication tools, ...) around the user-interface. The editor should involve the authors as soon as possible as they are the main source of ideas and the creative task is left to them. By doing that it is possible to conceal, at an early stage, the practical (editor) and technical (developers) issues with content and creativity.

Ad 1. Functional specification document
The functional specification document defines standards, architecture, navigation, features and storyboard design of the application (refer to 4.4). In general the functional specification document should include the following sections (refer to the index on the left page). When producing an application many of the below described phases overlap. It may happen that the functional specification or the storyboards are almost finished when you find out that a crucial piece of information has been omitted.

In the Pollen project the following responsibilities are introduced
1. Communication structure
   in charge of the implementation: project manager/ editor
2. Architecture - overall structure
   in charge: project manager/ editor,
   collaborative decisions by: authors, developers and project manager/ editor
3. Functional specification - navigation functions
   in charge: project manager/ editor,
   collaborative decisions by: authors, developers and project manager/ editor
4. Storyboarding - writing of contents
   in charge: authors,
   collaborative editing by: authors, developers and project manager/ editor
5. Multimedia assets - standards for the materials and file transfer formats
   in charge of the arrangement: project manager/ editor,
   collaborative agreement and editing by: authors, developers and project manager/ editor
6. Realisation of the application
   in charge: developers,
   tested by: authors and project manager/ editor

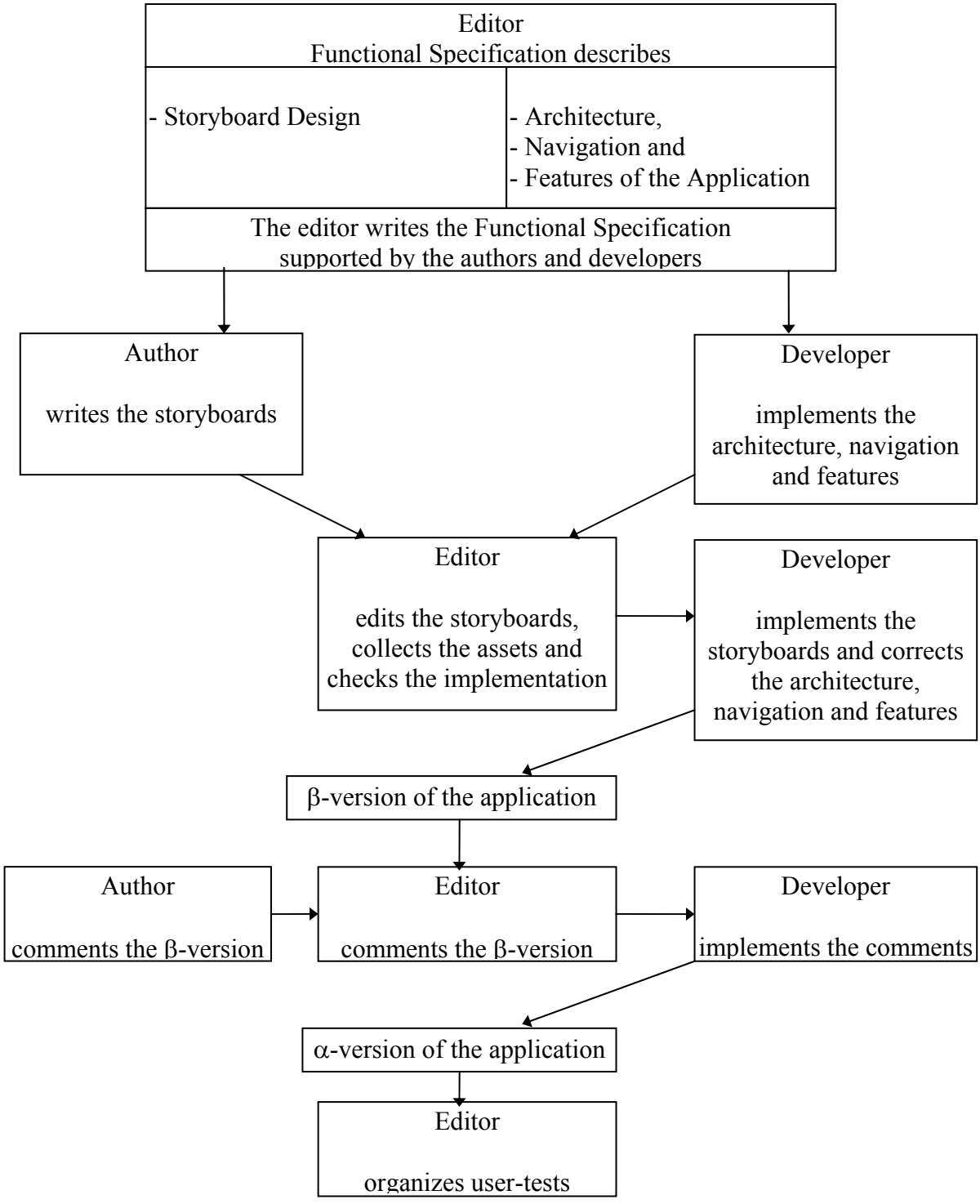
Tips:
- The editor should have meetings with the authors and developers at regular intervals to keep them up to date on the progress of the project
- Involve the authors in the designing of the user-interface, architecture and navigation of the application

4.2 COMMUNICATION/ MANAGEMENT

CO-ORDINATION OF WORK WITHIN THE AUTHORING TEAM

1. Pollen production process:

please notice, the following diagram is divided into three columns: author, editor and developer. Each of them describes the role of the above in the specification phase.



4.2 COMMUNICATION/ MANAGEMENT
COMMENTS AND REFERENCES

Co-ordination

In concrete terms, co-ordination of work within the authoring team should exploit the following tools and methods:

- face to face seminars gathering the whole authoring team or a sub-set of the authoring team, with specific issues and objectives (e.g. training of authors to the design methodology, set-up of the initial user-interface, mid-term and final review);
- generic telematic tools (e-mail, video conferencing, www-server) for the continuing communication within the authoring team;
- standard software is used for the design of the user-interface, files being exchanged between authors, editor and developers through telematic infrastructures;
- good planning. There are three main types of planning: technical, quality and resource planning. Another very important step in planning is to identify the dependencies. All this helps to reduce omission to a minimum and avoid a number of future problems.

Communication

Project documents and supporting files can become scattered and unmanageable. It is important that the project manager take control early in the project to establish procedures for everyone to follow in supplying and maintaining project files. There are many management tools available to help the responsible person keep control of files.
Responsibility: project manager/ editor. Internal evaluation and updating of storyboards, functional specification document and application

The keyquestion of the internal evaluation of the production process is:

- Were the outcomes defined in the user analysis and tasks/user analysis achieved?

Ongoing testing and evaluation will point out unforeseen weakness in the educational product. It may become necessary to redesign individual pages or segments of content should the content become dated and new information become available. Usability issues should have been addressed completely during initial testing of the interface, but added features or content may require interface modification and new testing. The advantages of a modular design will become evident during this last phase because updates become easier and faster.
Responsibility: Project manager/ editor, author, developer

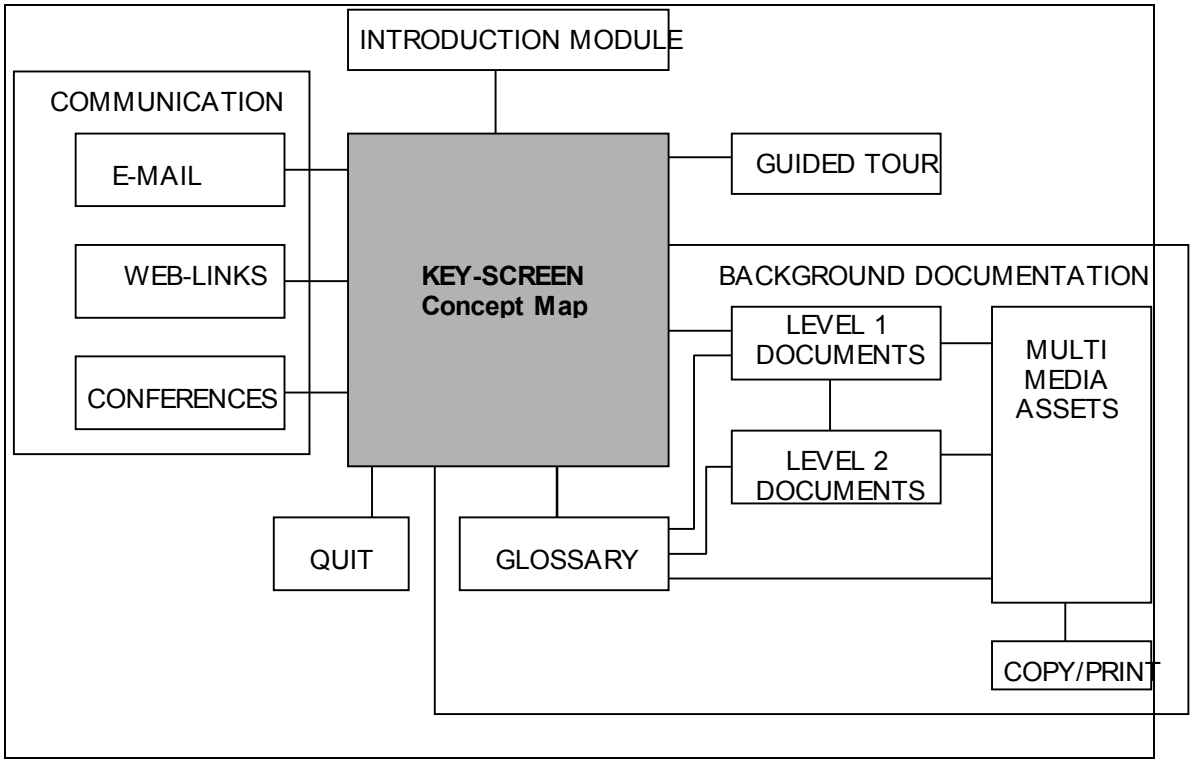
Tips:

- Set realistic milestones. An example might be: January through March Research and script development. April, May Production, and June July, testing and changes.
- The editor should jointly agree on milestones and have the authors, editor and developers approve of each step and sign them.
- The editor should be careful when setting goals, don't cut himself short on time. It is almost sure that the project will take longer than expected. And it is also sure that the implementation team of authors, editor and developers will change its mind mid way through the project and the team will have to start over on some aspects.

4.3 ARCHITECTURE

SPECIFICATION OF THE APPLICATION'S OVERALL STRUCTURE

1. Overview on the architecture of the Pollen Genome prototype



2. The architecture of the Pollen prototypes

According to the POLLEN design methodology, specification of a prototype is an electronic document composed of:

- A conceptual map
The conceptual map has the form of 2D diagram linking concepts; in the conceptual map, concepts and relations between two concepts are represented thanks to labels (a name for a concept, a verbal expression for a link);

- A set of interactive features associated with the conceptual map
The interactive features constitute the main part of the specification. They are grouped in two categories: first the circulation features, allowing the learner to browse in the conceptual map) and second the interrogation features, allowing the learner to test his/her understanding of the concepts.

- A set of multimedia sequences associated with the conceptual map and the interactive features
The multimedia sequences constitute the didactic material elaborated by the authors on the scientific domain treated by the educational software. Different levels of multimedia sequences are being considered. The lower level is a graphical element which can be displayed on the screen. Higher levels incorporate video sequences and animations.

Pollen, 1996

4.3 ARCHITECTURE
COMMENTS AND REFERENCES

Interface design
The designing of the interface is the first step to achieve the application's architecture and one of the most critical phases of the design process. The user interface must provide all the features needed for the user to navigate the application as intuitively and transparently as possible. We suggest to apply user centred design methodologies like the concept map design method for the construction of the interface (refer to section 5).

User-centred design
The implementation of on-line services should be discussed thoroughly in the design stage. This will help minimise "feature creep" which can destroy an interface design and derail a project in later phases. User-centred design dictates that the interface provide features that allow the learner to control the learning process.

The user analysis should have already defined the range of user computer experience so that the developer may choose design elements most appropriate for the target users. Developers best understand the complex, non-linear way learners will use the product. Developers work with editors and authors to define metaphors and the interface to support those metaphors and, if necessary, mesh with established design standards.
Responsibility: developer, editor, with input from cognitive psychologists and authors

Usability testing
The usability of the interface is tested on real end users or those with similar skill and knowledge levels. Through careful observation, scientific analysis and subjective evaluation the effectiveness of the interface can be determined.
Responsibility: cognitive psychologists contacted by the editor if required

Ad 1.
The definition of the architecture starts with resuming the main modules of the application. The editor prepares a graphical representation of the architecture by specifying:

- communication tools, e.g. e-mail, video conferencing, web-links, newsgroups, chatting groups, etc.,
- features, e.g. a glossary, an index, etc.,
- the content level and
- the background level, i.e. the multimedia assets.

The next step is to link the modules with the user-interface to specify the path the user will have to follow when browsing in the application.

Ad 2.
In case of the Pollen project the concept map design structured the interface design process in an dynamic way (refer to section 5).

4.4 FUNCTIONAL SPECIFICATION

SPECIFICATION OF THE APPLICATION'S DESIGN

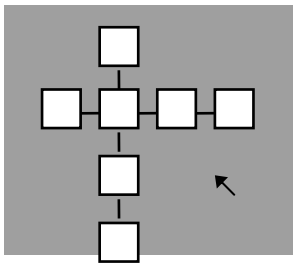
1. Example Functional Specification Pollen Sun

Click on background picture

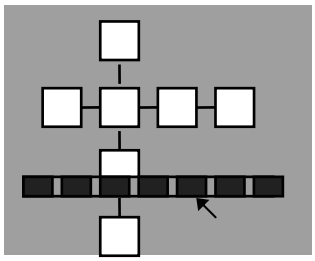
A click on a background picture activates the pause function and the button bar appears on the screen. A further click on the background picture of the new screen e.g. the e-mail-system closes the e-mail-system screen and returns to the button bar of the entrance screen.

Activation of the „pause" function and the „button bar"

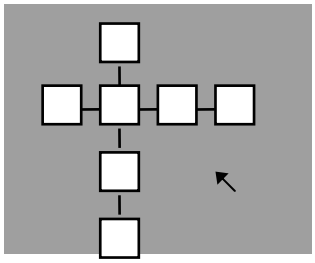
In general a click on inactive screen parts (here gray) will activate the pause function and the button bar will appear on the screen.



Example concept map screen:
A click on the background picture of the screen. The button bar pops up.
The button bar appears at the same height where the pointer appears.



A further click on inactive screen parts deactivates the pause function, the button bar disappears and the application will continue.



4.4 FUNCTIONAL SPECIFICATION
COMMENTS AND REFERENCES

Standards and architecture definition in the functional specification document
For the benefit of all processes that follow, it is wise to prepare a functional specification document which defines the:

- architecture,
- navigation,
- features and
- storyboard design of the Application.

The project manager/ editor is in charge of writing the functional specification document and submitting it to developers and authors. The implementation team provides the project manager/ editor with input into the functional specifications which include required software, bandwidth, software settings, file naming conventions, and technical details required by the interface. In case of an on-line or on-line supported application the project manager/ editor supported by a webmaster sets standards for site maintenance and internal security on the end user platform . The webmaster should specify procedures and standards which must be followed for server compatibility, external security, and user access control. Additionally standards for the design of the storyboards (to be written by the authors), file transfer formats for the multimedia assets, authoring tools and needs for the user tests are defined.
Responsibility: project manager/ editor, developer

Ad 1. Navigation and feature descriptions
The description of the navigation and the feature follows the path a user would follow when browsing in the application. Describe the user's choice at each screen of the application and specify each of his possible selections step by step.

Guidelines for storyboards
The design process is based on content descriptions (storyboards) of the prototypes which are prepared by the authors and the editor. To ensure the communication between authors, editors and without misunderstandings, standards for the content descriptions are needed. The guidelines for storyboards organise the way to deliver the content descriptions. These guidelines should be organised considering the produced type of application. Basic media elements in such an interactive PC-based application could be audio and video elements more than written texts: then storyboard information is arranged according to this basic assumption, i.e. the main element of the storyboard is the text to be spoken with a set of written notes with which to describe both events to be activated and data to be shown during the audio sequence.

Tip:

- There are several storyboard programs available for PC and MAC which facilitate the structured writing and exchange of the storyboards.

4.5 STORYBOARDING

SPECIFICATION OF THE APPLICATION'S CONTENT

1. The European Publishers of Educational Materials

6.0 Introduction

1
6-0/1.wav The earth receives the energy from the sun in form of radiation. Nearly half of it is absorbed in the earth atmosphere **2** How the atmosphere is formed and to what extent the different types of radiation penetrate through, you will find out in the next lesson „The air mantle".
3
6-0/2.wav Some of the factors which determine the weather and a possible connection between solar activity and climate **4** have been analysed in the section „Water in Air: Weather and climate".
5
6-0/3.wav The magnetic field of the earth influences the solar wind around the earth. In the lesson „ A further protection: the magnetic field of the earth" **6** you learn about the structure of the magnetosphere.
7
6-0/4.wav The last lesson „The other lights of the sun „takes a look to how the solar activity is noticeable on the earth.

Instructions

1 picture 6.1.20
2 picture 6.1.25
3 picture 6.2.1 seaice_sts45.jpg
4 picture 6.2.13 Ewinkel.jpg
5 picture 6.3.1 MAGNETF.JPG
6 picture 6.3.10
7 picture 6.4.16. cme1.jpg(take the last of the 4 pictures)
8 picture 6.4.6 aurora _orion_sts59.jpg

Pollen Project Storyboard Pollen Sun Concept Atmosphere, 1997

4.5 STORYBOARDING
COMMENTS AND REFERENCES

Storyboarding

The storyboarding process is one where a trained, highly experienced author organises and presents content in such a way that the end user meets his or her learning goals. The author knows the subject matter and with the aid of the developer and the editor he is able to apply the teaching methods best suited for the medium and the learner. Much effort must be placed on structuring the information (refer to section 5), culling it down to the essential and presenting it in discrete informational units. Typically, the editor and developer will review and approve the storyboards for accuracy and applicability.
Responsibility: author

How to start the storyboarding?

The storyboarding should start with a strong collection of related ideas. The best way to generate these ideas is to brainstorm. Brainstorming involves the authors and the editor either alone or sitting together and writing down a continuous stream of spoken thoughts. For example say the editor has to produce a multimedia program on the sun. The brainstorm session might go like this: sun, solar spot, eclipses, universe, stars, energy, nuclear fusion, etc. It is easy to see that many good ideas were generated. Some ideas are not important, but some can be put into a list to make a rough out line or a first table of contents.

Tip:

- By brainstorming each of the individual points in the rough outline, even more detail can be written into the structure. The implementation team keeps one thing in mind while brainstorming. Never think anything would be too insignificant to write down. Write all ideas down. Now is a time for creation not editing. If the team later finds out that the idea isn't important then it is deleted. It is always better to have too much than not enough. The editor shouldn't be worry about the potential costs of something at this point, it is important to have lots of ideas.

Writing of the storyboards

The next step is to write the storyboard chapter by chapter using the standard form of the storyboard specified in the functional specification document. The authors complete the chapters following the table of contents and specify each change on the screen clearly. If producing an interactive educational product, the author needs to list all locations or events, pictures, videos, sounds, etc. that the learner will experience without these descriptions the developer is unable to implement the multimedia assets correctly.

Tip:

- In case the editor is not sure if what he or the author want to do will be possible due to either the capabilities of the computer software or the programmer, he shouldn't be worry about it and add it to the storyboard anyway. Even though a specific event may be costly, or difficult to do, mostly there is a way to incorporate the idea into the application, usually a bit modified although.

4.6 MULTIMEDIA ASSETS
COMMENTS AND REFERENCES

Ad 1.
Multimedia requires, as a minimum, a palette of 256 colours (i.e. 8-bit colour depth) and a screen resolution of 640 x 480 pixels.

BMP-Picture, size 640*480 (full screen VGA)		
quality factor	colour depth	file size
100 %	32 bit	1.228 kb
75 %	24 bit	922 kb
50 %	16 bit	614 kb
25 %	8 bit	307 kb

Ad 2.
A minimum requirement for video is 15 frames per second, so that the film is perceived as a fluent motion.

Video Codes in Comparison

Method/ Product	**Frame Rate (FPS)**	**Data Rate (kilobits)**	**Resolution**	**Audio Synch**	**Special Hardware**	**Compres-sion**	**Quality**
QuickTime	15-24	150	320 X 240	Yes	None	Asymmetric 150:1	Low-Medium
INDEO	15-30	150-500	160 X 120 (320 X 240)	Yes	None	Symmetric and Asymmetric	Medium
MPEG-1	30	150	352 X 240	Yes	CL 450/950	Asymmetric 15:1 and 500:1	Medium-High
MPEG-2	30	15-2000	720 X 480	Yes	CLR-4000	Asymmetric	Very High
Motion JPEG	30	600-1500	640 X 480	No	CL550/560	Asymmetric	High
True Motion	30	600	640 X 480	Yes	1750	Asymmetric 5:1	Very High
CinePak	15-24	150	160 X 120 (320 X 240)	Yes	None	Asymmetric	Low-Medium
Laser Video-Disc	30	22,700	640 X 480 (450 hori-zontal lines)	Yes	Videodisc Player	N/A	Very High

Ad 3.
There is a possible range of audio quality between CD quality (16 bit stereo, 44 kHz sampling rate) and the bottom line of spoken audio (8 bit mono, 11 kHz sampling rate). Below these resolution/sampling rate, reasonable audio is not possible.

WAV-audiofile, 1 min				
		file size at different sampling rates		
quality factor	resolution	44 kHz	22 kHz	11 kHz
100 %	16 bit stereo	10,56 MB	5,28 MB	2,64 MB
75 %	16 bit mono	5,28 MB	2,64 MB	1,32 MB
50 %	8 bit stereo	5,28 MB	2,64 MB	1,32 MB
25 %	8 bit mono	2,64 MB	1,32 MB	0,66 MB

4.7 IMPLEMENTATION

SPECIFICATION OF THE APPLICATION'S ASSETS (2)

1. Data Formats and Related Formal and De Facto Standards

DATA FORMATS	FORMAL AND De Facto STANDARDS
Text ISO 646, 2022, 8879, 10646	RTF, SGML, PostScript, HTML
Vector Graphics	Computer Graphics Metafile (CGM)
Raster Graphics	TIFF, GIF, PICT, MacPaint, MS Windows bitmap (BMP) and X Windows bitmap IPI-IIF (Image Interchange Facility) JPEG, CCITT/ITU group 3 (T.4) and group 4 (T.6) fax
Mixed Text Graphics	CGM, PICT, PostScript, SPDL
Analog Video	PAL, SECAM, NTSC, HDTV:ITU-R 709, HDTV:SMPTE 260M, EBU 3271
Digital Video	MPEG-1 Video, MPEG-2 Video ITU-T Rec. H.120, H.261 (Videoconferencing) D-1, D-2, D-3, D-5 ITU-T 601, ITU-R 656 HDTV:SMPTE 240M, EBU 3271
Digital Audio	ITU-T G.711, G.722, G.726, AND G.728 (Telecom) CD-ROM-XA audio; MIDI MPEG-1 Audio, MPEG-2 Audio
Mixed Digital Video and Audio	MPEG-1 System, MPEG-2 System ITU-T H.20, H.320, AND T.120 series (Videoconf.) Intel's DVI and Indeo Apple's Quicktime, Phillips VD-I Sony's CD-ROM-XA, Avid's OMFI, and Microsoft's Video for Windows (AVI)

4.7 IMPLEMENTATION
COMMENTS AND REFERENCES

Ad 1. Implementation of the multimedia assets
Based on the storyboards the editor collects the multimedia assets and delivers the files to the developers which create or process the variety of content that will make up the product: text, still graphics, movies, animations, music, narrations, databases, Shockwave, Neuron content.

There are a variety of formal and de facto standards. It is important that delivered media are conform to the standards to be fully compatible with the interface. Such standards are specified in the functional specification document.
Responsibility: developer

The choice of the right standard is an important issue. Compressed and uncompressed data formats are available. If an uncompressed format is chosen, the file size is big but the processing time is short. In the case of compressed file formats it is the other way round. This seems to be trivial but it needs extensive consideration when an application is to be distributed off- and on-line (at different network speeds). Faster image compilation might be outweighed by longer download times.

Tip:
- Always be aware of the trade off between file size and CPU time needed to build up the asset on the output device (image, video)

Even though a standard for a certain asset is specified, there is still the choice of the quality within this data format.

Multimedia has to meet certain minimum standards of quality in order to fulfil a given communicative or cognitive objective. However, the brain also likes quick responses to its commands and users only benefit in full from a product if there are no time lags. So from a multimedia perspective it is necessary to deliver high resolution colour animations and graphics, high quality audio and video files and at the same time high speed in all target environments (PC, Mac, UNIX).

Tip:
- There are not many (technical) limitations to quality in CD-ROM and on-line applications. However, the nature of video and high resolution graphics have an effect on access speed of the program from the CD-ROM player and especially in the World Wide Web.

4.8 QUALITY CRITERIA

CHECKLIST

1. ***Technical criteria***

a. definition and statement of hardware and software requirements (CPU, disk space, RAM, graphics adapter, operating system)
b. ease of installation process
c. functioning features? (colour scheme, on-line connection ...)
d. extent of control (volume, media player control bar?)
e. possibility to set bookmarks, ad notes
f. undo/reset function
g. support of several input devices (keyboard and mouse)
h. technical quality of assets (graphics, audio, video, animation)

2. ***Usability criteria***

a. definition and statement of target user group (age, prerequisite)
b. ergonomy (used colourschemes, size of fonts)
c. interface (screen design, interface design, metaphors)
d. structure/form of dialogues
e. orientation hints
f. history of learning path (which parts are already done)
g. clear program structure
h. exit always possible
i. (free) choice of learning content and learning route (free navigation)
j. adequate help system (considering age and target group)
k. context sensitive help
l. glossary

3. ***Pedagogical criteria***

a. statement of learning objectives
b. program idea fit for target group?
c. underlying pedagogical model
d. visualising complex topics
e. offer of parallel learning channels
f. immediate response
g. adequate failure responses (no negative response)
h. discrimination of orthographic and content failures
i. learning success statistics
j. is the program giving a sense of achievement?
k. entertainment/motivation

4. ***Criteria related to content***

a. choice of topic adequate to target group
b. correct content
c. depth of content adequate to age and ability of users
d. does the content match the specified objectives/learning goals
e. (non-technical) quality of assets (pictures, animations, audio etc.): e.g. up to date or aged?

4.8 QUALITY CRITERIA
COMMENTS AND REFERENCES

Quality strategy
In order to guarantee a certain quality standard of the multimedia applications the criteria of the checklist have to be fulfilled.

Tip:
- To avoid costly misdirections of funds at each stage of the development the project should be checked according to the provided list. Some features have to be implemented at the conception phase already, others at the implementation of the assets. But it is important to keep the complex totality of the final application in mind.

In the case of criteria, where only absence or presence of a certain feature has to be stated, evaluation of quality is easily possible. Also technical criteria can be evaluated easily: there is no problem to find out whether an audio file is codexed at a resolution of 8 or 16 bits.

A more difficult task is the definition of metrics of non technical criteria: for example evaluating an underlying pedagogical model. It is not possible to measure its quality directly. However, it is possible to evaluate the logical concept of the model and the fact, whether the implementation of the application has stuck to the model or not.

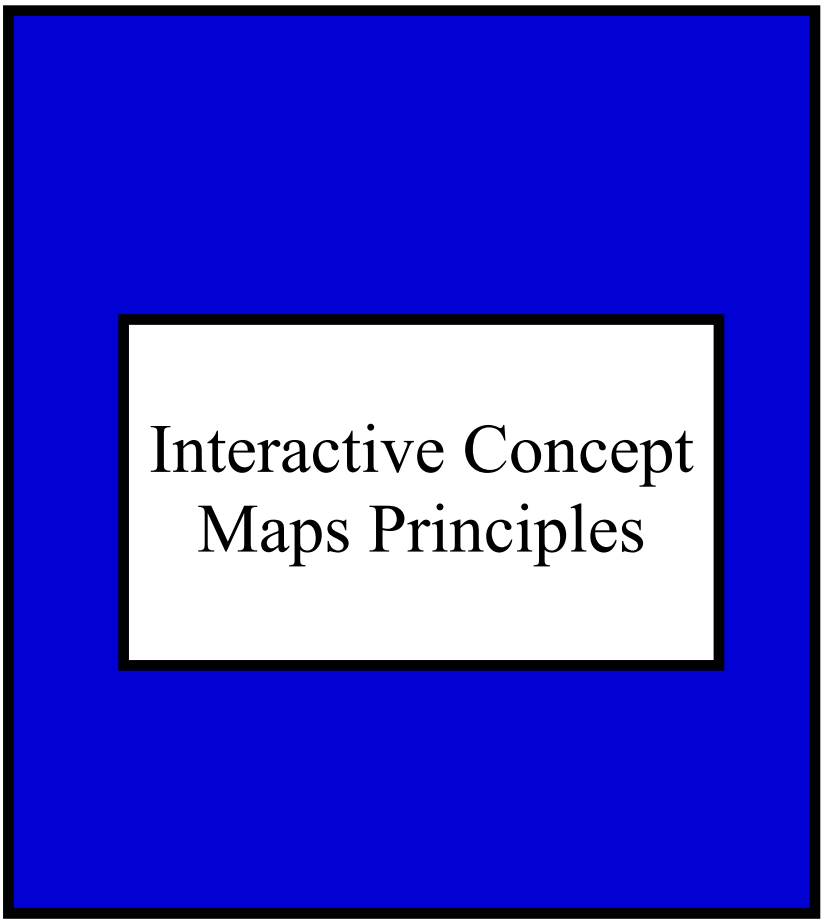
Quality criteria and pedagogical and contextual necessity
However, it is not sensible to evaluate the provided criteria isolated from the pedagogical and contextual concept.

For example: it has to be considered whether an audio file is used as background or as subject of the application (e.g. analysis of a symphony). Also there are differentiated requirements to spoken audio and music.

Another example is the choice of the learning route, which has to match the underlying pedagogical model. When an open learning environment is propagated in the model and the freedom of choice in the realised application is restricted to one or two learning paths, there is no inherent reason for those restrictions, but economical reasons.

If there are economical restrictions, the reduction of standards has to be chosen very carefully.

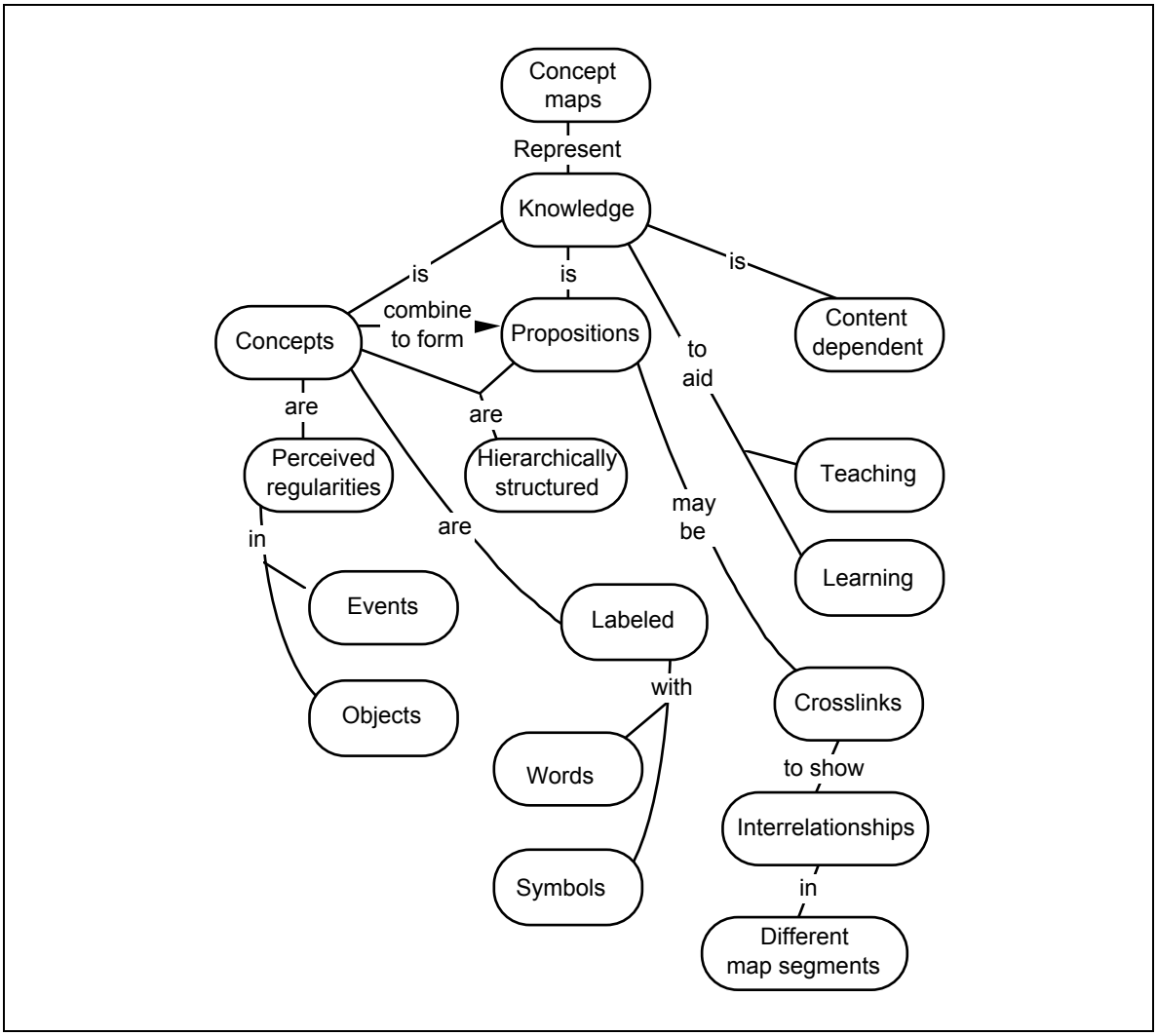
In the case of restrictions in learning paths an appropriate pedagogical model should be selected from the start.



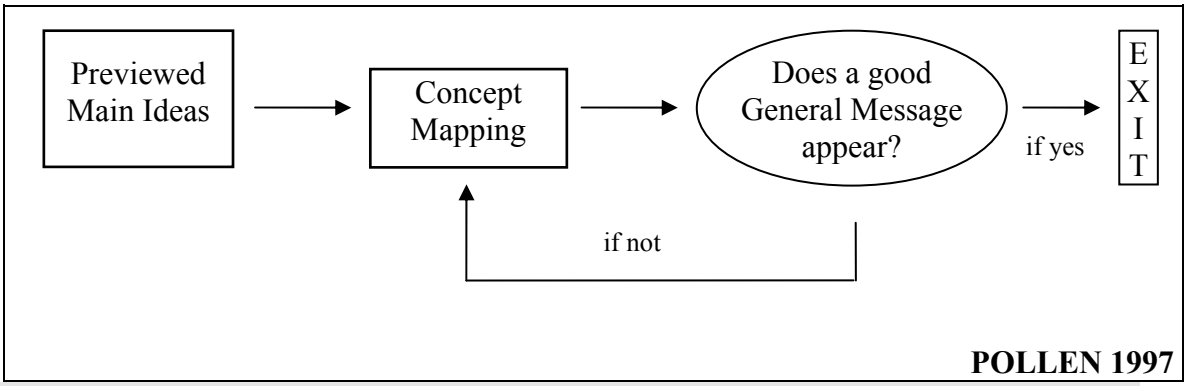
5.1 METHODOLOGY MAIN LINES (1)

CONCEPT MAP AS AN INTERFACE BETWEEN AUTHORS

1. A concept map representing concept mapping (by J. D. Novak, 1994)



2. General message definition process



5.1 METHODOLOGY MAIN LINES (1)
COMMENTS AND REFERENCES

Keeping a global overview of an hypermedia product
The efficiency of the work done within the authoring team of an hypermedia product can be much increased if the team members can keep a global overview of the product all over the authoring process phases. This overview can become a methodology for managing the complexity of the authoring process. One can state, when considering educational hypermedia products, that their content structure should be the basis of this overview for two main reasons:

- for the authoring team members, this is the global object to define;
- for the end users, this is the global network to be understood.

The concept map is the tool for applying such a methodological idea. It is a knowledge representation graphic that the authors can easily build (after about two days of practical training) to visualise the main structure of the topic they have to define. Furthermore, its network shape fits well for becoming a global overview of an hypermedia product.

Ad 1. The building elements of a concept map
A concept map (cf. upper schema on the left page) is made of three elements: concepts, links and propositions. Concepts are designated by a word or a short expression. Links are drawn and labelled for combining two or more concepts and forming propositions which are building up a network structure. The author has to select these propositions according to the importance of the meaning they can have for the aimed public.

Ad 2. Defining a general message is crucial
Defining a general message is crucial into the design process of popularisation products, as in many other communication situations. Indeed, while limiting the contents, this task is deeply linked with the product content definition itself and with its clarity. It can be defined as answering the two questions:

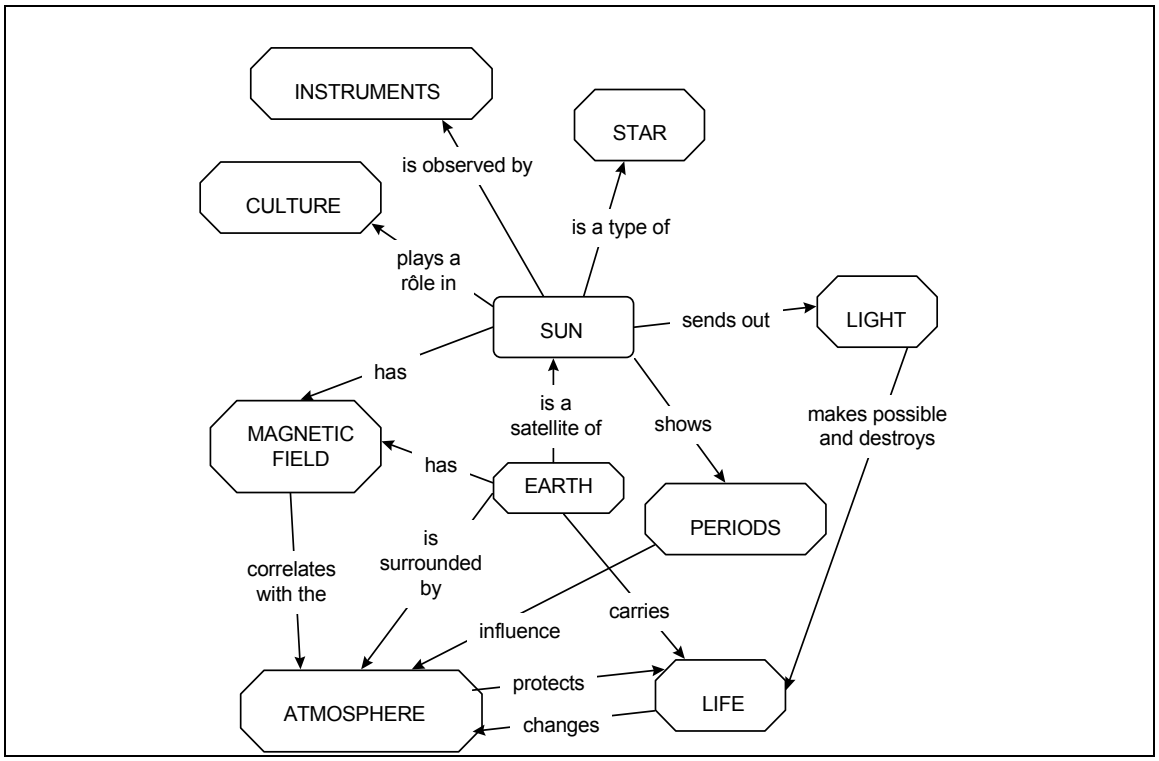
- "What do I really want to say?
- "How can I say it in a small series of short sentences?"

While building a concept map, the author globally thinks about the set of documents, related with the product topic, he is assembling and about the main ideas he would like a priori to enhance. This process thus helps him to define the general message(s). After having built one concept map (cf. lower schema on the left page), the author should always have in mind the question: "Does a general message appear from the map?" If he has to answer no, he should build a further concept map. If he can answer yes, one can say he defined the global structure of the content.

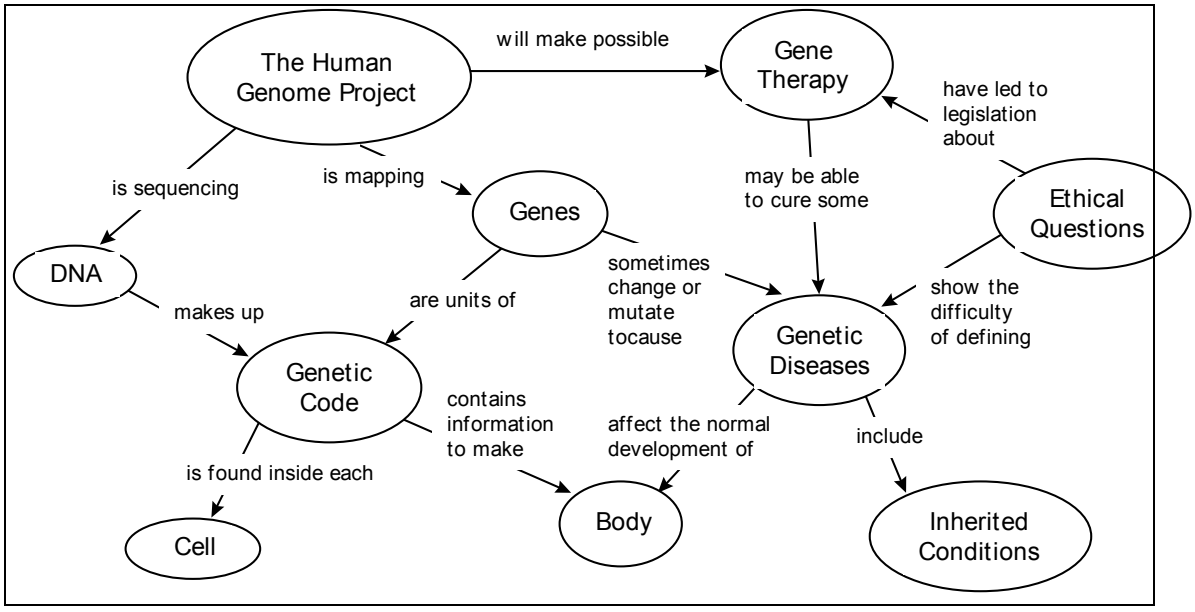
5.2 METHODOLOGY MAIN LINES (2)

CONCEPT MAP AS AN INTERFACE BETWEEN EDITORS, AUTHORS AND DEVELOPERS

1. Sun and Earth, a Strong Connection/ Author: Hildrun Bäzner-Zehender (July 1996)



2. The Human Genome Project/ Author: Stephen Webster (October 1996)



5.2 METHODOLOGY MAIN LINES (2)
COMMENTS AND REFERENCES

Increasing the efficiency of the collaborative hypermedia design process
The educational hypermedia product design imposes the creation of a heterogeneous people group for collectively defining a content and its structure. Indeed the authoring team is composed of authors, editors, developers and pedagogues whom competencies are required to know about all the different constraints, specific to this process, and to overpass all the obstacles they constitute. Having a meaning negotiation and function, the concept map is therefore an adequate tool to be used in such a process. This function supports and favours the interpersonal communication happening among the authoring group members.

The communication dynamics will be especially favoured because the negotiation tool easily allows to share, among the group members, a common understanding of the resulting content definition, at any particular time of the work. Indeed this permits to face two events which happen often into such an authoring process. First the content definition evolves, globally or only a detailed item, because it is built through the design process. The group members have thus to be well aware of the implied changes so to continue sharing a common experience. Second the authoring group can have to host a new member because of his needed competencies. Then the fastest he becomes able to share the previous group experience and to be active in the future changes of the content definition, the fastest he is efficient within the group.

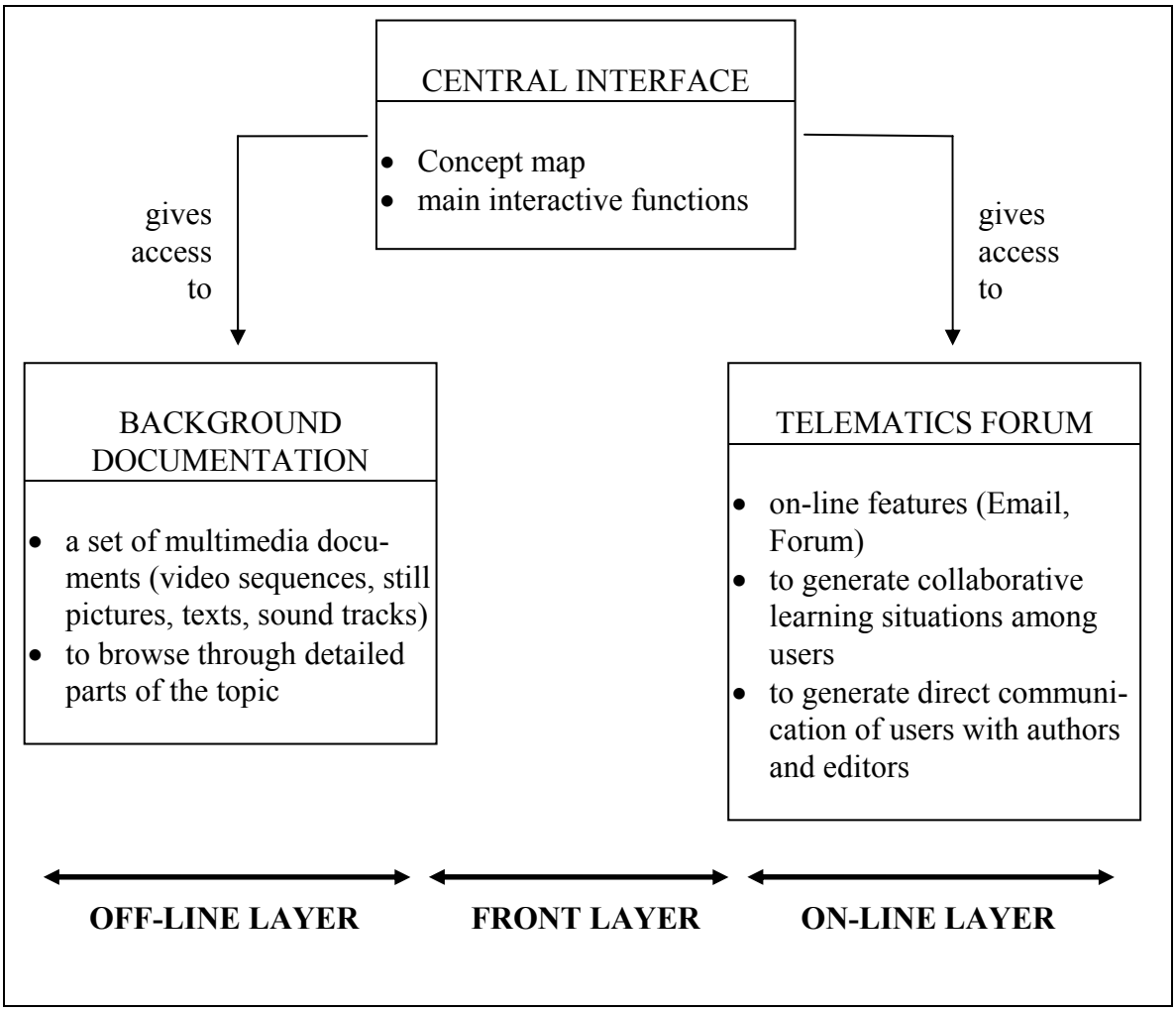
Ad 1. Turning concept map into interactive concept map
As we saw above, while the authors are defining the content structure, the concept map favours the possible inputs of the other members, concerning this definition and based on their own competencies. After this aim is achieved, the concept map can be turned into an interactive concept map which becomes a user interface element having the function of an interactive table of contents (cf. the two interactive concept maps of the POLLEN prototypes on page 3.4).

Within this perspective, each member of the authoring group can take advantages of the concept map so to transform or complete it according to his particular responsibilities:
- the authors can better link the concept map elements with the multimedia documents they assembled and which then become a resource background layer;
- the editor can more easily manage the next work phases by having kept a global overview of the product;
- the developers can implement the product software based on the concept map while already knowing much over its global structure;
- the pedagogues can more efficiently prepare the pedagogical evaluation process of the product.

5.3 A THREE LAYER SOFTWARE PRODUCT

CONCEPT MAP AS AN INTERFACE BETWEEN USERS AND CONTENTS

1. A three layer software structure for an educational hypermedia product



2. A tool for representing the information structure of an educational hypermedia

This tool must be retrospective, which means it should allow to retrace the individual learning path, but it should be also prospective while allowing the learner to visualise the future possibilities that his choices could lead him to. Let us note that the visualisation possibility of the past path is shared by the most of the actual systems. At the contrary the prospective visualisation, in spite of its importance (because of the help it can bring for the learner decisions) is very rarely implemented.

Depover C., Quintin J.-J. and De Lièvre B., 1993

5.3 A THREE LAYER SOFTWARE PRODUCT
COMMENTS AND REFERENCES

Ad 1. A three layer software structure for an educational hypermedia product
According to the modern pedagogical models, for instance Constructivism from Piaget, a person learns a new knowledge by himself and mainly through his own actions. In the case an educational hypermedia product is used by home learners, and more generally by people learning alone or almost, the role of the software application is therefore to offer the materials, the support of activity and to help the autonomy, which will favour the start and the development of this activity, of the end user.

We propose a global three layer hypermedia structure (cf. schema of the left page) as a solution for a software architecture which enhances the learner activity:

- a central interface, based on a concept map and presenting the most important interactive functions, constitutes the front layer;
- a set of multimedia documents (texts, video sequences, still pictures, sound files, animated sequences) constitutes the background layer;
- a Telematics Forum, allowing collaborative learning to settle down among the end users, constitutes the on-line layer.

Ad 2. How does the three layer structure works?
The concept map, which is the basis of the central interface constituting the front layer, is representing a structured synthesis of the content, developed about the topic, in the hypermedia product. The concepts and the propositions of the map can be easily implemented as interactive areas, with the software tool used for the development of the application, and can thus become the entry nodes for the hypertext links which give access to the different multimedia documents explaining about the various details and aspects relative to the topic.

The concept map plays then the role of an interactive table of contents linking the front and the background layers considered within the two points of view of the software architecture and of the content structure. This role of the concept map brings a valuable input for the learning activity of the end user. It helps him to build up a mental construction of the hypermedia structure and therefore allows a prospective navigation (cf. citation on the left page) where the end user can better define a strategy, corresponding to the learning aim he has, for the use of the documents available in the product.

The on-line layer consists in a Forum which is based on a server of a cable network. Users can exchange, ideas they have about it and/or problems they can not solve alone. They can by means of a discussion with other users, with the authors and the editor. There the table of content function of the front layer is also of great help to the user.

5.4 THE END USER BECOMES AN ACTOR

CONCEPT MAP AS AN INTERFACE BETWEEN AUTHORS AND USERS

1. Concept mapping as an selection and concentration process

Observations of real life construction processes reveal that concept mapping is firstly a selection and a concentration process: the concept map, outcome of this process, agglomerates and summarises a part of the information selected, used and produced all along the creation process, through the interaction occurring among the participants. This mass of processed information belongs to different categories:

- *documents (texts, pictures, films, sound tracks) imported from the outside world in the authors group;*
- *documents mentioned by authors but not directly imported;*
- *documents internally produced by the authors through the concept mapping process;*
- *talks exchanged inside the authors group.*

Pollen Project, 1996

2. Implementation of questions in educational multimedia applications

Following the suggestion of the Pedagogues, I have tried to think to some trigger questions, perhaps acting to introduce the concept map. The questions I have suggested are simple and popular.

Main idea 1: Molecule and the Human Genome Project
Question: Genes? They decide what I look like. Don't they?

Main idea 2: You and the Human Genome Project
Question: The Human Genome Project! It's got nothing to do with me. Has it?

Main idea 3: Society and the Human Genome Project
Question: Bio-ethics? Do I really have to worry?"

Stephen Webster, Author, POLLEN, 1997

3. The learning process

Constructivist models no longer see the learning process as the result of impressions left in the pupil's mind by sensorial stimulations emanating from the teaching, like the effect of light on a photographic film. It is quite rare for the mental structure of a pupil to be spontaneously in tune with that of a teacher, even if the teacher has done his or her job well and the pupil has been listening carefully; in any event, it never happens immediately.

A. Giordan, 1994

5.4 THE END USER BECOMES AN ACTOR
COMMENTS AND REFERENCES

Ad 1. To favour a answer construction process at the end user
The connection between the Forum, the background documents and the concept map used as an interactive table of contents, which makes a synthesis of these contents (cf. upper citation on the left page), allows to modify the traditional schema of communication (Sender → Message → Receptor) into a more innovative schema (Actor → Answer Construction) which enhances the learning activity of the end user.

Ad 2.
A person buying a cultural software product has interests and questions relative to the topic of the product. As the concept map is defined while taking into account these preconceptions of the end user places him/her in the role of an actor of the design process (cf. middle citation on the left page). Furthermore, as his/her questions are used in the concept map motivates him/her to really use all the available document and knowledge resources of the hypermedia product and thus places him/her into the role of an actor constructing his knowledge by himself.

Ad 3. How the product layer architecture enhance this process?
The way the front layer (the concept map) is built is the global philosophy followed to implement this process into the product. The connection of the front layer with the two background and on-line layers is then improving its implementation. Indeed, the research of an answer can be supported by two main inputs:

- the access to documents explaining about the questions (access to the background layer);
- the access to a discussion, with other people, about the questions (access to the Forum of the on-line layer).

One can not consider the Background Documents are the only resource type to be made available because they are not produced by the end user (cf. lower citation on the left page). There is a need for a resource like the Forum because of the importance of discussions, and exchanges, into the comprehension: the learning process has a social dimension. One can indeed imagine many different situations happening:

- the Forum can serve as a feedback for an answer which has been constructed by a user and proposed to the Forum;
- the user can not build alone an answer, with the only help of the Background Documents, and then finds other persons to help him/her into the Forum;
- some users can prefer to join in the Forum for constructing together an answer because they would not desire "working" alone.

Into the Forum there can be interactions between different types of persons: user(s)-user(s) (collaborative learning), user(s)-author(s) (tutorial) and user(s)-editor (talk on the product).