MULTIMEDIA IN EDUCATION
SPECIALISED TRAINING COURSE

Bent B. Andresen
and Katja van den Brink
TABLE OF CONTENTS

GENERAL INFORMATION

MODULE 1: Introductory Workshop on the Use of Multimedia in Education

MODULE 2: Course Participants' Evaluation of their Knowledge and Competencies

MODULE 3: The Use of Scenario 1, 2 and 3 – the Learner as an End-User of Multimedia

MODULE 4: The Scenario 4 – Production of Multimedia

MODULE 5: Critical and Reflective Use of Educational Multimedia

MODULE 6: Learning with Educational Multimedia

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GENERAL INFORMATION

UNESCO INSTITUTE FOR INFORMATION TECHNOLOGIES IN EDUCATION
# TABLE OF CONTENTS

## INTRODUCTORY NOTES for Specialised Training Course on 'Multimedia in Education'

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Target Audience</td>
<td>5</td>
</tr>
<tr>
<td>2. Level of Preliminary Knowledge of Participators</td>
<td>5</td>
</tr>
<tr>
<td>3. Aims and Outcomes of Specialised Training Course</td>
<td>6</td>
</tr>
<tr>
<td>4. Content of Specialised Training Course</td>
<td>6</td>
</tr>
<tr>
<td>5. Brief Descriptions of Instructional Methods</td>
<td>8</td>
</tr>
<tr>
<td>6. Brief Description of Main Phases of Modules</td>
<td>9</td>
</tr>
<tr>
<td>7. Recommendations for Organisation</td>
<td>10</td>
</tr>
<tr>
<td>8. Total Time Requirements</td>
<td>10</td>
</tr>
<tr>
<td>9. Link Collection</td>
<td>10</td>
</tr>
<tr>
<td>10. Curriculum – Learning Modules</td>
<td>10</td>
</tr>
<tr>
<td>11. The Order of Modules and Sessions</td>
<td>11</td>
</tr>
<tr>
<td>12. Overall Teaching Guide</td>
<td>13</td>
</tr>
<tr>
<td>13. Evaluation of Specialised Training Course 'Multimedia in Education'</td>
<td>16</td>
</tr>
</tbody>
</table>

## REFERENCES

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCES</td>
<td>17</td>
</tr>
</tbody>
</table>

## APPENDIX 1: Link Collection

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIX 1: Link Collection</td>
<td>27</td>
</tr>
</tbody>
</table>

## APPENDIX 2:

### Recommendations Concerning Equipment

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIX 2: Recommendations Concerning Equipment</td>
<td>28</td>
</tr>
</tbody>
</table>

## APPENDIX 3:

### Examples of Tools for Multimedia Production

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIX 3: Examples of Tools for Multimedia Production</td>
<td>29</td>
</tr>
</tbody>
</table>
INTRODUCTORY NOTES for Specialised Training Course on ‘Multimedia in Education’

IITE UNESCO has asked Dr Bent B. Andresen from the Danish University of Education to coordinate preparation of materials for a specialised training course on ‘Multimedia in Education’.

In particular, Bent B. Andresen has been asked to coordinate the preparation of proposals for an introductory note, curriculum and supplementary set of materials for IITE UNESCO Specialised Training Course. He, then, invited Katja van den Brink from the University of Landau in Germany, to be the co-author.

Moreover, Bent B. Andresen was asked to select a group of experts for an international team to develop the materials for the UNESCO Specialised Training Course ‘Multimedia in Education’. The members of this expert team are:

Christopher Abbott, School of Education, King’s College, United Kingdom
Roger Säljö, Göteborg University, Sweden
Sigmund Lieberg, Oslo University, Norway
Jari Multisilta, Tampere University of Technology, Finland
Peter Reimann, University of Heidelberg, Germany
Antonio M. Duarte, The University of Lisbon, Portugal

1 Target Audience

The Specialised Training Course is developed within the framework of The IITE Educational Programme on ICTs in Education.

According to the classification of IITE UNESCO Educational Programme the target audience is:

1. Heads of pre- and in-service teacher training and vocational development institutions, trainers of trainers for ICTs in education, instructional guidance and support specialists;
2. Teachers, ICT school coordinators and other educational personnel.

2 Level of Preliminary Knowledge of Participators

- ‘Teachers’ education;
- ICT literacy (for example, acquired via other courses in the IITE Educational Programme on ICTs in Education);
- Basic knowledge about the function and application of ICT into schools.
Aims and Outcomes of Specialised Training Course

The aims of the UNESCO Specialised Training Course ‘Multimedia in Education’ are that the target groups construct deep knowledge and high competencies regarding:

- Why, where and how multimedia can be used in school educational settings;
- Pedagogical scenarios concerning the mainstream and future use of educational multimedia;
- Important learning and teaching aspects, in particular, teachers’ roles, students’ learning strategies, social/collaborative learning, ICT literacy, metacognition, and motivation;
- Present educational goals and how educational multimedia can support these goals;
- Critical and reflective selection and use of educational multimedia according to mainstream scenarios for the use of multimedia in education;
- Evaluation methods related to the educational use of multimedia.

In particular, the objective is development of motivation to use multimedia in education and to adapt the knowledge and skills of the course into the educational practice.

Knowledge means in this sense theoretical and practical knowledge concerning the content to be learnt. Competencies mean the ability to transfer and adapt the skills of the course into a real classroom situation. After this Specialised Training Course, the trainees are expected to be able to use and apply the acquired knowledge and competencies in their school situation.

Content of Specialised Training Course

The content of the course regards the use of educational multimedia in education. In particular, the content regards the role of teachers and students and the potential impetus of multimedia on the students’ learning, motivation, cooperation, etc.

Currently, the students are encouraged to use a growing number of multimedia products in a number of different ways. The application of interactive multimedia into educational systems takes place all over the world, although the range and speed of the implementation varies from country to country. In educational settings, the multimedia products and on-line services serve as a means of communication and expressive tool in various pedagogical scenarios.
The notion of pedagogical scenario designates a postulated sequence of imagined events of a learning situation. Each of these is characterised by particular roles of teachers, students and educational multimedia products. Some educational products are designed to control the process of presentation, and students are assigned a somewhat passive role as receivers of information. Other educational multimedia products are interactive in the sense that students are assigned an active role where they can select topics and jump between these.

The different ways in which students deal with multimedia are categorised — according to the scenario model — in four pedagogical scenarios (Andresen 1999d):

1. The use of multimedia linear educational sources;
2. The use of multimedia hypertext-based materials;
3. The use of multimedia supervising products;
4. The use of multimedia productive tools and ingredients.

Scenarios No. 1-3 concern the students as end-users of messages from educational multimedia, whereas Scenario No. 4 regards the students as producers of small-scale multimedia products.

The use of linear multimedia in Scenario No. 1 regards the students’ reception of the content of linear multimedia products. These lead the students through different tasks in sequence. They can pick the episodes they want. However, once the potential useful sources have been located, the students have very limited control over the narration.

The use of hypertext-based educational materials in Scenario No. 2 encompasses the students’ reception of the content of non-sequential multimedia products. These non-sequential narratives encompass hypertext-based, interactive CD-ROMs and Internet services and they are often used as information providers. No guidance is offered through the different sections leaving the student as an explorer.

The use of multimedia tutoring products in Scenario No. 3 regards the students’ reception of the content of multimedia products aimed at teaching. These products display various guides for the students and help them break down and structure different tasks. This type of products typically consists of a kind of tutoring strategy e.g. knowledge about a subject matter and about instruction, often presented in drill-and-practice sessions and a critiquing strategy e.g. provision of feedback tailored to the particular needs of each student helping her/him confirm hypotheses and refine proposals.

The use of multimedia productive tools in Scenario No. 4 covers the students as authors and producers. This scenario regards production of their own multimedia presentations by means of proper multimedia elements to be used by the students to produce multimedia in the classroom and proper
tools to handle these texts, graphics, sounds, etc. The students take on the role of a producer.

The four Scenarios cover widely used multimedia genres in educational settings that differ with respect to the role of the students and the teachers as well as the function of the multimedia products and on-line services. Many mainstream approaches are similar to one of the Scenarios presented or consist of a mixture of these.

It does not mean, however, that the widespread multimedia pedagogical practices are considered limited to these four approaches. The intention is to describe some typical pedagogical scenarios and not to present an exhaustive list of scenarios. More specialised scenarios may, of course, also be found.

The participants taking the course ‘Multimedia in Education’ are expected to be able to develop knowledge and skills regarding the following topics:

- The scenario model concerning the use of multimedia in education and important learning and teaching aspects while learning with educational multimedia;
- Critical and reflective selection of educational multimedia according to educational objectives of the use of multimedia (what knowledge and competencies do students need to develop and how might educational multimedia support these goals?);
- The applications of educational multimedia according to Scenario 1, 2, 3 and 4 and mixtures of these into schools/educational settings;
- Proper methods of evaluation of the knowledge and competencies acquired.

From the point of view of school organisation, the integration of multimedia in the process of teaching and learning demands reflexive, pragmatic and experiential approaches which place the teachers, ICT school coordinators and other educational personnel at the centre of the innovation. Using multimedia, the teacher’s role is extended from the transmitter of information and the primary source of knowledge to being one among other sources of knowledge and a facilitator or a conductor of the learning processes.

**5 Brief Descriptions of Instructional Methods**

The course can be given in two ways. The form can either be conventional classroom education or e-learning (i.e. open and distance learning via the Internet).

Conventional provision is the most common offering of in-service teacher education. This form requires the participants to travel to the
institution for the purpose of in-service education. In most cases, it is characterised with oral presentations by the instructors and dialogue with the participators, tutorials and guidance, and laboratory practice in the computer lab and other labs. Often, it includes periods with study in libraries or media resource centres.

It is recommended to use the characteristic technologies such as an overhead projector and presentation of images from the computer screen. Furthermore, the computer is necessary as a learning and teaching tool to use for constructing knowledge.

E-learning is characterised by the separation of the teacher and the participators. The interpersonal face-to-face communication of the conventional education is replaced by a mode of communication and guidance mediated by the Internet. This form of in-service education is considered a complement to conventional provision in many countries. The evaluations are positive if both forms are connected with each other. Many school leaders, coordinators and teachers prefer to be able to work on their own and in teams of participators in part of the course (Andresen, 2000).

It is planned to provide separate guidelines concerning the conventional provision and the e-learning approach devoted to the instructors of the course ‘Multimedia in Education’ as well as to the participators (a student guide).

The instructional method of the presented curriculum is based on a common approach for both forms of learning i.e. e-learning and conventional classroom learning. The basic instructional approach is a learner-centred approach – self-regulated and collaborative learning guided and supported by the trainer. The integration of multimedia in the process of teaching and learning demands very reflexive, pragmatic and experiential approaches which place the individual course participator at the centre of the learning process. Placing the course participators in the centre of their learning means that they have to find their own individual access to the information for constructing their knowledge. Therefore, they need a huge pool of appropriate individualised strategies, which enable them to be active and critical learners.

6 Brief Description of Main Phases of Modules

The individual modules/sessions are divided into three phases: construction of declarative knowledge (knowing that), construction of procedural knowledge (knowing how), construction of structural knowledge (knowing why) and reflection on the information, the acquired knowledge and capacities.

The order of these three phases differs. In some cases it makes sense to reflect on the topic. In other cases it is recommended to try a certain multimedia ap-
application or tool without a big body of knowledge or reflection. Therefore, the modules of the course will be taught differently according to the learning goals and the participants' previous knowledge. The particular didactics recommended will be described in connection with each of the Specialised Training Course modules.

7 Recommendations for Organisation

The course should be held in classes with no more than 20 students at the same time.

Every student should have access to a computer during the course. Since the course also deals with the multimedia materials on the Internet, it is recommended to have Internet access.

A list of recommended equipment can be found in Appendix 2.

There will be times when the students work together in teams of three.

8 Total Time Requirements

50 hours.

In practice, the time needed will depend on the participants' previous experiences with ICT and education.

9 Link Collection

There is a broad link collection (for web address see Appendix 1) on learning and teaching with multimedia. This gives further perspectives and information on how to work with multimedia in the classrooms.

10 Curriculum – Learning Modules

Module 1) Introductory Workshop: The Use of Multimedia in Schools
The overview Introductory Workshop provides the participants with a first insight in the state of the art of the topic 'Multimedia in Education'. The workshop considers teaching and learning with educational multimedia from a teaching and learning perspective as well as from a practical point of view.

Module 2) Course Participants' Evaluation of Their Own Knowledge and Competencies
Module 2 deals with the participants' assessment of their own knowledge and capacities. Positioning the topic assessment/evaluation at the second part of the module is due to didactical reasons: the students will learn from the beginning to reflect on their own activities and knowledge.
The participants are expected to work out a performance assessment (Collins, 1992) in form of a portfolio approach. The production of their own file during the course with the help of multimedia tools can feed several needs of the curriculum — self-evaluation, outside evaluation and the development of various competencies.

**Module 3) Multimedia Use According to Scenario 1/2/3 — The Learner as End-User of Multimedia**

The application of multimedia in education means many things to many people. However, the use of educational multimedia can be classified according to some mainstream scenarios. As mentioned in the previous section, the Scenario model encompasses four pedagogical scenarios which cover the most common use of multimedia applications (Andersen, 1999).

This module deals with the reception of linear-narrative elements (Scenario 1), of non-sequential elements (Scenario 2) and of elements aimed at teaching (Scenario 3) of educational multimedia.

The concept of the Scenario model will be worked out practically in pairs/group work at the computer.

**Module 4) Multimedia Use According to Scenario 4 — The Learner as Producer of Multimedia**

Concerning this scenario, the participators are supposed to produce their own multimedia presentation by the means of proper tools to handle texts, graphics, video, sounds, etc.

A multimedia portfolio evaluation will be integrated into the multimedia production.

**Module 5) Critical and Reflective Use and Selection of Educational Multimedia**

In this module, pedagogical reflections on the use of educational multimedia will be considered as well as the critical selection of multimedia applications.

**Module 6) Learning with Educational Multimedia**

This module deals with theories on learning. In particular, the learning aspects such as learning conceptions, learning strategies and self-directed learning, metacognition, social/collaborative learning, ICT literacy, and motivation will be deepened and experienced.

**The Order of Modules and Sessions**

It is suggested to start with the workshop. During the workshop the course participants will be introduced to the main topics of the Specialised Training Course.
Thereafter, it depends on a course trainer how to organise the structure of the course. The order provided in the description of the Specialised Training Course might be suitable in many situations.

The trainers are expected to deal with the order of the sessions according to the individual needs of the course participants.

Since Module 6 regards the rationale behind the use of multimedia in education, it is possible to change the order of the modules and provide it immediately after the introductory workshop.

It is suggested to follow the market metaphor (Figure 1) which means that the trainer can choose the order of the topics according to his or her own needs. The starting point is the workshop. However, after completing the workshop, the trainer might prefer to start with theories on learning or he/she might like to start by selecting the practical parts of the curriculum. The assessment of the course participants is a topic, which could be placed directly after the workshop, if the trainer is interested in the portfolio approach and if he/she wants to integrate the participants into their own assessment.

Moreover, there are many opportunities to structure the content of the curriculum. For instance, teaching Module 4 (Scenario 4) might alter with
teaching Module 6 (Learning with Multimedia) due to the aspect that Module 6 deals with certain learning theories and learning aspects which are important to understand, and apply Module 4 in a pedagogical way.

Overall Teaching Guide

Didactics for All Units

The integration of ICT and multimedia in schools can change the existing learning principles tremendously. The school's organisation may become innovative in the sense that it adopts reflexive, pragmatic and experiential approaches which place the individual student closer to the centre of the learning processes. Using multimedia often means there are more student-centered work and flexible schedules. The teacher's role is often changing from being an authority or the source of knowledge to being a facilitator or a conductor of the learning process. Students have to find their own individual access to the fast changing world and, therefore, they need a huge pool of appropriate individualised strategies, which enable them to be active and critical learners. The ability to share knowledge collaboratively with others in a world where most products are the result of teamwork having the appropriate strategies and knowing why and how to apply them, will be one of the most important qualifications in lifelong learning.

The individual modules/sessions are divided in three phases: construction of the declarative knowledge, (knowing that), construction of the procedural knowledge (knowing how), construction of the structural knowledge (knowing why) and reflection on the given or found information, the acquired knowledge and capacities, whereby the order of these three phases is not important. This means sometimes that it will make sense to reflect first on the topic or to try a certain multimedia application or tool without a big body of knowledge or reflection.

What is learned may not be what the teacher intends to be learned (Candy, 1999; Driver and Oldham, 1986 - cited according to Biggs and Moore, 1993). The major determinants of learning are internal to the learner:

1) What is learned depends on what is already known. Most important determinant of learning is existing knowledge: the students construct with the bricks and blueprints they already have. New knowledge obviously affects the outcome, but not as powerfully or directly as we assume.

2) Learning is an ongoing process; it is continuous and active. The learner will have relevant experiences prior to and following formal instruction. It is better if formal instruction tries to encourage and make those links explicit rather than ignore them.

3) Learners have responsibility for their learning. In line with a constructivist view of learning, one must allow learners to develop self-direction and not to force 'correct' constructions onto them.
4) Constructed meanings share common characteristics. Through language and shared social experiences people's constructions allow communication and acknowledgement of mutual validity.

The link collection (for web address see Appendix 1) on learning and teaching with multimedia gives further perspectives and information on how to work with multimedia in the classroom.

**Teachers’ ICT Competencies**

For using ICT in the classroom, teachers need four different types of competencies:

- General pedagogical/didactical competencies;
- ICT literacy;
- ICT/multimedia pedagogical competence.

**General pedagogical/didactical competencies.** Here, especially the student-centred teacher didactics under consideration of constructivist perspectives plays a big role (see the aspects of these perspectives listed above).

**ICT literacy.** To teach a foreign language the teachers need to be fluent with respect to that language. For example, the teachers of English have to be fluent in English. In the same way, teachers need to be fluent with respect to ICT. For example, they need to know where and how to find materials on the web, using the web in different subjects for teaching and learning purposes, how to present the content of the subjects by means of multimedia, and how to use multimedia products and on-line services in education.

These competencies include a general understanding of central functions and methods of computer use.

Such competencies are also needed for being able to discuss and experience multimedia issues in schools.

**Multimedia Competencies.** Teaching with multimedia calls for competencies according to the use of the Scenarios (see Scenario modules 1-4). The user of multimedia (as an end-user and as a producer) needs a lot of knowledge and experience with multimedia.

The Specialised Training Course ‘Multimedia in Education’ will enable pre- and in-service teachers to construct knowledge, especially, according to the last multimedia competencies. Therefore, ICT literacy is a prerequisite to join the training course. However, competencies in all four dimensions will be constructed during the course.

**Role of Teachers**

As mentioned above, the teachers get new competencies and new roles in a multimedia-learning environment. The teachers’ new role is — be-
sides having a broad knowledge base — to offer pedagogical guidance and supervision to the students by inspiring, motivating and guiding them in their search for knowledge and to stimulate the continuous process of asking questions. Having the competence to support the students in constructing learning strategies, metalearning strategies and strategies for developing information-handling skills is important (see also McFarlane, 1997, cited in Witfelt, 2000). According to Harasim et al., (1997, cited in Witfelt, 2000), the teacher’s activities in the classroom when guiding the learning processes seem to be:

- Plan and follow the conversation;
- Offer guidance;
- Play a facilitative, observing, background role;
- Monitor and encourage participation;
- Form groups;
- Assign roles and responsibilities;
- Moderate and facilitate group processes;
- Coordinate interaction, set up guidelines and expectations;
- Pace interaction;
- Organise the interaction by relating inputs;
- Stimulate metacommunication.

The idea of facilitating the students’ learning processes demands a mutual responsibility for learning — the responsibility belongs to both — students and teachers.

A further important aspect is the support of metalearning processes: the students need to reflect on their own learning processes to get ahead with their development of effective learning and working strategies (van den Brink et al., 2000).

Some typical roles of a teacher, guiding a class using multimedia, are (Witfeld, 2000):

- The *initiator* who can kick the learning of the whole class at once. To start pupils’ teams up at once, giving them the necessary technical support (to start their work can be challenging).
- The *critical friend* who provoke the pupils to seek beyond the easy solutions. It is easy to browse the web or to navigate in the multimedia encyclopaedias and collect a lot of data, but the teacher’s role here is to inspire the pupils to sort the data and present only the data that can be used to reach the goal.
- The *process adviser* who gives hints on how to work and study. When the pupils take the responsibility for their own learning, they are in need of supervision. In this case the teacher assumes the role of an expert and must be able to give advice about learning and working processes.
- The role of an *expert* who feels familiar with special matters and can give hints according to the topic of the subject’s content.
The inspier who supports when spirits get low. Many teamwork processes and problem-based projects have an almost built-in frustration phase. Teachers should be aware of this and able to inspire the pupils to get over the 'dead' periods.

The moderator of group discussions. If discussions or arguments turn to be non-solvable, the teacher should be a moderator. This does not necessary mean to overrule the pupils' discussions and force a solution, but to listen to the arguments and point at possible ways to get on with the work satisfying as many points of view as possible.

Many other roles could be mentioned depending on the national level of team learning and other topics such as:

- Organiser's role that organises the learning tasks so that any pupil feels supported by the fact that the working proposals are adjusted to his/her possibilities.
- Creator who creates a student-centred and cooperative environment/atmosphere which makes it possible for the classmates as well as for the teachers, to be a source of stimulation and help.

The link collection includes more supportive guidelines and ideas on teaching with multimedia.

Evaluation of Specialised Training Course 'Multimedia in Education'

It is planned to implement and evaluate the Specialised Training Course 'Multimedia in Education'. The results will be published on the Internet and in a book-format.


Andresen, B. B. (1999). *The Art of Seeing the Wood and the Trees: Teachers’ New Competencies in Terms of Multimedia Literacy and ICT Genre Didactical Competencies.* Copenhagen, Royal Danish School of Educational Studies Research Centre for Education and ICT.


Technology Swedish-British workshop. University of Lund, Sweden (http://ltc.law.warwick.ac.uk/publications/ltj/v3n2/ltj3-2.html).


APPENDIX 1: Link Collection

A collection of links concerning multimedia and education can be found at the IITE web-site: http://iite.artstyle.net/iite/index
APPENDIX 2: Recommendations Concerning Equipment

In order to provide the course, there is a need for facilities for ‘hands-on’ as well as ‘brain-on’ activities. The resources for the hands-on activities and the demonstrations encompass:

- One or more examples of educational multimedia, on-line or on disc, which are adequate for Scenarios No. 1-3;
- One or more computers that fulfil the technical requirements of these pieces of software or web-sites;
- One or more easy-to-handle multimedia tools for producing own multimedia products (three examples of such tools are given in Appendix 2; common web-editors and many other tools could be used);
- One or more multimedia computers for producing multimedia.

The hardware and software standards change rapidly. Two examples of equipment are:

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<th>Windows</th>
<th>Macintosh</th>
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<td>Windows 95, 98, NT4, 2000 or later</td>
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<td>400 MHz processor</td>
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<td>64 MB available RAM</td>
<td>128 MB available RAM</td>
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<td>CD-ROM drive</td>
<td>CD-ROM drive</td>
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<tr>
<td>Colour monitor capable of 800 x 600 resolution</td>
<td>Colour monitor</td>
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<tr>
<td>Windows compatible sound card</td>
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<tr>
<td>100 MB of available disc space</td>
<td>100 MB of available disc space</td>
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<td>Internet Explorer or Netscape (latest version)</td>
<td>Internet Explorer or Netscape (latest version)</td>
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<tr>
<td>Word processor</td>
<td>Word processor</td>
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<tr>
<td>Graphic software to process and produce images in proper formats</td>
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## APPENDIX 3: Examples of Tools for Multimedia Production

<table>
<thead>
<tr>
<th>Program</th>
<th>mPOWER 4.0</th>
<th>HyperStudio 4.0</th>
<th>Web Workshop Pro</th>
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<tbody>
<tr>
<td>Publisher</td>
<td>Tom Snyder Productions</td>
<td>Knowledge Adventure</td>
<td>Sunburst 800–321–7511</td>
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<tr>
<td></td>
<td>800–342–0235</td>
<td>800–545–7677</td>
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<tr>
<td>Platform</td>
<td>Mac/Win</td>
<td>Mac/Win and online</td>
<td>Mac/Win (requires a Web browser)</td>
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<tr>
<td>Price</td>
<td>$79.95</td>
<td>$199.95</td>
<td>$89.95</td>
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<tr>
<td></td>
<td>Lab packs, site licenses and</td>
<td>Lab packs and site licenses available</td>
<td>Lab packs, site licenses and network</td>
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<td></td>
<td>network versions available</td>
<td>$89.95</td>
<td>versions available</td>
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<tr>
<td>Target User</td>
<td>All school grades</td>
<td>All school grades</td>
<td>Grades 6–12</td>
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<tr>
<td>Targeted Skills</td>
<td>Language arts, computer</td>
<td>Language arts, computer literacy</td>
<td>Language arts, computer literacy, web page design</td>
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<td>literacy</td>
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<tr>
<td>Special Features</td>
<td>• One-button HTML conversion for</td>
<td>• Comes with Morph 2.5, an animation</td>
<td>• Sunburst will host your Web Workshop</td>
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<td>web publishing</td>
<td>tool kit</td>
<td>page; publication can take 5–7 days</td>
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<td>• Plays streaming video right</td>
<td>• Lots of support, curriculum</td>
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<td>• Plays animated GIFs</td>
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<td>• Users can scan or import</td>
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<td>digital materials directly into</td>
<td>• Drag-and-drop support</td>
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<td>Program</td>
<td>mPOWER 4.0</td>
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| **Limitations** | • No spell checker  
• Lacks clip art collection  
• Lacks sound clip collection  
• No content-sensitive help  
• No support for WYSIWYG editing  
• No Teacher's Guide  
• No network version available  
• No support for on-screen ToolTips (pop-up descriptions to explain what buttons do)  
• HyperLogo scripting language aimed at older course participants  
• Only one stack open at a time  
• Limited control over page design because you can't edit the HTML directly | | |
| **Strengths** | • Hybrid Mac/Win CD  
• Network versions available  
• Ready-made cards with prebuilt buttons and text objects that you can copy, paste and modify in your own projects  
• Full-text editing with built-in spell checker  
• Record and edit your own digital movies  
• Lots of add-ons for classroom projects, including theme-based projects in Month by Month for HyperStudio  
• WYSIWYG, in-context editing  
• Browser plug-in for viewing stacks on the web  
• Designed especially for young children  
• Publish and Review command gathers all pages and graphics into one folder and previews the web site off-line using your installed browser  
• Built-in spell checker  
• Knowledge of HTML is not necessary | | |
| **Support Materials** | • Detailed User's Guide instructions for working through program features  
• Operating instructions in both electronic and printed formats (although clicking electronic Help returned an error message)  
• Extensive Teacher's Guide with lesson plans and work-sheets for normal and special education  
• A separate User's Guide features project-based activities  
• Several online resources with examples and troubleshooting tips  
• Program instructions in both print and electronic format  
• Detailed teacher support materials, including a lesson plan on creating a class web site, sample assessment rubric and information on creating an acceptable use policy for safety on the Internet | | |
Multimedia in Education

SPECIALISED TRAINING COURSE

MODULE 1

Introductory Workshop on the Use of Multimedia in Education
TABLE OF CONTENTS

ABSTRACT ........................................... 5

INTRODUCTION ....................................... 6

SESSION DESCRIPTION ................................. 7

SESSION 1 ........................................... 8
  1. How to Use Educational Multimedia? .............. 8
  2. The Pedagogical Scenario Model
     for Using Multimedia in Education ............... 8

SESSION 2 ........................................... 12
  1. Multimedia in Education ........................ 12
  2. What is Multimedia? ............................. 12
  3. Why Do We Use Multimedia in Education? ........ 13
  4. Some Advantages of Using Multimedia
     in Education .................................... 16
  5. Some Disadvantages of Use of Multimedia
     in Education .................................... 18

DIDACTICS ........................................... 21
The overview of introductory workshop provides the participators with the first insight in the state of the art of the topic 'Multimedia in Education'. The workshop considers teaching and learning with educational multimedia from a teaching and learning perspective as well as from a practical point of view.

DURATION: 6 hours.
The overview of introductory workshop refers to questions such as why, where and how to use multimedia in educational settings.

First, different pedagogical scenarios will be presented. Then, some decisive aspects of learning will be considered. Furthermore, the main goals of education and the implications for the students’ learning will be considered. Finally, concrete questions on the use of educational multimedia will be addressed.

The following demands placed on the course participants for Module 1 are to get an overview, first insights and experiences of multimedia in education.

<table>
<thead>
<tr>
<th>Goals</th>
<th>Topics</th>
</tr>
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</table>
| Declarative knowledge (knowing that – facts, theories, connections amongst theories) | Overview over the course ‘Multimedia in Education’:
The use of multimedia in schools:
  • The Scannar model
  • The concept of learning with multimedia
  • Goals of education
  • Different kinds of knowledge
  • Characteristics of multimedia
  • Building-up the connections among the presented theoretical approaches to learning and motivation |
| Procedural knowledge (knowing how)         | The practical use of multimedia application
  Strategies and competencies in dealing with multimedia hard- and software
  Meta-cognitions in learning, reflections on one’s own learning and teaching processes
  Use of learning and teaching methods |
| Strategic knowledge (knowing why to apply)  | Development of learning strategies concerning the use of multimedia
  Learning to learn within a group and collaboratively |
SESSION DESCRIPTION

Session 1:
Introduction to the use of multimedia via Scenario model — Definitions and Aspects of Learning with Multimedia — Definition of Multimedia and Interactivity.

Session 2.
Multimedia in Education — Present Goals of Education — Different Forms of Knowledge — Why to Learn with Multimedia?
How to Use Educational Multimedia?

The first session will give a preliminary answer to the question that many teachers, coordinators and teacher trainers have regarding educational multimedia: How to use these products to foster the learning and motivation of students?

The participants will construct knowledge and attitudes concerning the use of multimedia to foster learning and increase motivation by students. The main topics are:

- Introduction in the use of multimedia by the Scenario model
- Definitions and aspects of learning with multimedia
- Definition of multimedia and interactivity.

The participants get the first insight into the use of educational multimedia. They are introduced to the Scenario model, the common use of multimedia, and experiences with various scenarios.

Two other common questions regarding educational multimedia are: What is multimedia and why do we use multimedia?

The participants are assumed to be familiar with some multimedia products or online services which are suitable for their field of teaching. If this is not the case, it is recommended to begin with demonstrations and activities in the computer lab in order for the participants to become aware of these new learning opportunities.

The choice of activities and the selection of examples of multimedia products can be done in accordance with the curricula and with the objectives of the particular educational system to which the participants are affiliated.

In some cases, the instructor of the course might prefer to begin with the second question: why do we use multimedia in education? If this is the case, it is recommended to exchange the sessions of the workshop and start with presenting the second session of Module 1. Furthermore, according to the needs of the course participants, the trainer might introduce some of the themes of Module 6 before moving on with the topics of this Module.

The Pedagogical Scenario Model for Using Multimedia in Education

The Scenario model proposed by Andresen (1999) classifies the use of multimedia in education according to the roles of teachers, students and...
the application. The notion of Scenario "designates a postulated sequence of imagined events aimed at learning" (Andresen, 1999; p. 10).

The Scenario model identifies and describes four scenarios which cover the most common use of multimedia applications in education. They are:

**Scenario 1 – The use of linear applications:** Some multimedia applications have a linear structure in their presentation of content, which leads students through the application in sequence. This form is similar to traditional narratives presented in films. The students can control the application only in the sense that they can select what they want to learn (i.e. a digital encyclopedia where one can find video, sound or animation clips, etc.). Some applications provide linear tours through the whole application (similar to a book, but there are opportunities to get a simulation according to a difficult topic, etc.). However, when the users have located the source, they have very limited control over the narration. Often, they can go forwards or backwards but they cannot alter the content.

*Use:* Scenario 1 applications and elements often make sense when there is very limited previous knowledge concerning a certain topic/subject. See Module 3.

**Scenario 2 – The use of non-sequential applications:** Hypertext-based applications with more interactive opportunities mostly used as information providers (encyclopedia, handbooks, etc.). The students can search for information according to their tasks and problems: Where is Greenland? What kind of weather do they have up there? Which ethnic groups live in this area?, etc. Compared to ordinary books, this application allows an approach in the presentation of the content with an integration of different types of media such as text material, speech, music, animations, simulations of complex relations, numbers, video clips, etc.

Often, the interface offers a search engine and a big amount of buttons and options that students must decide upon when using the multimedia product.

*Use:* Scenario 2 provides the students mainly with information. But also, the use of this Scenario helps the students to become self-regulated learners concerning a huge pool of strategies. The teachers mainly do not provide content knowledge, but strategy knowledge and support by searching for information and reflecting students' own actions. See Module 3.

**Scenario 3: Guided discovery:** These types of applications guide the students through the application by breaking down different tasks and helping them to structure a task sequence. Its narrative style can be located between Scenario 1 and 2. Often, the content provides motivational elements such as games, competitions or explorations (i.e. educational content in an adventure game environment). The application provides support, if needed.
There are two different kinds of applications: the tutoring strategy which provides knowledge concerning a subject as well as an instruction, and the critiquing strategy which answers immediately if the students did something wrong (spelling checking, number checking, etc.). Examples of these types of applications are adventure games in history, biology, etc., drill and practice applications in math, spelling, language learning.

*Use:* Scenario 3 is recommended when the students are supposed to practice their knowledge, but also to support critical thinking and problem solving because many of these applications demand tricky solutions within the motivational games. The teacher can support in using strategies and collaborative work, etc. See Module 4.

**Scenario 4 – Production of multimedia:** In Scenario 4, the student is a producer or author of a multimedia application (and not the end-user like in Scenario 1-3). The students use multimedia tools mainly for the purpose of knowledge representation or as a communication tool for expressing their ideas and sharing resources. For instance, the student can use a certain multimedia tool for producing a homepage or a game. These tools provide material for text-based elements, numbers, graphics, images, sound, moving pictures, animation, etc.

*Use:* Scenario 4 is recommended when students are supposed to present and to structure their knowledge according to critical, creative and complex thinking, reasoning and problem solving. Not only can the teachers support them by providing help in using the tools themselves but also by structuring their thoughts, ideas, etc. See Module 4.

See the table for a short summary of Scenario descriptions, their advantages, disadvantages and common base.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Scenario 1</td>
<td>Reception of linear multimedia presentation of content Use: presentation of complex functions, connectedness of aspects or procedures, No or little learner's previous knowledge</td>
<td>Structured presentation of a topic with a beginning and an ending Learners experience less distraction Little ICT literacy is needed</td>
<td>Structured presentation of a topic with a beginning and an ending; Very limited control over navigation Content cannot be altered No feedback</td>
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<tr>
<td>Scenario 2</td>
<td>Reception of the content of non-sequential multimedia application such as hypertext/media application Use: as an information provider</td>
<td>High control over navigation High interactivity Very flexible and individual use of contents Access to knowledge bases outside the 'classroom'</td>
<td>Risk for being 'Lost in Hyperspace' due to no guidance Information management strategies are needed for effective use Content cannot be altered No feedback</td>
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<tr>
<td>Scenario</td>
<td>Description</td>
<td>Advantages</td>
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<td><strong>Scenario 3</strong></td>
<td>Reception of the content of multimedia applications aimed at teaching</td>
<td>The content is structured like a textbook</td>
<td>The content is structured like a textbook</td>
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<td></td>
<td>Use often closely related to the curriculum: Practising knowledge</td>
<td>Learners learn according to their own pace and learning needs</td>
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<td></td>
<td>Supporting critical thinking by offering tricky problems to solve</td>
<td>A navigation guide is provided throughout the application</td>
<td>Content cannot be altered</td>
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<td></td>
<td>Introduction to the topic to be learned</td>
<td>Learners get feedback</td>
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<td></td>
<td><strong>Scenario 4</strong></td>
<td>Production of the student's own multimedia presentations by means of proper tools to handle texts, graphics, video, sounds, etc. Use: multimedia as a thinking, communication and presentation tool</td>
<td>The presentation of one's own concepts – actively engaged in learning by developing and not just reproducing material Concrete (and multiple) representations of abstract ideas Conceptualisation of thinking Support of thinking and problem solving Support of collaborative learning High motivation due to the ownership of the product Construction of knowledge</td>
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<td><strong>All Scenarios</strong></td>
<td>Many different types of content is provided (1-3) or possible to produce (4) New roles for teachers and learners: both groups are actively involved The teachers support and guide learners' learning processes and are not anymore the only one information provider Learners use the application according to their own pace and educational needs – support of self-directed learning Students can be supported individually by the teacher</td>
<td>Learners use the application according to their own pace and educational needs – support of self-directed learning Students can be supported individually by the teacher</td>
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Multimedia in Education

The main topics of session 2 are:
- Multimedia in education
- Present goals of education
- Different forms of knowledge
- Why to learn with multimedia?

In particular, the session intends to answer a common important question among teachers and teacher trainers: Why is it worthy to use educational multimedia and where can it be used?

What is Multimedia?

There are many definitions, altogether they almost all agree on the aspect that multimedia contains texts, graphics, animations, video and sound in an integrated way, the content can be structured and presented differently. One of the most crucial characteristics is the aspect of interactivity of the multimedia products used in Scenario No. 2-4.

Rhodes and Azbell (1985, cited in Schulmeister 1997) distinguish three forms of interactivity:

1. **Reactive interaction:** Learners give responses on a presented stimulus. The order of tasks is determined very strongly and the individual influence on the programme is very small (Scenario 1).
2. **Proactive interaction:** Learners control the programme. The learners decide by themselves the order of tasks or where to go within the application (Scenario 2).
3. **Mutual interaction:** Learners and programme are able to adapt to each other – as in virtual reality (in some Scenarios 2 and 3).

According to these, three interactivity levels the learners' level of control are rather different. At the reactive level the producer/designer has total control over the content, its presentation, the sequences, the practice level. On the proactive and mutual levels, the control and manipulation are much more in the hands of the users.

According to Reimann (1997), interactivity contains a broad range of possibilities for influencing the learning and content of information:

1. Manipulating objects on the screen by mouse activities;
2. Linear navigating: turn over forward/backward on the screen;
3. Hierarchic navigating: select sites/contents by using special menus;
4. Interactive help function. Such help function can be available by special menu buttons. Help functions are most effective if they are adapted to the topical information presentation;
• Feedback: The programme answers by giving an assessment on the quality of the users activities. These answers are visible on the screen. If the course programme is further dependent on this assessment, then adaptability is established;
• Constructive interaction: The programme provides the possibility for constructing or configuring objects on the screen. For example, the users have the possibility to actively create their own nodes and links models – this means that they can add new nodes and new links between already existing nodes and in this way develop their own hypertext structure;
• Reflective interactions: The programme stores the learner’s individual activities for further analyses (e.g. the navigation path within a hypertext lesson). Furthermore, a programme can provide the learner with an ‘expert path’ or a ‘guided tour’;
• Simulative interactivity: Objects on the screen are linked together and exchange information in such a way that a particular configuration of these objects produces ‘behaviour’ in these objects (simulations of machines, simulations of social interactions, etc.);
• Non-immersed contextual interactivity: The learner is involved in an activity, which implies a didactic meaning. Much edutainment software (software, which combines education and entertainment) or adventure games uses this kind of interactivity (Scenario 3);
• Immersed contextual interactivity: This is virtual reality. Within virtual reality the user dives into a simulated three-dimensional world.

3 Why Do We Use Multimedia in Education?

Using Multimedia for Knowledge Construction
Multimedia can be considered a learning tool and a means of communication. Within the learning situations, the multimedia products and online services can be used creatively and reflectively in order to prepare the students to deal with the new demands in the learning or networking society.

Furthermore, multimedia can be used to foster learning regarding subject matters and cross-curricular topics. Present goals of education function as prerequisites for this use of multimedia in education. Of course, there are different perspectives on the conceptualisation of the present goals of education. Important current goals of education are the following ones (Weinert, 2000):

Construction of meaningful and understood knowledge which means the development of a well-structured, disciplinary, interdisciplinary and daily-life-oriented, net-organised system of flexibly usable competencies, abilities, skills and content knowledge.

Construction of applicable knowledge: How to transfer meaningful and understood knowledge into applicable knowledge?
Construction of knowledge about learning (reflection and metacognition of learning processes) is a very helpful and effective way to support the construction of meaningful and understood knowledge as well as applicable knowledge. This important competence enables students to be an expert of their own learning processes. Learning to learn means to find out and to apply specific successful ways and strategies in every subject. One aim is to increase the knowledge of every student about the idea of learning in itself and about his/her own memory. Students can reflect and use metacognitions by asking the following questions: How can I control my own learning processes? How do I plan my learning? How do I divide a certain task into units? How can I observe myself when learning? How do I check and evaluate my learning results? What do I think, what learning is? For what? Why does learning (with multimedia) make sense?

Although the concept of knowledge has developed since the Antique, we still do not have a clear picture of the ways in which knowledge is acquired and applied by individuals. Concepts like learning, competencies and human potential represent different attempts to describe or explain the processes where individuals become subjects with a substantial body of knowledge. These concepts vary according to their underlying epistemological and ontological assumptions. In the language of the computer technology, different approaches are not compatible.

We know that individuals have great learning potential. The human potential seems to be almost unlimited. There are certainly some limits for the ‘zone of proximal development’ in a particular learning situation, but in the long run the limits can be pushed very far away from the starting point. Many definitions of learning take into account the realisation of these learning opportunities and the development process of understanding, capacity, disposition, etc.

According to Alan H. Schoenfeld (1999), “one has learned when one has developed new understanding or capacity”. Some aspects are decisive for this development of new understanding and/or capacity. According to current learning theories, some important learner aspects are:

- Capacities and abilities (physiological and intellectual prerequisites, previous knowledge concerning the topic, etc.);
- Interests, learning strategies, metacognitions, conceptions of learning, motivation, emotions, attitudes concerning the content to be learned, social competencies, etc.

The different approaches to learning almost all agree that two factors are essential to learning:

- Social contact and relationship to people (family members, classmates, teachers, friends), i.e. communities of practice, communities of communication and cooperation;
Learning objects, i.e. learning materials (books, videos, tapes, and multimedia on the Internet or on CD-ROM/DVD), physical objects and artefacts, and virtual learning spaces.

Also the environment, in which learning takes place, influences learning. This includes the structure, conditions and access to the environment itself (society, libraries, media resource centres, computer labs, nature, cities or countryside, etc.).

In this sense, multimedia applications can be used as one out of many learning environments that are suited to be used in different learning situations where the learners are mulling over the subject matter and are engaged in a dialog with peers and teachers concerning their learning experiences.

**Learning Goals**

In order to handle this complex situation, in which learning takes place, it is recommended to adopt the term *learning goals*.

The teachers and learners typically define these goals or objectives within the frame of the curriculum. The goals are specified as either declarative knowledge (knowing that) or procedural knowledge (knowing how) or strategic knowledge (knowing why), or a mixture of these kinds of knowledge and skills.

The learning modules do not state the domain specific knowledge of the multimedia applications, i.e. the explicit knowledge that is represented in these applications. Since this content can refer to many different subject matters at many levels, the modules only contain examples of the explicit knowledge that are stored, processed, and presented by means of educational multimedia.

It is recommended that the instructor of particular courses provides proper examples of multimedia products that can foster learning in particular teaching fields of the participators.

Research has shown that educational multimedia — under certain conditions — can be used as effective learning objects (see for overview Hasebrock, 1999; Schulmeister, 1997). Learning with multimedia can foster different aspects of learning:

Firstly, it can foster cognitive aspects of learning such as information processing and understanding (Jonassen, 1996; Mayer and Sims, 1994).

Secondly, it can increase the motivational aspects of learning (See Chapter 6).

Thirdly, it can increase the collaborative or social-cognitive aspects of learning (Chapter 6).
Fourthly, educational multimedia has the potential of fostering a learners’ deep approach to learning and consequently deep learning (Hambleton et al., 1998; Lamon et al., 1993; Ramsden, 1992).

Multimedia products and on-line services provide many opportunities for these different aspects of effective learning. The potentials are, among others, to:

- Use several perception channels during the learning processes and, hereby anchoring information processing with several senses;
- Simulate complicated real experiments;
- Visualise abstract contents presenting processes in a dynamic manner.

Stimulate learners’ cognitive structures and interpretations by embedding the content in the broad context of the environment, society, history and by relating to the interpretation made by the learner.

**Some Advantages of Using Multimedia in Education**

Multimedia is very helpful and fruitful in education due to its characteristics of interactivity, flexibility, and integration of different media that can support learning, take into account the individual differences amongst the learners and increase their motivation.

The provision of interaction is the biggest advantage of the digital media in comparison with other media. Interaction refers to the process of providing information and response. The interactivity allows control over the presented content to a certain extend: learners can change parameters, observe the results or respond to choices offered. They can also control the speed of the application and the amount of repetition to meet their individual needs.

Furthermore, the ability to provide feedback tailored to the tasks of the students distinguishes the multimedia computer from any other media without a human presence.

However, many aspects need to be taken into consideration when using multimedia in education. Even if multimedia is spread over the world, there are not the same opportunities of students concerning access to learning material and hardware.

Also, the use of the multimedia by students needs to be supported by very skilled teachers in order to release the learning potentials. The teachers must, among the rest, be able to guide the students through the learning processes and provide them with appropriate and effective learning strategies (metacognition).
Like the use of textbooks, the use of educational multimedia fosters teaching strategies where the teachers' role is not just an information provider but a guide, a supporter, and a facilitator.

Multimedia allow for a variety of media usually combined in a meaningful manner. This gives the opportunity to use the digital computer to present ideas in different ways including by means of:

- Images including scanned photographs, drawings, maps, and slides;
- Sounds i.e. voice tracks, (heard) sounds and music;
- Video, including complex procedures and 'talking heads';
- Animation and simulations.

Often, presentations supported by attractive images or animations are more visually appealing than static texts, and they can support the appearance of emotions to complement the information presented.

Multimedia can appeal to many learning styles and multiple intelligences (Gardner) – some students prefer to learn by reading, some like hearing and some like watching, etc.

In addition, the use of multimedia allow different ways of working — the students can decide on their own how to explore the materials and to use the interactive and collaborative tools. The students, thus, become actively involved in their learning processes.

The students can adjust their own learning processes according to their abilities and preferences. They can work on their interests, repeat the learning as much as they want, and this can reduce embarrassment concerning their learning presentations.

The use of a proper constructed multimedia can, thus, be tailored to the students' differences in social and cultural backgrounds, learning styles, learning rates and interests.

The individual learning can promote active, self-directed learning where the students decide about the questions to answer or the themes to study.

Multimedia application can also be used to facilitate group work. Small groups of students can work through multimedia applications together, that supports learning by improving dialogue between students.

The interactive opportunities of multimedia lead to high flexibility which can be very helpful for the students with special needs concerning learning:

- Autistic children show an increase of phonologic awareness and word reading by using multimedia (Heimann, M. et al., 1995).
- Students with severe speech and physical impairments (Steelman, 1993).

Also these students gain from learning with multimedia because the
computer is flexible enough to meet the individual needs — they can repeat as often as they want, can hear it loud, etc.

- **Deaf students.** The visual presentation of contents improves deaf children's motivation to learn (Voltena et al., 1995).

The computer can markedly improve student access to information, depending on the particular delivery medium and the student population. Delivery platforms like the World Wide Web, provide 24-hour access to material.

Moreover, it is relatively easy to update educational material when it is web based i.e. to change design, content, instruction methods, etc.

### Some Disadvantages of Use of Multimedia in Education

**Self-regulated Learning.** Some learners are not able to handle the freedom, hyper-based multimedia provides.

**Distraction.** Often, confused presentations of the material can cause distraction of the user from the content because of conflicting messages. Furthermore, the most non-linear structure of the content in multimedia invites to follow the supplied links which can distract from the topic to be learned. The massive amount of information provided by the multimedia application may distract our attention during learning.

Furthermore, the human short-term memory is limited; usually it can hold around seven pieces of information. When there are several media presented at the same time, the learner might need to selectively attend to some of them and to ignore others. This could result in ignoring important information. Moreover, humans are limited to use all channels available simultaneously which might limit the full use of the potential of multimedia.

**Low interactivity.** The interactivity between learner and multimedia application is still on a low level and much less than in human-human interactivity.

**No selective feedback.** Feedback is generally very limited within a computer-assisted learning package. Computers generally cannot substitute for person-to-person teaching, only enhance encounters. Often, the feedback provided is just a right/wrong feedback, and it does not support in learning strategies or further content explanations. The multimedia application cannot identify individual needs or problems of the learner, so multimedia applications cannot respond like people.

**Simulations are not always enough.** It may be important for students to have true hands-on experience. For example, studying insects in biolo-
gy, it is necessary to go out in nature, to see insects living within their natural environments.

Lack of skills – pupils and teachers. Many students, particularly mature-age students, may not have used computers before. There may be a degree of concern over using the medium, as well as simple skills that need to be acquired, such as typing or use of the mouse. Also teachers lack many skills which are needed to learn effectively with multimedia.

Difficult to do. Creating audio, video and graphical material can be more challenging than creating an ordinary text.

Time consuming. Both – the use of multimedia as an end-user and as a producer – is very time-consuming. Especially, the production of multimedia takes much time.

Access. Not all students have appropriate access to hardware and software. This may limit the scope of the teaching.

Social in/exclusion. Not all members of a society can be involved in the use of multimedia technology due to lack of access to the Internet or lack of software or hardware to make full use of the educational material on the web.

Equipment problems. Hardware and software need to be configured in a way that their usage is as simple as straightforward as possible. Multimedia requires more expensive computers to view than simple computer activities such as text production, etc.

Bandwidth issue. A limited bandwidth means slow performance for sound, graphics, video causing long waits for download which can effect the ease of learning.

Multimedia is not readily portable. Paper-based notes can be read everywhere, on the tram, at the beach, but web-based material or multimedia material is not so easy to bring with.

Computer screens are not paper. Screens are not as easy to read as paper. If there are large chunks of information which need to be read from top to bottom, it is probably best to view the documents on paper. Books and journal articles are still best to read in paper. Often technology may be used to search for the appropriate piece of information, with the user printing it out before reading it.

In summary, the multimedia products can be used to represent and process various types of knowledge. They can be used as means of representation and communication of knowledge. The use of these products, thus, can foster the students' construction of their own knowledge. The students can
construct knowledge and develop skills related to various subjects by accessing or producing digital representations of knowledge. In particular, they can develop literacy and other core competencies. For example, they can develop motivation for learning activities, communication abilities, social competencies as well as learning competencies, values and ethics.
The trainer of the module is supposed to develop the sessions in a very student-centred but teacher-guided approach. The introduction to the Scenario model and presentation of examples, introduction to the learning theories, to learning with educational multimedia, and multimedia applications according to Scenario 1-3 will be experienced shortly. Concerning Scenario 4, the trainer can present a video or an example of self-made multimedia. A three-step approach to experience the Scenarios can be suggested: Phase 1: Open exploration; Phase 2: Think of task pupils (i.e. real students in school) who have to perform around such a resource; Phase 3: Solve the tasks you would provide students for yourself. What is needed is an overarching goal that makes it reasonable to use the resource instead of just experiencing it.

The course participants already have a body of (intuitive) knowledge concerning learning, important learning aspects, present goals of education, etc., especially, according to their own experiences. The workshop’s goal can be both:

- To construct a common understanding within the student group on what is learning and which aspects are important when learning with educational multimedia (by class discussion, group work, class brainstorming, etc.);
- To construct knowledge on the different opportunities and perspectives in the use of educational multimedia.

The trainer can collect students’ different approaches and perspectives and construct a common model based on these different constructions. This model can then form the basis of the course for the training module.

One opportunity to activate students thinking could be to ask the students: What is learning for you? Give me a definition! What do you think are important aspects for learning? What do you think it means to learn and teach with multimedia? Why is it useful?, etc.

The trainer might search for other definitions, examples and perspectives of learning and learning with educational multimedia and of present goals of education and offer these to the students in the end. Also, invite them to discuss the definitions and finally agree on a definition that they will work with throughout the module.

Furthermore, papers on relevant topics concerning the political/ethical questions can be handed to the students.
### Content to be learned

<table>
<thead>
<tr>
<th>The use of multimedia in school. Scenario model. Definition on learning. Goals of education. Forms of knowledge. Characteristics of multimedia. Building-up the connections among the individual theoretical approaches</th>
<th>Student-centred teacher guided approach; use and ask for their previous knowledge; develop models together with the students; reflection exercises; Use link collection (web address in Appendix 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use of multimedia application (Scenario 2); competencies in dealing with hard- and software</td>
<td>Collaborative work - students can work in pairs or small groups according to a specific task (to search for something)</td>
</tr>
<tr>
<td>Reflection on one's own learning processes</td>
<td>Homework/group discussion</td>
</tr>
<tr>
<td>Metacognition in learning. Development of learning strategies within the use of multimedia; learning to learn within a group and collaboratively</td>
<td>Modelling</td>
</tr>
<tr>
<td>Experiencing and reflection on non-hierarchical use of learning and teaching methods</td>
<td>Modelling/reflection by using self-reports on experiences, group discussions</td>
</tr>
</tbody>
</table>
MODULE 2

Course Participants' Evaluation of their Knowledge and Competencies
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>5</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>6</td>
</tr>
<tr>
<td>SESSION DESCRIPTION</td>
<td>7</td>
</tr>
<tr>
<td>SESSION 1</td>
<td>8</td>
</tr>
<tr>
<td>1. Portfolio Assessment</td>
<td>8</td>
</tr>
<tr>
<td>2. Design of Portfolio Assessment</td>
<td>11</td>
</tr>
<tr>
<td>3. Analysing and Reporting Data</td>
<td>13</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>14</td>
</tr>
<tr>
<td>SESSION 2</td>
<td>15</td>
</tr>
<tr>
<td>Portfolio Assessment in Specialised Training Course 'Multimedia in Education'</td>
<td>15</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>18</td>
</tr>
</tbody>
</table>
Module 2 deals with the participators' assessment of their own knowledge and capacities. Positioning the topic assessment/evaluation at the second part of the Module is due to didactical reasons: the students will learn from the beginning to reflect on their own activities and knowledge.

The participants are expected to work out a performance assessment (Collins, 1992) in form of a portfolio approach. The production of their own file during the course with the help of multimedia tools can feed several needs of the curriculum: self-evaluation and outside evaluation and development of various competencies.

DURATION: 2 sessions/each session 2 hours
Module 2 covers new approaches to assessment and evaluation.

The following demands on the course participants for Module 2 are:

<table>
<thead>
<tr>
<th>Educational goals</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of declarative knowledge (knowing that – facts, theories, connections amongst theories)</td>
<td>Presentation of new assessment forms (performance and portfolio assessment)</td>
</tr>
<tr>
<td>Construction of procedural knowledge (knowing how)</td>
<td>The use of assessment methods /portfolio/multimedia portfolio (Scenario 4) Competencies in dealing with hard- and software; network use, etc., non–hierarchical use of learning and teaching methods</td>
</tr>
<tr>
<td>Construction of strategic knowledge (knowing how to apply)</td>
<td>Metacognitions in learning, reflections on participators’ own learning processes, working in groups, supporting each other, non–hierarchical use of learning and teaching methods</td>
</tr>
</tbody>
</table>
SESSION DESCRIPTION

Session 1:
Portfolio assessment: Portfolio – Advantages and Disadvantages of Portfolio Assessment – Design of Portfolio Assessment – Analysing and Reporting Data of Portfolio Assessment

Session 2:
Design of the Portfolio for the Course
The general use of qualitative assessment (portfolio assessment)

**Portfolio Assessment**

The use of multimedia in education does not have to be accompanied by innovations in the methods of assessment and evaluation. If the course trainer wants, he/she can use the standard methods. These methods, however, can be supplied with computer-based methods. This is where the course participants in a systematic way collect their assignments, written reports, drawings, calculations and multimedia products together with the feedback they receive from their teachers and their own notes (dairy or log) regarding their learning activities. These methods are based on the so-called portfolio model.

This chapter deals with such new types of assessment which ask for course participants' demonstration and documentation of their deep understanding of subject matter together with their actual ability to solve complex problems and to work in groups or teams.

Assessment requires making a judgement. For example, the course participants' own judgements could address some of these questions:

- Did I obtain the goal — are the results satisfactory?
- How do I use this — do I possess the skills needed for this application?
- How can I decide that the task or project is completed?
- How do I know that I have learned sufficiently well? How do I evaluate not just the outcome but the stages of the learning process? How do I evaluate the strategies I have used and my approach to a task?

The portfolio assessment makes educational assessment an integral part of the course participants' learning processes (Collins, 1992). Educational portfolios provide information about learners' considerations, interests, motivation, abilities, knowledge, skills and progress.

**What is a Portfolio?**

The portfolio is a collection of objects assembled for a specific purpose — for instance, a file of drafts, sketches, and completed projects. The idea is that the course participants provide material from various sources, through multiple methods, and over multiple points in time (Shaklee, Barbour, Ambrrose, and Hansford, 1997, cited in Sewell et al., 1998).

The contents of portfolios can include materials such as drawings, photos, written or other work samples and copies of standardised tests.
Furthermore, the materials can include information from people who communicate or cooperate with the course participants during the learning activities as well as the course participants' self-reflections.

Portfolio assessment provides a practical strategy for collecting and organising systematically such data. The production of an own folder — for example, produced with the help of various software tools — can feed several needs of the curriculum: the self-evaluation, the external evaluation; the development of different competencies such as ICT literacy and media competencies; deep learning approach, etc.

The folders then represent some evidence concerning the course participants' construction of three kinds of knowledge:
1. Domain specific (declarative knowledge — to know what — facts, numbers, concepts, etc. and conditional knowledge — to know the relations of the concepts);
2. Procedural knowledge — to know how — this indicates how well the learner can make the domain knowledge work;
3. Self-management and metacognitive skills (strategic knowledge — to know about one's own learning and competencies).

Since motivation is an important target of assessment, the content of the folders might also contain some evidence concerning the motivational orientation and effort of the course participants.

Advantages and Disadvantages of Portfolio Approach to Evaluation

Many teachers, heads and coordinators of schools appreciate the portfolio model of evaluation because of its contribution to the student's development of reflexive skills and learning skills (Elmin, 2000).

In order to foster such development, the criteria for appraising portfolio products must be selected carefully by teachers and must be given to the course participants well in advance of the portfolio's preparation.

Other teachers prefer the portfolio model because of the strong character of documentation of learning and change. Portfolio assessment provides a means of conducting assessments throughout the life of the learning activity because of its multiple points in time. This formative assessment where the planned activities can be refined or redefined accordingly to meet the demands of the course, supports to maintain focus on the outcomes of the learning activity. Furthermore, it ensures that the implementation is in line with the goals established.

According to Sewell et al. (1998), portfolio assessment can be used to:
- Provide insight into learning processes and related changes. Because portfolio assessment emphasises the process of change or growth at multiple points in time, it may be easier to see patterns within the learning behaviour.
Be a tool to foster communication and accountability to teachers and course participants. In this way, a portfolio can reveal the attitudes and learning motives of the course participants regarding both more complex and important aspects of the curriculum.

Portfolio assessment is not useful for:

- Ranking learners in a quantitative or standardised way (although teachers may be able to make subjective judgements of relative merit).
- Comparing learners to standardised norms.

According to Sewell et al. (1998), the following advantages and disadvantages have to be considered when implementing portfolio assessment.

Advantages:

- It allows the evaluator to see the student as an individual; each is unique with his/her own characteristics, needs and strengths.
- It provides a basis for future analysis and planning. By viewing the pattern of individual learners, one can identify areas of strengths and weaknesses and barriers to success.
- It serves as a concrete vehicle for communication, providing ongoing communication or exchanges of information among those involved.
- It promotes a shift in ownership; learners can take an active role in examining where they have been and where they want to go.
- Portfolio assessment offers the possibility of addressing limitations of traditional assessment. It offers the possibility of assessing the more complex and important aspects of an area or topic.
- It covers a broad scope of knowledge and information from many different sources.

Disadvantages:

- It may be seen as less reliable or fair than more quantitative evaluations such as test scores.
- It can be very time-consuming for teachers to organise and evaluate the contents, especially, if portfolios have to be done in addition to traditional testing and grading.
- Having to develop your own individualised criteria can be difficult or unfamiliar at first.
- If goals and criteria are not clear, the portfolio can be just a miscellaneous collection of artefacts that do not show the patterns of learners' growth or achievement.
- Like any other form of qualitative data, the data from portfolio assessments can be difficult to analyse or aggregate to show the change.
Design of Portfolio Assessment

According to Barton and Collins (1997), three main factors guide the design of a portfolio: purpose, assessment criteria and evidence.

1) Purpose
At the beginning the purpose is that the portfolio will serve needs to be established. The purpose defines the operational criteria as guidelines for the course participants for collecting materials. For example, is the goal to use the portfolio as data to inform the trainer and/or the course participants about the course participants' competencies? Is the goal to report progress? Or is it to identify special needs? Or is it to report many different aspects together?

2) Assessment Criteria
According to the purpose or goal of the portfolio, decisions are made about the criteria or standards and what strategies are necessary to meet the goal. The selection of the items for the criteria can be done together with all participants: teachers and course participants.

3) Evidence
Many questions arise when it comes to evidence of the portfolio: What sources of evidence should be used? How much items for the portfolio should be collected? How can one interpret the evidence that is collected? Which type of information weighs more than others? And do they weigh more than others and under which conditions? According to Barton and Collins (1997), evidence can include different types of information:

- Artefacts and productions (items produced in the normal course of classroom activities i.e. multimedia production, documentation and reflection diary);
- Reproductions (documentation of activities done outside the classroom);
- Attestations and feedback (statements and observations by others about the learner);
- Presentations and show cases (items prepared especially for the portfolio such as the learner's reflections on their learning or choices).

Most portfolio assessments are both process and product portfolios (Cole, Ryan and Kick, 1995).

In some learning activities it is recommended to adopt a two-step approach. For example, Sewell et al. (1998) propose the following procedure:

Step 1 is the development of a process portfolio, which documents the growth over time toward a goal. This documentation includes statements of the end goals, criteria and plans for the future. The portfolio should also give space for baseline information or items describing the learners' performance or mastery level at the beginning of the course.
Other items or information are “works in progress” selected at many interim points to demonstrate steps toward mastery.

At this stage, the portfolio serves as a formative evaluation tool, probably most useful for the internal information of the student(s) and teachers.

Step 2 is the development of a product portfolio (a “best pieces portfolio”), which presents examples of the best efforts of the learner. These examples lead to the “final evidence” which demonstrates attainment (or not attainment) of the end goals. These portfolios encourage high reflection about change or learning. The learners, either individually or in groups, are involved in selecting the content, discussing the criteria for their selections, the criteria for judging merits, and the “evidence” that the merits might meet (Winograd and Jones, 1992).

For the course participants, this provides opportunities for a sense of ownership and strength. It helps to present or communicate the accomplishments of that person. At this stage, the portfolio is an example of summative evaluation.

According to Barton and Collins (1997), certain characteristics have to be considered for the development of any type of portfolio used for assessment:

Multi-sourced: Multiple data sources include both statements and observations of learners, teachers or parents, etc. and artefacts/products (anything from test scores to photos, drawings, text documents, numbers, animations, multimedia presentations, homepages to video and sound tapes).

Authentic: The items/information selected or produced for evidence should be related to curriculum activities as well as the goals and criteria.

Dynamic: The data or evidence is collected at many points in time. Rather than including just the best work pieces, the portfolio should also include examples of different stages of mastery. This allows reflection and rich understanding of the process of learning.

Explicit: The course participants should know in advance what is expected of them, so they can take responsibility for developing their own portfolio.

Integrated: Learners should be asked to reflect and demonstrate how they can apply their competencies or knowledge to real life situations.

Based on ownership: The portfolio assessment process demands that the participants should engage in reflection and self-evaluation as they select the evidence to include and set or modify their goals. They are not simply being evaluated or graded by others.
**Multi-purposed:** A well-designed portfolio assessment process evaluates the effectiveness of teachers' intervention at the same time when it evaluates the growth of individuals. It also serves as a (collaborative) communication tool when shared with class members, so that they can also learn from each other. Also, it can be passed to other teachers as the student moves from one level of grade or course to another.

### Analysing and Reporting Data

According to the purpose of the portfolio and the types of data collected methods of data analysis will vary (Patton, 1990 cited in Sewell et al., 1998). If goals and criteria have been clearly defined, the evidence in the portfolio makes it relatively easy to demonstrate that the individual has moved from a baseline level of performance to achievement of particular goals (Sewell et al., 1998). Often, the obvious subjectivity of judgements of portfolio assessments is seen as problematic (Bateson, 1994 cited in Sewell et al., 1998). According to Barton and Collins (1997), teachers can rate independently the same portfolio to see if they are in agreement on scoring. This serves as a simple check on reliability and can be very easily reported.
**DIDACTICS**

Introduce the content to the course participants by following the methods used in Module 1. Connect course participants' knowledge build on their previous knowledge from Module 1 and other resources. Allow time for reflection, ask questions similar to: Why do we use portfolio assessment? When is it useful to implement the portfolio model in school assessment?, etc. Use collaborative forms of learning, maybe they can search in small groups (2/3/4 course participants) for more information in the Internet according to the topic ‘assessment’. Reflection.

<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Proposals for didactical method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio assessment – its advantages, disadvantages; portfolio as formative and summative assessment; design of portfolio and its main characteristics to consider, analysing and reporting data)</td>
<td>Use methods from Module 1&lt;br&gt;Distribute material/references according to the topic (before the session as homework for reflection)&lt;br&gt;Ask questions, collect ideas, refer to Module 1&lt;br&gt;Course participants develop ideas/models in groups&lt;br&gt;Use link collection</td>
</tr>
<tr>
<td>Reflection: content/own learning processes/didactics for use in school</td>
<td>Homework/portfolio assessment/group discussion</td>
</tr>
</tbody>
</table>
SESSION 2

Portfolio assessment in Specialised Training Course 'Multimedia in Education'

This session is devoted to the development of the structure of an individual portfolio of the course participants.

The following box gives a possible example of the development of a portfolio in the specialised training course 'Multimedia in Education' (the structure is according to Lissmann, 2000). The portfolio guidelines address directly to the participants, therefore, 'you' means the course participants.

To all course participants of specialised training course 'Multimedia in Education'

Aim of the portfolio:

The aim of the portfolio covers two aspects: the documentation of your own learning processes and the presentation of the whole course content, reflected and constructed into knowledge on your own. This means, the contents of the portfolio should document the development of your content knowledge, your methodological skills (when solving tasks) and your attitudes. The portfolio serves as an evaluation tool for the trainer as well as for you as a reflective self-evaluation and learning tool. Choose on your own, which parts of the portfolio the trainer will evaluate. Include your best practice work.

Furthermore, the portfolio presents you as a learner to other course participants, so that they can learn from you and exchange their opinions and perspectives with you (and vice versa).

Structure of the portfolio

Give a contents structure of the (electronic) portfolio. You might use either an index, a guided tour or a hypertext structure. Mention all materials you included.

Contents of the portfolio

The contents of the portfolio are determined to a certain extent: the portfolio should mirror your ability to deal with the content of the curriculum. This means, there are some mandatory contents of the curriculum:
Materials on the workshop contents on Multimedia in Education (Module 1: Scenario model, Introduction into learning theories etc.)

Your evaluation of your own work (reflection on the portfolio approach: What is a portfolio? What are the prerequisites of a portfolio assessment? What different types of portfolio exist? What is to be considered when producing a portfolio, etc.)

Working with Scenarios 1–4 (Why, where and how do you want to implement this Scenarios? If the answer is yes, what, then, are the main characteristics of the educational setting, etc.)

Furthermore, the following aspects need to be considered:
- Critical selection of multimedia for educational use
- Ethical points when using multimedia in education
- Theories on learning and teaching with multimedia.

Materials can be different types of information produced by typing, scanning, sound production, animations, etc.: Artefacts and productions (items produced in the normal course of classroom activities i.e. multimedia production, documentation and reflection diary);

Reproductions (documentation of activities done outside the classroom);

Attestations and feedback (statements and observations by others about the learner);

Presentations and show cases (items prepared especially for the portfolio such as learner's reflections on their learning or choices).

Furthermore, you might need to discuss more (or less) criteria to include into the portfolio. Discuss within your group of course participants which aspects of the course are important for you, what your aims of the course are, etc.

Structure the contents according to your own needs and points of views. You might include a team portfolio into your personal portfolio. This means, that if you work in teams, do not hesitate to include the outcome of working processes into your portfolio. Mention and reflect the teamwork.

Evaluation based on the portfolio

The evaluation based on your portfolio aims at the criteria you worked out together with your trainer and the group you have worked in. The trainer
suggestions some evaluation criteria which will be discussed and maybe changed in the team of the trainer and the participators.

Possible criteria could be:
The development of your own abilities, knowledge and skills (registered in a diary which includes dimensions such as reflections on the workday, work outcomes, knowledge representation on learning and teaching with multimedia i.e. by reading and analysing articles on certain topics, etc.)

The quality of the presented materials (variation of the material, the used tools and the level of the use; the analytic structure of the material; the aesthetic structure of the material; the consideration of learning theories when developing the materials, etc.)

The evidence of the selection of the materials (why did you select this work for best practice?)
DIDACTICS

Prepare carefully your specific goals according to the content. The course participants have to have certain knowledge and skills after finishing the course 'Multimedia in Education'. The portfolio in itself provides many opportunities to meet this final goal. Follow the content of the last session together with the course participants. Let the course participants reflect on what they want to assess: knowledge, reflection, change, learning processes, etc. What kind of sources do you integrate in the portfolio? Do not forget, this is a multimedia course. See some recommendations in the table.

Build on their previous knowledge from the last session. Allow time for reflection.

<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Didactical Method</th>
</tr>
</thead>
</table>
| How to design a portfolio for the course 'Multimedia in Education' | Use methods from Module 1
Define purpose, assessment criteria and evidence of the portfolio
Use for reflection a 'reflection diary' (can be done as a word file). Course participants can use this as a reflection instrument for all sessions but also notes, etc. The file is portable and therefore always usable (in class, at home, etc.)
The combination with Scenario use: Scenario 1, 2, 3 and 4. Report about the use of Scenario 1–3 and Scenario 4 will be part of the portfolio itself. (See Scenario 4 module.) |
MODULE 3

The Use of Scenario 1, 2 and 3 – the Learner as an End-User of Multimedia
TABLE OF CONTENTS

ABSTRACT ......................................... 5
INTRODUCTION ................................... 6
SESSION DESCRIPTION ............................. 7
SESSION 1 ......................................... 8
  Active Use of Educational Multimedia according
to Scenario 1 – Linear Applications .............. 8
  DIDACTICS ..................................... 10
SESSION 2 ........................................ 11
  1. Scenario 2:
     Use of Non–Sequential Applications .......... 11
  2. Searching for and Collecting Information .......... 13
  3. Research on the Internet ....................... 14
  4. Analysing Navigation Structures .............. 14
  5. Searching, Selecting and Evaluating Information .... 14
     Using Simulations ............................ 15
  7. (In)Effective Strategies ........................ 16
  DIDACTICS ................................... 18
SESSION 3 ........................................ 20
  Scenario 3: Guided Discovery Use of Multimedia
  Applications .................................... 20
  DIDACTICS ..................................... 25
ABSTRACT

The application of multimedia into education means many things to many people. However, the use of educational multimedia can be classified according to some mainstream scenarios. As mentioned in the previous section, the scenario Model encompasses four pedagogical scenarios which cover the most common use of multimedia applications (Andresen, 1999).

This module deals with the reception of linear-narrative elements (Scenario 1), of non-sequential elements (Scenario 2) and elements aimed at teaching of educational multimedia (Scenario 3).

The concept of the scenario Model will be worked out practically in pairs/group work at the computer.

DURATION: 4 sessions; each session 2 hours
Module 3 gives a broad insight in the scenario where the learner is the end-user of some multimedia applications.

After this module, the course participants should be able to plan the use of multimedia in their own teaching according to the following three Scenarios:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Example of multimedia applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The use of linear educational multimedia</td>
<td>Applications that tell one or more stories to the student</td>
</tr>
<tr>
<td>2. The use of non-linear multimedia</td>
<td>Hypertext based sources and websites, in which the student can navigate and search for information</td>
</tr>
<tr>
<td>3. The use of supervising multimedia</td>
<td>Applications that are able to provide some kind of feedback to the answers and problem-solving strategies of the student</td>
</tr>
</tbody>
</table>

The following demands on the course participants for Module 3 are:

<table>
<thead>
<tr>
<th>Educational goals</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of declarative knowledge – (knowing that – facts, theories, connections amongst theories)</td>
<td>Deepening their knowledge on how, why and where to implement Scenario 1–3</td>
</tr>
<tr>
<td>Construction of procedural knowledge (knowing how)</td>
<td>The use of multimedia according to Scenario 1–3. Competencies in dealing with hard- and software; network use, etc.</td>
</tr>
<tr>
<td>Construction of strategic knowledge (knowing how to apply)</td>
<td>Metacognitions in learning, reflections on their own learning processes. Working in groups, supporting each other. Non-hierarchical use of learning and teaching methods</td>
</tr>
</tbody>
</table>
The course participants will get knowledge about the use of educational multimedia according to Scenario 1, 2 and 3 and at the same time they will become active end-users of educational multimedia, so they will develop the capacity to handle these pedagogical scenarios. This means that the participants can learn how and with which learning goals they can use multimedia.

Session 1: Scenario 1

Session 2: Scenario 2

Session 3: Scenario 3
Active Use of Educational Multimedia according to Scenario 1 – Linear Applications

Scenario 1: The Use of Linear Applications

Some multimedia applications (or elements of them) have a linear structure in their presentation of content which leads learners through the application in sequence. Some products provide linear tours through the whole application. Compared to ordinary books, these applications allow a more advanced integration of different types of media such as text material, speech, music, animations, simulations of complex relations, numbers, video clips, etc. When the users have located the source, they have very limited control over the narration. Often, the users can go forwards or backwards or they can finish the application or influence the speed of it but they cannot alter the content.

What to Expect when Using Scenario 1 Applications or Elements?

Linear narrativeness – as in scenario 1 – is recommended especially when learners do not have any or just very little previous knowledge and want to get an overview or an insight regarding a specific domain. Such narratives are, among others, suitable when learners get certain fundamental knowledge on a certain topic. The multimedia use according to Scenario 1 provides the learners with an already structured information entity – the linear format has a beginning and an end like the chapters in a textbook – and this structure supports the first knowledge construction in a certain domain.

According to cognitive science research (e.g. Kintsch & Greene, 1978), texts which are unfamiliarly structured, make excessive demands on the learner’s cognitive processes. Memory and comprehension can be used most effectively when the text is clearly structured and navigable. Learners have got schemata derived from exposure to conventional narratives and are constantly adjusting their understanding in accordance with these making the construction of ‘story’ a central cognitive goal.

Teaching example for the use of Scenario 1 – linear representation of content in a school context:

The biology teacher wants to introduce the class to the concept of evolution. First, she asks the pupils what they already know about the topic or what their thoughts on the topic are.
After the first discussion, brainstorming and collecting more questions, the teacher wants to set up 'common knowledge' by showing a multimedia presentation on the topic on a big screen – the use of integrated media such as sound, animation, video and simulation. This might give pupils the first insight on what is socially constructed as being the term meaning 'evolution'. The interactive aspect is very little here. Then, the pupils can use the application on their own – individually or in small groups pairs – repeating the presentation, stopping it when needed, going forward or backward.

After the pupils' exploration of the multimedia application, the teacher encourages the pupils to discuss the topic again, to speak about their own ideas (what is evolution for them), whether they agree on the multimedia presentation, etc.

The next lesson, the teacher provides pupils with some subtopics. Now, with certain knowledge, pupils are able to ask questions and expand those questions to problems for investigation. They can then use multimedia within Scenario 2-4.

An example of Scenario 1 can be seen at the homepage on mummies: 'Unwrapped – The Mysterious World of Mummies' (www.discovery.com/highspeed/tlc/mummies/).

**Scenario Example**

This site is hosted by an Egyptologist who has been in charge of TV broadcasting on mummies on the Discovery channel. The site introduces the user to a worldwide collection of unusual mummies. It reveals how mummies have been made – from Tutankhamen to Lenin. You can then discover 10 different places in the world where mummies have been found. The application offers Scenario 1 environment with animation, sound, text, speaking, video, etc. You can get information on four different dimensions: finding, unrevealing, making, and listening to the mummies.

The site gives a good overview on mummies of different forms. It also offers a hypertext navigation according to Scenario 2, but it is not a very rich hypertext environment.

Scenario 1 application can be used effectively in both ways: individually and collaboratively (see Module 6).
**DIDACTICS**

Build on course participants' previous knowledge from the sessions from Module 1 (scenario Model) and Module 6. Select one of the sites from the link collection or the Internet and search on your own for an example for Scenario 1. Furthermore, you can find many examples in CD-ROM encyclopaedias or on the Internet (i.e. Encyclopaedia Britannica where you can use the site www.eb.com for free for one week before you have to subscribe to a monthly rate). There, course participants can search for appropriate Scenario 1 elements by using Scenario 2.

Give the course participants different tasks. Let them develop a learning environment according to Scenario 1. Let them apply Scenario 1 within a topic where they already have a lot of knowledge and also within a topic that they are not at all familiar with. Use it individually for each participant (therefore, an encyclopaedia will serve many). Support them according to their individual needs, give examples to the whole group, if you meet the same problem more than once. Support, especially, in using and constructing strategies.

Give time for reflection — ask questions and let them develop questions on their own.

<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Proposed didactical method</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use of Scenario 1: why, how and where to use linear applications</td>
<td>Use methods from Module 1</td>
</tr>
<tr>
<td>The use of Scenario 1 practically</td>
<td>Experiencing and experimenting with Scenario 1</td>
</tr>
<tr>
<td>Reflection: content/own learning processes/didactics for use in schools</td>
<td>Homework/portfolio assessment/group or class discussions</td>
</tr>
</tbody>
</table>
Scenario 2: Use of Non-Sequential Applications

Hypertext-based applications with interactive opportunities are often used as information providers, i.e. as encyclopaedia, atlas, handbooks, etc. The learners can search for information according to their tasks and problems. For example, they can research on the Internet in order to get answers to the following questions: Where is St. Petersburg? What kind of weather do they have there? How many people live in the city?, etc.

Teaching example for the Specialised Training Course

A trainer of the course on 'Multimedia in Education' invites the participants to work on a small project: to find some facts on their own country. They should find out the exact size of the country, the exact size of the population, the geographical position and different cultures living in the country, etc. The participants are asked to work in teams on this topic by searching on the Internet. The trainer guides the individual teams according to their individual needs and supports them by providing effective searching strategies concerning the tasks. If the teacher recognises, that many teams meet similar problems, she stops the work of the group and asks for attention from the whole group of participants. Then, she works together with the whole group on the common problem. She describes the problem: "Typing BRASIL as a search term brings too many results. It is too difficult to select the required information from all these sites!" The teacher then asks for possible solutions to the problem. If she does not get any fruitful answers, she should then give concrete examples on how to proceed.

Often, the interface offers a search engine and some buttons and options. The learners must decide upon their use.

Examples of Scenario 2 — non-linear hyper-structure environments are electronically based newspapers or journals (www.guardian.com) because they offer many links to subject related topics (science, education, literature, critical public discussions, etc.).

Example for Scenario 2 application

The CNN Millennium Special sites provide a rich content for a multimedia Scenario 2 example (www.cnn.com/SPECIALS/1999/millennium/inside/). It presents a thousands years of history. The homepage is an added medium of content representation within a TV series which is broadcast in ten onehour
episodes – one episode deals with one century. Therefore, the navigation on the site allows a selection of up to 10 centuries. Within these centuries one can choose among certain aspects such as Timeline (important events are chosen); Map/Profiles (of important persons); Unsolved History (still unknown mysteries about certain aspects of this time); Having dinner with xx (for example, a Viking king in the 11th century or an astronaut in the 20th century); A further aspect is called Artifact (a very special invention of this period).

Scenario 1 elements are the ones where little features are shown according to the selected topic.

Scenario 2 elements are offered in huge navigation opportunities. Furthermore, Millennium Special offers an Educator Guide for teachers or course participants on how to use the site as a learning environment (Scenario 3). This part of the site provides answers to questions such as How should I use Millennium in my classroom? Furthermore, the site provides proposals on how to organise student work, for instance, according to topics such as religions/faiths or diseases in history.

In some sections, feedback is given on questions asked.

American Miles Markers. Matt Frondorf drives from the Statue of Liberty in New York City to the Golden Gate Bridge in San Francisco. He takes a picture at every mile (3304 photos). This homepage offers different opportunities of exploring the topic: "How wide is the US?" To get an impression on what the US looks alike. How is the landscape changing over this distance? How many miles are there from New York to San Francisco, if you drive almost directly from coast to coast? Which cities are in between? Describe the architecture of the houses, etc. The learner can see short movies on certain areas such as the journey from Pennsylvania to Indianapolis. Furthermore, an interview introduces the photographer, his motivation and the way he takes the pictures.

The Smithsonian’s African Voices Exhibit. This site explores objects that attest to African diversity and history. The site contains the following sections: History Themes/Focus Gallery/Learning Centre, whereby history explores the African past on an interactive timeline; themes meaning to present how life is in Africa today (Wealth in Africa; Market Crossroads; Working in Africa; Living in Africa; Kong0 Crossroads; Global Africa) and the Focus Gallery presents an African sculptor. The Learning Centre offers a web link collection and a broad bibliography on topics such as slavery, history, culture and anthropology and art, but does not provide any feedback driven activities.
Some more examples of sites for Scenario 2 can be found in the link collection.

**What to Expect when Using Scenario 2 Applications or Elements?**
Scenario 2 is used for getting information and understanding complex processes. The search for information is a main activity in the use of Scenario 2. Due to its hypertext/hypermedia format, Scenario 2 includes the Internet and CD-ROMs such as Encyclopaedias. Hypertext gives the reader far more control of what is read and in which sequence. There is also the assumption that the organisation, the reader puts on the text, is more personally meaningful than the organisation imposed by the author of the hypertext. This means that the reader creates his/her own track of reading.

So, Scenario 2 strongly supports the construction of an individual's knowledge base. The learners can search for information according to their own need in information and according to their own pace (see also Module 4 -- Scenario 4 where the functioning and the characteristics of hypertext is explained).

Scenario 2 can be used under different conditions. Firstly, when the learners have some previous knowledge about a certain topic, then they already can ask specific questions. The second condition is, if learners do not know anything and want to get the required information on a specific fact (for example, how many people live in the capital of Sweden?).

**Information Management Strategies**
The effective strategies of Scenario 2 can be seen as information management strategies. This includes searching for and collecting information and the development of deep understanding of certain processes or procedures.

These forms of learning strategies support a collaborative learning style.

**Searching for and Collecting Information**
If learners have to collect information for a project, a seminar or a presentation, they are expected to focus, mainly, on strategies such as:

- Identifying what information is needed;
- Selecting and evaluating the information found;
- Embedding the information in context.

These strategies support analytic thinking and learning as well as creative complex thinking.

These three strategies can be applied in (van den Brink et al., 2000):

- Intense discussions amongst the pupils;
- Exchanging material;
- Interactions with the teachers;
- Applying searching strategies;
Analysing Navigation Structures

Some pupils discussed the structure of the CD-ROMs and found it very interesting: “So, we could get an impression of the internal logic, it was so interesting to see the connectedness amongst all these different aspects” (interview information). “And it was a very nice experience for me to see how I could get through the CD-ROM, it is easy to find a way, to click on the topics, to select the topics I am interested in, not the teacher, it gives me much more freedom”.

“Yes, I could go where I thought; this is important, this is not. Then, sometimes I found out that I was not right, but I found it out by myself or together with the group but not by the teacher telling us how it works”.

Searching, Selecting and Evaluating Information

The pupils applied different searching strategies. Most of them performed very poorly developed searching strategies — they worked only with the index or they surfed within the CD-ROM or the Internet according to very non-specific keywords. The more pupils surfed, the more or less intuitively and oriented they became on each other’s strategies.

Many pupils reported in interviews that they wished an introduction into search strategies. They did not know how to deal with search engines. Most pupils used links to access information.
Thus, it is recommended to introduce search strategies and methods to the pupils.

Most pupils selected the information found especially by looking at the headlines, then they would glance at the articles and decide — individually or in groups — if it fits or not. If there was a fit, they would print it.

Evaluation of the selected information was also a main issue. Some of the pupils commented on this issue:

- "How to find information depends on the topic. If the topic is difficult, it is also harder to find good information on it".
- "We have learned a lot in the last two sessions. After we had the initial information during the last session, we could integrate the new information much better. However, the real learning starts after these sessions, when we have to analyse the information".
- "Okay, we already knew something about the topic. But we have learnt very much in both sessions, especially, background knowledge".

6 Deep Learning of Processes and Procedures Using Simulations

In classes, where special processes should be understood (for instance, the blood circulation in the human body), Scenario 2 was used more with simulations and animations (Scenario 1) of complex procedures. Often, the teachers guided the pupils. They acted as role models — they introduced the pupils to different learning strategies by showing them how to access the required information. Then, the pupils could explore the content of the programme or manipulate the simulation variables, so they could repeat the simulations and discuss the content to be learned together with the teachers. In this form of using Scenario 2, further information management strategies were needed:

- Embedding the information in a context;
- Giving relevance to the information;
- Constructing knowledge from information;
- Linking knowledge and creating knowledge nets;
- Transmitting, transferring and distributing knowledge;
- Exchanging and adding knowledge;
- Applying and transposing knowledge;
- Evaluating knowledge-based actions;
- Developing new knowledge from the evaluated actions.

Collaborative Learning: Active Discussions/Debates and Problem Solving

When using Scenario 2 as an information resource the pupils within one study (www.pedactice.com) asked their neighbours and debated very actively different approaches to solve the problem. (Which links they should follow, which kinds of words they should use for the search engines, if they should use search engines, etc.). Teachers in classes supported the pupils by
encouraging them to reflect on the learning sets obtained, to anticipate their actions, to foresee their needs and to make joint decisions.

*Reflections on one's own activities.* When using Scenario 2, most pupils discussed again and again the way they went, often they tried out other ways and new terms to go in different directions. One of the pupils said to his partners: “We can’t find adequate information when we go further in this direction. We have to find other terms and we have to think about what our topic really is”. Another girl reported: “Sometimes we stopped and thought about the topic.”

*Comprehension, monitoring and checking.* Some pupils tried to match new content with information already consulted, and in case of doubt, they turned back and checked it out.

7 (In)Effective Strategies

In a study of Scenario 2 (van den Brink et al., 2000) some groups of students worked in a way that everybody was looking for everything, so there was an overlap, but then they were sure that they were on the ‘right track’. Other groups divided their teams into different topic searching groups and worked very efficiently. Two groups divided the information searching into an Internet group and a CD-ROM group, according to the skills within the group. Some pupils were very creative in applying searching strategies.

*Problems when Learning with Scenario 2*

*Time pressure.* When using Scenario 2 as an information resource, many pupils felt the pressure of time. They wanted to find as much information as possible.

*Lack of searching strategies.* Many pupils experience difficulties when searching for adequate information. As mentioned above, they may lack effective searching strategies.

For example, a student who worked with the Internet stated: “One is searching and searching and searching. We need the information, but it is very difficult to find the adequate information”.

*Special problems with the software/computer.* In some Scenario 2 cases, pupils experienced difficulty in accessing the central menu (used as the main “navigation” reference) from many specific themes due to the need of going “backwards” through all the opened levels (they missed a button that permits this). For example, one student stated:

“Someone who wants to leave a theme must go all the way back through the pages ... then it takes time ... for someone who searches a lot of
things, as they must come back all the way instead of going directly to the main menu.”

Content problems. In some Scenario 2 environments, the pupils experienced problems, if they wanted to know more about certain themes due to a shallow treatment of those within the application. For example, one student stated: “Sometimes we wanted to know a little more and it was not adequate ... it was all too superficial”. 
Build on the participants’ previous knowledge concerning learning and motivation and on their knowledge from the workshop (Module 1). Use the different recommended sites; there, you will find many ways and ideas how to teach with scenario 2 applications. Reflect together with the course participants on the given examples on pupils’ use of multimedia in schools in these articles and sites. Look through the link collection and select some of these sites or go on the Internet and search for similar ones, where some sites having a rich multimedia environment. Give time for both: exploring and experimenting with the sites and reflecting on the use of certain sites. Provide the course participants with the opportunity to surf according to their needs, interests and pace.

Furthermore, the course participants could search for information on how teachers in their own country and around the world experience learning and teaching with multimedia in the classroom. Some (inter)national teacher networks, for example, provide information about “best practice” with ICT.

Furthermore, to support the course participants according to their individual needs – give examples to the whole group, if the same problem is presented more than once. Support, especially in using and constructing strategies and reflect on the importance of using strategies (see link collection on learning and teaching strategies). Give them links for the use of effective searching strategies and how to use the Internet (also as a Scenario 2 application).

The following table gives a short summary concerning teaching strategies with Scenario 2 applications:

<table>
<thead>
<tr>
<th>Situations</th>
<th>Recommended teaching strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course participants get lost in hyperspace</td>
<td>Prepare the course participants for the possibility of getting lost and discuss strategies such as 'stick to the topic', 'find effective search terms', 'allow yourself to distract if it seems constructive for the topic'</td>
</tr>
<tr>
<td>Situations</td>
<td>Recommended teaching strategies</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Participants' need of developing searching strategies and information management strategies</td>
<td>Introduce course participants into the effective use of search engines – use the previous knowledge of participants, who already know how to search effectively. Use the link collection. Watch the group while working with scenario 2 – give support to the teams who get into trouble – give hints, ask questions, invite them to develop different search strategies.</td>
</tr>
<tr>
<td>Collaborative learning</td>
<td>Invite course participants to discuss and exchange opinions, perspectives – to learn from each other. Invite course participants to divide the work into subtasks.</td>
</tr>
<tr>
<td>Problems when navigating; the user can get lost, can become disoriented, can lose track of the route or can become unable to leave the hypertext to go to another one.</td>
<td>Support the integration of the information found in the participant’s knowledge base, support the construction and reorganisation of these in the participants’ own way.</td>
</tr>
<tr>
<td>Using the multimedia potential</td>
<td>Invite the course participants to use the potential of the presented multimedia scenario – the graphics, animations, links, sounds, etc.</td>
</tr>
<tr>
<td>Analysing the navigation structure</td>
<td>Invite the course participants to analyse the structure of the site and to evaluate it – are there other opportunities to structure the content? What ideas are beyond the structure of the site?, etc.</td>
</tr>
<tr>
<td>Navigating / surfing through the application</td>
<td>Support course participants by hints such as consider headlines/links/search engines</td>
</tr>
<tr>
<td>Time pressure</td>
<td>Plan the lesson carefully in advance; be able to use many different search strategies to support the course participants</td>
</tr>
<tr>
<td>Soft–hardware problems</td>
<td>See introductory notes</td>
</tr>
<tr>
<td>Content problems</td>
<td>Tell the course participants that many applications are not sufficient in terms of knowledge prosperity.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Proposed didactical method</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use of Scenario 2 theoretically: why, how and where to use linear applications</td>
<td>Use methods from Module 1</td>
</tr>
<tr>
<td>The use of Scenario 2 practically</td>
<td>Experiencing and experimenting with Scenario 2 under certain tasks, work collaboratively and individually</td>
</tr>
<tr>
<td>Reflection: content/own learning processes/didactics to use in school</td>
<td>Homework/portfolio assessment/group or class discussion</td>
</tr>
</tbody>
</table>
Scenario 3: Guided Discovery Use of Multimedia Applications

The type of applications used in Scenario 3 guides the learners through the application by breaking down different tasks and helping them to structure a task sequence. Its narrative style can be located between Scenario 1 and 2. Scenario 3 very often contains Scenario 1 and 2 elements. Often, the content provides motivational aspects such as games, competitions or explorations (i.e. educational content in an adventure game environment). Scenario 3 applications often provide feedback, tests and support, if required. The tests are mainly constructed in a quantitative way, using multiple choice construction. Often, the learners are not allowed to jump from one section to another within a certain section.

Teaching example:

The biology teacher wants to introduce the children to the world of spiders, insects and snails. She opens the lesson by asking the course participants: What do they already know about these animals? Which families do they know? How do they live?, etc. After this exploration phase, she invites the pupils to explore the homepage on the MiniBeasts\(^1\) - a site where children can learn many different things about spiders, insects, snails, etc. The teacher tells the pupils that the site provides a test, where many questions are asked to the users. The teacher says, that the pupils can use this test for checking their own knowledge. It is a free option for them. Furthermore, the teacher invites the course participants to go to the city's gardens in the next session of the subject, to be very attentive because they might find very similar, or maybe, very different animals than the ones they found in the multimedia application. The kids work in pairs, exploring the site. The teacher is present observing the class and giving support, if needed. The class ends by assessing the lesson: Did the pupils like to work with this type of multimedia? What did they like and what did not they like?, etc.

A further Scenario 3 multimedia example:

Scenario 3 example: The Art of Japan\(^2\).

The Art of Japan is a site on the thinkquest-server\(^3\), which provides many different multimedia sites on very different topics. The Art of Japan gives an insight in five different art genres such as origami/architecture/gar-

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1. www.hedde.co.uk/mini_beasts/mini_beasts.htm
dens/painting/sculplture. The sitemap gives you an overview concerning the content. Besides the content on the different genres, the learners can find links, quizzes, puzzles and a bibliography on this site, or you can construct your own Japanese garden. There is also a test provided where the learner can check his/her knowledge and a facility to search for information.

Furthermore, the CNN site on the history of the millennium is also a good example for Scenario 3, because here you can find some questions to test your knowledge.

What to Expect when Using Scenario 3 Applications or Elements?
Scenario 3 learning is often thought to be for individual use as in MiniBeasts. Here, the kids can systematically construct knowledge on ‘little beasts’ such as spiders, insects, etc. They can test their own knowledge, play games and listen to the noises that these animals make. The difference from a textbook is the flexible use of the chapters. There is often a guided tour on how to use the learning application, with the authors of the application recommending what they think might be the best way to use it depending on certain conditions (for instance, if the pupils do not have any knowledge).

Scenario 3 offers many opportunities for different needs of different learners. The strategies used in Scenario 3 are, among others, computer based training strategies (CBT), self-regulated learning strategies and also computer supported co-operative learning (CSCL). Multimedia applications tailored to Scenario 3 are meant to support these strategies; often, they offer many different learning units and the course participants can decide on their own which aspects of the topic they would like to deepen their knowledge or in which aspects they have already built up a knowledge base.

Furthermore, learners can decide on their interests and in which modules they want to start their learning. Within Scenario 3 learning applications, the learner gets the opportunity to test and evaluate his/her own knowledge. Therefore, they can go first to the testing part and judge on how much they already know. However, the tests are often quantitative and do not cover widely the content to be learnt. For teachers, it might make more sense to add other evaluation methods. There is often an introduction to the application where the functions (such as print/export information/index/glossary/search, etc.) and all other elements of the application (navigation opportunities/content/structure, etc.) are explained, and where the learner gets information on how to deal with the application. Furthermore, an introduction to the structure and content of the application is often provided.

A Scenario 3 learning tool can support many different functions:

- An information source (hypertext structured information);
- A learning programme — the application leads the learner according to his/her needs through the subject — one can learn according to the proposed learning routes or by the individual structure;
A deep learning tool with the help of authentic and situated presentations of the learning content and with different perspectives on it (by videos, graphics, animation, audio, etc.);

An opportunity to check and evaluate one's own knowledge;

A reflection tool about the content to be learnt (if the application provides, i.e. a word or drawing programme for expressing one's own thoughts).

These aspects support strongly self-regulated learning. However, often the learners need the teachers' support in applying these strategies for working independently/efficiently/sufficiently?

Collaborative Use of Scenario 3

A collaborative use can also be recommended, if the site is not a simple drill and practice application (van den Brink et al., 2000). If the application is rich in information and provides authentic situated presentations and different perspectives on the topic, learners can discuss and exchange their perspectives with each other.

Learning strategies when using Scenario 3

In Scenario 3, different learning strategies can be applied in classroom (van den Brink et al., 2000):

- **Implementation strategies.** Repeating information by rehearsal – surface learning;
- **Organisation.** Grouping items on some characteristics – deep learning strategy;
- **Elaboration.** Construction of a meaningful context – deep learning strategy.

Simple rehearsal is usually less effective than other strategies that require learners to process the material more actively by organising related ideas or elaborating new ideas by making connections to previous knowledge.

Simple rehearsals can be found in Scenario 3, especially, in language and spelling programmes. These applications foster the user to repeat the pronunciation or spelling of the words.

Examples:

In a study, simple rehearsal was found in the use of ‘Le francais facile’, a French spelling and word programme. The pupils only reacted on the application (www.pedactice.com). The focus of the application is to learn the pronunciation and new vocabulary. They could only repeat the words or tasks again and again. They can listen to the voices as much as they want, and most pupils wanted and needed to listen to the pronunciation again and again. Furthermore, they asked for help from their partners: “Did I pronounce it right?” The most
used strategy was repeating the words or phrases the programme had spoken before.

*Elaboration strategies.* Making meaningful associations requires extensive knowledge (Chan, Burtis, Scardamaglia and Bereiter, 1992). Elaboration could be found in almost all cases in a study of Scenario 3 applications, especially, where the pupils had the opportunity to develop rules – German spelling and to make connections to previous knowledge (van den Brink et al., 2000). However, in all cases pupils created the strategies intuitively, but not because the programmes invited them to use certain strategies. Some pupils, who used a German spelling programme, reported in the interview that they developed their own rules: pronouncing the words, which were presented in the programme, again and again, listening carefully again and again, and dividing the words into parts. A further rule: they thought where the words came from. Mehrheit – majority – Meerheit or Mehrheit: Meer means sea – it can not be because it is not coming from the sea, but from mehr – more. During the next session some pupils, who were in pairs, developed more and more rules – the teacher invited the children to do so and facilitated this process: “Could you do anything else?”

**Active Discussions/Debates – Problem Solving**

Furthermore, the above mentioned study showed that task-oriented debates took place in the case of the adventure practice package. The pupils ask their neighbours and debate with them different approaches for solving the problem. Two girls stated:

> “Don’t go there with the mouse. You have to go this way. It is there we have to go.”

> “Why?”

> “Because this way leads us into the spaceship. You can see it on this sign”.

They were successful by confronting each other with new ideas, asking for reasons and discussions. Some minutes later they were wrong:

> “How can we get out of here?”

They started to discuss – they decided to write something new (“please, write something”).

They glanced at their neighbours to see, if they were further ahead concerning the spaceship. But they did not ask. They discussed with each other:

> “I would like to try this out, because I want to see, if it works.”

The other girl:

> “Okay.”

Here, exploring ways is a sense of problem solving that could be observed. No discussions were found when using pure computer-based training programmes. The pupils only spoke about the answers, if it was right or not, but these were very short conversations. Some pupils were given audio instruction from the programmes. The pupils were more or less testing their
knowledge according to what they had already learned. If they did not manage to solve the problem, they went back to their desk with further textbooks and other materials and practiced more. Their main goal was to solve the tasks successfully. The ones, who worked in pairs, were debating and trying to achieve the best possible results between them.

These findings show that the use of complex games, where many different events happen, is a good method to implement discussion amongst pupils for complex problem-solving. The pure computer-based training programmes are recommended, if the learning task is testing their knowledge.

Metalearning

Comprehension, Monitoring and Checking
The pupils working with a Scenario 3 adventure programme (to learn spelling) recognised after getting some feedback from the application that they had problems with their spelling and the correct placing of the comma. Then they practiced more tasks, even if it was not required for getting the points for the spaceship.

The pupils, who were working with *Lefrancaisfacile*, recognised by themselves that they had problems with the pronunciation. So, they repeated to listen to the words again and again and asked for help from the pupils and the teacher who should also repeat the word to them.

Feedback Checking
Most kids using Scenario 3 checked the feedback function (in some application, using the feedback function is voluntary). They did it because — as they said in the interviews — they really wanted to know which words they wrote were wrong. Some kids wrote down their mistakes with a pencil and they wanted to practise these words at home.

Performing Similar Activities
When working with drill and practice most pupils do very similar things — they just do what is demanded from them to do — they repeat the words and the phrases or they spell the words and phrases but only as repetition (van den Brink et al., 2000).

Problem Solving
Most kids when using the adventure game tried more than one possible solution. However, many pupils had problems to develop more than one or two solutions — the teacher invited them to look for further solutions.
DIDACTICS

The following table gives a short summary concerning teaching strategies in the course with possible Scenario 2 applications:

<table>
<thead>
<tr>
<th>Situations in the classroom</th>
<th>Recommended teaching strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide course participants with a Scenario 3 application (find it on the Internet according to the culture of the participants) – testing knowledge / using feedback / reflect on knowledge</td>
<td>Give the participants enough time when using the Scenario 3 guided discovery and invite them to test their own knowledge</td>
</tr>
<tr>
<td>Collaborative learning</td>
<td>Invite the course participants to discuss the topics within the application – discussion topics can be the content, the structure, the motivational aspects, the design, etc. of the application</td>
</tr>
<tr>
<td></td>
<td>Encourage the course participants to support and help each other</td>
</tr>
<tr>
<td></td>
<td>Watch the group while working with Scenario 3 – give support to the teams, which got into trouble – give hints, ask questions, invite them to develop different search strategies</td>
</tr>
<tr>
<td>Using the multimedia potential</td>
<td>Invite the course participants to use the potential of the presented multimedia scenario – the graphics, animations, links, sounds, etc.</td>
</tr>
<tr>
<td>Analysing the navigation structure</td>
<td>Invite the course participants to analyse the structure of the site and to evaluate it – are there other opportunities to structure the content?, what ideas are beyond the structure of the site?, etc.</td>
</tr>
<tr>
<td>Time pressure</td>
<td>Plan the lesson carefully in advance; be able to use many different search strategies in supporting the course participants</td>
</tr>
<tr>
<td>Soft-hardware problems</td>
<td>See introductory notes</td>
</tr>
<tr>
<td>All situations</td>
<td>The teacher should be very familiar with the content of the site or application for supporting the course participants' work.</td>
</tr>
</tbody>
</table>

Build on their previous knowledge from former sessions on Scenario 1 and 2 and the sessions in Module 6 and from the workshop (Module 1). Use the different recommended sites for exploring Scenario 3 applications. Look through the link collection, especially, for teaching and learning with multimedia. There you may find many methods on how to use certain strategies within the use of Scenario 1, 2 and 3.
Also here, the course participants need time for both: exploring and experimenting on the sites and the reflection on the use of certain sites. Provide the course participants with the opportunity to learn according to their needs, interests and pace. As in Scenario 2, support them according to their individual needs, give examples to the whole group, if you meet the same problem more than once. Support, especially by using and constructing appropriate strategies and reflect on the importance of the use of these strategies (see link collection).

<table>
<thead>
<tr>
<th>Educational goals</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content to be learned</td>
<td>Proposed Didactical Method</td>
</tr>
<tr>
<td>The use of Scenario 3 theoretically: why, how and where to use linear applications</td>
<td>Use methods from Module 1</td>
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<tr>
<td>The use of Scenario 3 practically</td>
<td>Experiencing and experimenting with Scenario 3</td>
</tr>
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<td>Reflection: content/own learning processes/didactics to use in school</td>
<td>Homework/portfolio assessment/group or class discussion</td>
</tr>
</tbody>
</table>
MODULE 4

The Scenario 4 – Production of Multimedia
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>5</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>6</td>
</tr>
<tr>
<td>SESSION DESCRIPTION</td>
<td>7</td>
</tr>
<tr>
<td>SESSION 1</td>
<td>8</td>
</tr>
<tr>
<td>1. Active Use of Educational Multimedia According to Scenario 4</td>
<td>8</td>
</tr>
<tr>
<td>2. Thinking Skills for Producing Multimedia</td>
<td>10</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>15</td>
</tr>
</tbody>
</table>
Concerning this scenario, the participators are supposed to produce their own multimedia presentation by means of proper tools to handle texts, graphics, video, sounds, etc.

A multimedia portfolio evaluation will be integrated into the multimedia production.

DURATION: 4 sessions / each session 4 hours
Module 4 gives a broad insight into the use of Scenario 4 where the learner is the creator and producer of multimedia. In this Scenario, the course participants represent their knowledge in a way that can be stored, processed and presented in the multimedia products. The content of these products are the course participants' knowledge represented by means of letters, numbers or icons/images in a linear and/or hypertext structure.

The following demands on the participators for Module 4 are the use of multimedia as a mindtool for presentation and communication knowledge. Typically, the course participants will work with a project.

After this module, the participators will be able to sketch a multimedia presentation within the curriculum or in relation to a cross-curricular content.

<table>
<thead>
<tr>
<th>Educational goals</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of declarative knowledge (knowing that – facts, theories, connections amongst theories)</td>
<td>Deepening the knowledge constructed in former sessions, constructing knowledge on the use of Scenario 4 as a mindtool</td>
</tr>
<tr>
<td>Construction of procedural knowledge (knowing how)</td>
<td>The use of multimedia for producing one's own multimedia application; competencies in dealing with hard- and software. The use of a multimedia portfolio (Scenario 4) and tools; competencies in dealing with hard- and software; network use, etc. non-hierarchical use of learning and teaching methods</td>
</tr>
<tr>
<td>Construction of strategic knowledge (knowing how to apply)</td>
<td>Metacognitions in learning, reflections on their own learning processes; working in groups, supporting each other; non-hierarchical use of learning and teaching methods</td>
</tr>
</tbody>
</table>
The course participants will develop knowledge about the production of educational multimedia according to Scenario 4 and use it as a cognitive tool.

Session 1:
- Deepening the Knowledge on Scenario 4,
- Why and How to Use Scenario 4,
- Start of Production: Planning the Project and Work with a Tool

Session 2: Project Work

Session 3: Project Work

Session 4: Project Work and Completing
Active Use of Educational Multimedia according to Scenario 4

In Scenario 4, the student is the producer or author of a multimedia application (and not the end-user like in Scenario 1-3). They use multimedia mainly for the use of knowledge construction and representation or as a communication tool for expressing their constructed knowledge and sharing resources. The student can use a standard webeditor or a dedicated multimedia tool such as FrontPage, Hyperstudio 4.0, mPower 4.0, Web Workshop Pro for producing a homepage or a game.

Alternatively, the students can use programmes such as PowerPoint to produce linear presentations. They might also use a word processor to produce webpages that can be linked together in a hypertext structure.

All these tools provide material for text-based elements, numbers, graphics, images, sound, moving pictures, animation, etc.

What to Expect when Using Scenario 4 Applications or Elements?
The use of multimedia in the framework of Scenario 4 means mainly using multimedia as a mindtool. According to Jonassen (1996, p. 1), “using computers as mindtools requires a change of thinking about how computers should be used in schools.” He speaks about the computer as a knowledge representation tool, a tool for thinking about the content being studied. According to him, the primary intellectual reason for using computers as mindtools is that they engage learners in critical, creative and complex thinking skills.

Mindtools as cognitive tools for learning consider the computer as an intellectual partner of the learner to facilitate higher order and deep learning processes (see Module 6). Derry (1990, cited in Jonassen, 1996) defines the term cognitive tools as mental and computational devices that support, guide and extend the thinking processes of their users. “Mindtools provide an environment and a vehicle that often require learners to think harder about the subject matter domain being studied than they would have to think without the Mindtool. Learners are creators of knowledge rather than receivers of presentations. So, Mindtools are cognitive reflection and amplification tools that help learners construct their own representations of a new content domain or revisit an old one.” (Jonassen, 1996, p. 11).

Learning is an active process, and deep processing needs active involvement (Module 6). The use of Scenario 4, where the learner is the au-
thor and creator of the multimedia content, demands an active involvement of the learner.

Furthermore, aspects such as motivation, interests and collaboration are also important when using the productive scenario. Research has shown (Carver, Lehrer, Connel and Erikson, 1992, cited in Jonassen 1996) that learners worked harder, were more interested and involved, collaborated and planned more when working within a Scenario 4 environment.

However, there are also practical reasons for producing multimedia on your own (Jonassen, 1996, van den Brink et al., 2000):

A shallow pool of software. According to Jonassen (1996) surveys have shown that approximately 85% of the available software was either drill and practice or tutorial software that supported rote learning but not a deep approach to learning. The supply of these software programmes does not cover at all the subjects taught in schools. Mindtools can be used across the curricula.

Costs. Many applications only address a single learning objective, and if schools want to use many of these applications, it will be very expensive. However, the further development of the Internet (in the sense of speed, etc.) will soon allow more affordable Scenario 3 applications.

Efficiency. Due to the opportunity of the flexible use across the curriculum, mindtools provide both: cost and operating efficiencies.

The Use of Scenario 4 Applications for Developing Complex, Critical and Analytical Thinking and Collaborative Learning

Complex thinking (see Module 6) might be one of the most crucial thinking skills pupils are expected to learn in schools. Multimedia can be used as a mind-tool for creative, complex and analytical thinking in construction. The construction of hypertext/hypermedia structures focuses on non-sequential, non-linear methods for organising and displaying content (see the use of Scenario 2). This form of presentation gives the learner much more control over the content which enables the learner to learn more in a personal way, because the learner decides according to his/her needs on how to determine the sequence in which to access the information. Here also, the interaction is the most important attribute.

The fact of an open architecture of hyperstructured learning content means that the same set of nodes can be organised in many different ways to reflect different perspectives or conceptions concerning the content.

According to Jonassen (1989), hypertexts are characterised by the following aspects:

- Nodes or chunks of information of varying size;
- Associative links between the nodes that allow travelling from one node to another;
The design and development of multimedia.

Problems often occur in using hypertexts when navigating due to the huge information source the hypertext provides. The user can get lost, can become disoriented, can loose track of the route or can become unable to leave the hypertext to go to another one. When using information from the hyperstructured content, the learner has to integrate this information in his/her knowledge base, to construct and reorganise in his/her own way. Developing hyperstructured content — collaboratively or individually — which reflects the learner(s)'s own understanding and perspectives or of the class could solve this problem. Jonassen (1996) supposes that learners learn more by constructing instructional material than by studying it.

According to constructivist perspectives on learning (Module 6), when learners create multimedia documents, they can construct knowledge in a deep way.

Nowadays, many teachers encourage and support learners in creating their own multimedia Scenario 4 applications on a specific topic.

Thinking Skills for Producing Multimedia

Designing multimedia is a complex process and demands high-order skills and strategies from the learner. According to Carver et al. (1992, cited in Jonassen, 1996), the following major thinking skills are needed in order to produce multimedia presentations:

- **Project management skills** (time management — time planning — time checking; allocating resources and time; assigning roles to team members);
- **Research skills** (determining the nature of the problem and the organisation of the research; developing questions concerning the topic itself and the structure; searching for information within the sources; developing new information with surveys, interviews, questionnaires and other sources; analysing and interpreting the information);
- **Organisation and representation skills** (deciding how to segment and sequence the information found, choosing the form of representation — text/graphics/video/animation, etc.; deciding how to organise and link the information to be presented);
- **Presentation skills** (mapping the design onto the presentation; implementing the ideas into multimedia; deciding how to attract and maintain the interest of the audience);
Refection skills (evaluating the application and the processes used to create the application; revising the design by using feedback).

Technical Organisation for Producing Multimedia
There are many technical opportunities to build up a multimedia product. The creator or producer has to decide on the editor she/he wants to use to construct the homepage. There are a number of powerful software packages which allow a production of multimedia applications. Packages such as Macromedia Director and Authorware Professional are highly advanced and expensive tools, whereas others such as FrontPage, mPOWER 4.0, HyperStudio 4.0 and Web Workshop Pro are simpler and cheaper (see Appendix 3). As mentioned above, tools like PowerPoint and wordprocessors (for example, Word) can also be used as editors of linear and non-linear presentations.

The tools have excellent manuals, which are very easy to read and understand. Of course, there are many other tools, and the listed tools should not be seen as a recommendation of particular tools to use.

Designing a Multimedia Application
Lehrer (1993) developed a framework for building hypermedia applications in the classroom. His framework contains four major processes:

1 – Planning
This process demands from the learners to make different decisions on the major goals of the knowledge base — who is the audience?, what should be learnt? topics and content of the knowledge base; relationships amongst the topics; interface design functions.

2 – Accessing, transforming and translating information into knowledge
This process contains the following activities — searching for and collecting relevant information; selecting and interpreting information sources; developing new interpretations and perspectives; allocating information to nodes and making decisions on the representation forms.

3 – Evaluating the knowledge base
During this process the course participants assess the work on different dimensions. They evaluate compromises in what was represented and how; they assess the information coverage and its organisation; they must test the browser and application with users and also consider feedback concerning the content for integrating it.

4 – Revising the knowledge base
In this stage the course participants have to consider all feedback and revise their application, accordingly — correcting content errors and reorganising and restructuring the content.
Collaboration within the use of Scenario 4 is strongly recommended because of the advantages of working cooperatively such as the facilitation of knowledge construction (see Module 6 and link collection).

**Teaching example for Scenario 4:**

The trainer of the course invites the course participants to discuss the most important steps for designing a homepage on 'Learning and Teaching with Multimedia' for the national teacher education. The course participants collect their ideas and present their results on a whiteboard. The teacher finds statements which fit into Lehrer's framework categories: Project Planning/Accessing – Transforming and Translating Information into Knowledge / Evaluating Knowledge / Revising Knowledge. The teacher asks the participants, which kind of skills are needed to meet the demands of these processes. The participants find similar answers, which can be summarised under project management skills, research skills, organisation and representation skills. The trainer summarizes and reflects on the results found by the participants.

The next step is the decision, if the course participants want to work individually or in pairs/teams. The trainer asks the participants about their opinion on working collaboratively and individually, on advantages and disadvantages. Then the group decides how to work (who with who, etc.).

Then the work starts.

**Phase 1: Planning**

The teams start to plan the work. They discuss the possible content of the site; the way they will address the audience; the way they will get the information; the way they will use the tools; and the way of distributing responsibilities within the teams.

One group decides to work on the topic Learning and Teaching with Scenario 2 (non-linear representation of content). Therefore, they decide the following planning steps. They want to present a hypertext structured site which includes different types of media: text on the content, a speech from one of the course participants, how she learned and experienced Scenario 2. Then they decide to produce and integrate a digital video where the course participants learn with Scenario 2, and one participant will take over the position of the trainer. That is all for the initial stage. The resources of this team will be the use of Internet and Encyclopedias as well as books and their own experiences on learning within the course.
They also plan the use of the hard- and software. They will need a tape recorder, a video camera, a multimedia tool and a scanner.

The trainer observes the planning phase and asks questions concerning the organisation of the planned activities. The trainer guides and supports the teams.

Phase 2: Accessing, Transforming and Translating Information into Knowledge

The next step is to search for the information they need for constructing and presenting their topic on 'Scenario 2 Learning and Teaching'. The team has to identify, select and interpret information sources (see also Scenario 2 strategies) and to develop their own perspectives on this information, to organise it in their own way. After discussion, the course participants decide on the presentation structure/format of their topic: the navigation, the structure of the hypermedia, etc.

The trainer supports as in Phase 1. In this phase, the trainer puts a lot of emphasis on the development on the course participants' own perspectives, presentation and organisation of their different points of view and ideas.

Phase 3: Evaluating the Knowledge Base

The evaluation is on their own work on the selected information, on the presentation of the topic, on the structure and organisation. Furthermore, they test the browser to see if all the links and nodes work as expected. Then they have to make a revised plan for the final draft.

The trainer strongly encourages the reflection on the selected topics.

Phase 4: Revising the Knowledge Base

This phase integrates the following activities. They have to consider all the feedback they have and then decide what they will change and what they will skip, and what will be new, etc. (correcting content errors, reorganising and restructuring the content). During these processes, the trainer's task is coaching, supporting, and guiding the course participants in order to meet their needs. According to Lehrer (1993), the trainer can ask questions similar to:

How are you going to organise your presentation and why?
How are you going to decide on what to include and what to leave out?
Can you draw a flow chart of your programme? Does it seem logical?
Which content do you want to include, and what does it represent?
Which are the most important themes when describing your content?
How did you determine that they were the most important?, etc.
For many examples go to ThinkQuest Inc., which is a non-profit organisation offering programs designed to advance education through the use of technology. Pupils and/or teachers have designed most applications. There is a ThinkQuest Internet Challenge contest where the applications receive prizes.

**Disadvantages of Scenario 4**

The use of Scenario 4 might be time-consuming and there are some hardware and software requirements for multimedia construction — devices such as scanner, audio/video capture card, speakers and, eventually, a video camera with more sophisticated software when needed (see link collection to Scenario 4).
The participators could do their own homepage concerning the courses they attended. This homepage could cover different aspects of the course – for instance, the homepage could have topics such as ‘Use of Multimedia in School’, ‘Applications on the Techniques Learned’, and ‘portfolios’ of each student. This provides the participators with both: they have to work individually within their portfolio where they can present multimedia work, i.e. their own interests, their family in a short manipulated movie or whatever. Furthermore, to work in a team – designing and developing the homepage collaboratively – the participators will experience the advantages and disadvantages of collaborative work intensively when working so closely (see Module 6).

Prerequisites for creating one’s own multimedia application will be:

- Being able to use computers as daily work devices;
- Being able to search for information (Scenario 2);
- Starting and shutting down the computer;
- Starting applications;
- Login;
- Organising files, copy, paste, delete files and elements of files;
- Searching for files;
- Installing and running CD-ROMs;
- Word processing;
- Writing a document, changing font, type, and size; saving the document;
- Designing text by using pictures, illustrations, lines and tables;
- Use templates, columns, headers and footers;
- Spreadsheets;
- Calculations;
- Creating diagrams and integrating them into word documents;
- Web – what is a URL, link, node, plug-in, portal, domain, etc.;
- Go to a homepage by writing the address, follow a link;
- Using a search engine;
- Download shareware and plug-ins;
- Send and receive e-mails.

Extended ICT competencies are needed for sophisticated applications, but they will be developed within the sessions:

- Creating multimedia;
- Editing and adding digital images – scanning, digital camera use, software for making and transforming pictures;
- Editing and adding digital sounds – recording and manipulating sounds;
- Editing and adding digital videos – recording and manipulating movies.
Identify and use course participants’ previous knowledge from former sessions. Develop and decide together with the course participants which kind of project you prefer. Offer the course participants some very broad ideas. Plan the project carefully together according to the listed characteristics. Start the project in groups and give them enough space, so that course participants can also work on their own developing their own portfolio (see Module 2). Use the link collection on ‘Teaching with Multimedia’. Give them time for reflection.

<table>
<thead>
<tr>
<th>Situations in the classroom</th>
<th>Recommended teaching strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide course participants with different tools to produce their own multimedia and give them a plan for the next Scenario 4 sessions</td>
<td>Give the participants enough time when using the Scenario 4 – plan the time according to the participants’ previous knowledge and needs</td>
</tr>
<tr>
<td>Collaborative Learning</td>
<td>Invite the course participants to share knowledge, to help each other, to discuss the topics they want to select. Watch the group while working with Scenario 4 – give support to the teams who get into trouble – give them hints and ask questions, invite them to develop different strategies.</td>
</tr>
<tr>
<td>Using the multimedia potential</td>
<td>Invite the course participants to use the potential of the tools to produce multimedia – they are invited to produce different kinds of media – the graphics, animations, links, sounds, etc.</td>
</tr>
<tr>
<td>Creating the navigation structure</td>
<td>Support the course participants when creating the structure of the site – are there other opportunities to structure the content? What ideas are beyond the structure of the site? etc.</td>
</tr>
<tr>
<td>Soft/hardware problems</td>
<td>See introductory notes</td>
</tr>
<tr>
<td>All situations</td>
<td>The teacher should be very familiar with the content and the tools for production for supporting the course participants’ work</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Didactical method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 4 application as a mindtool (why and how to use)</td>
<td>Use methods from former module (see link collection)</td>
</tr>
<tr>
<td>Use it for motivation, collaboration</td>
<td>Define together with the course participants the project in the use of Scenario 4</td>
</tr>
<tr>
<td>Implement the required thinking skills by reflecting on what is going on in the teams</td>
<td>Use Scenario 4 for course participants’ production of their own portfolio</td>
</tr>
<tr>
<td>Technics for producing multimedia</td>
<td>Homework/portfolio assessment/group or class discussions</td>
</tr>
<tr>
<td>Applying the tools for producing multimedia</td>
<td></td>
</tr>
<tr>
<td>Reflection: content/own learning processes/didactics for use in schools</td>
<td></td>
</tr>
</tbody>
</table>
Critical and Reflective Use of Educational Multimedia
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>5</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>6</td>
</tr>
<tr>
<td>SESSION DESCRIPTION</td>
<td>7</td>
</tr>
<tr>
<td>SESSION 1</td>
<td>8</td>
</tr>
<tr>
<td>Criteria for the Selection of Multimedia and the Planning of the Learning Activities in the Classroom</td>
<td>8</td>
</tr>
<tr>
<td>SESSION 2</td>
<td>10</td>
</tr>
<tr>
<td>Ethical Aspects and Copyright Law</td>
<td>10</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>12</td>
</tr>
</tbody>
</table>
ABSTRACT

In this Module, pedagogical reflections on the use of educational multimedia will be considered as well as the critical selection of multimedia applications.

DURATION: 2 sessions/each session 2 hours
Module 5 deals with reflections on the effective and critical use of educational multimedia.

The following demands on the course participants for Module 5 should deal with pedagogical and ethical reflections on the use of multimedia within education.

<table>
<thead>
<tr>
<th>Educational goals</th>
<th>Topics</th>
</tr>
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<tbody>
<tr>
<td>Declarative knowledge (knowing that – facts, theories, connections amongst theories)</td>
<td>Selection criteria for using multimedia; multimedia law such as copyrights and on sociological perspectives of social in/exclusion when using multimedia in education; cultural and gender differences</td>
</tr>
<tr>
<td>Procedural knowledge (knowing how)</td>
<td>The use of multimedia applications (Scenario 4 portfolio for reflection); competencies in dealing with hard- and software, metacognitions in learning, reflections on one’s own learning processes; non-hierarchical use of learning and teaching methods</td>
</tr>
<tr>
<td>Strategic knowledge (knowing why to apply)</td>
<td>Development of learning strategies within the use of multimedia; learning to learn within a group and collaboratively Construction of useful characteristics for selecting multimedia for educational purposes Construction of attitudes and perspectives on the ethical aspects of the use of educational multimedia The use of multimedia application (Internet research); using Scenario 4 competencies for reflecting on the topic by creating something for the portfolio; competencies in dealing with hard- and software, metacognitions in learning, reflections on their own learning processes; discussing in groups; non-hierarchical use of learning and teaching methods</td>
</tr>
</tbody>
</table>
SESSION DESCRIPTION

This Module focusses on the critical and reflective use of multimedia. In particular, the efforts of the teachers to identify proper multimedia products or on-line services according to the overall objectives of the learning activities, the previous knowledge and experiences of the course participants, the curriculum, the schedule, etc. will be deepened.

Session 1: Criteria for Selection of Multimedia and Planning of Learning Activities in the Classroom

Session 2: Discussions on Ethical Aspects such as Social In/exclusion and Copyright Law.
SESSION 1

Criteria for Selection of Multimedia and Planning of Learning Activities in the Classroom

An effective and meaningful use of educational multimedia in the classroom demands a careful selection of multimedia products.

Multimedia products and on-line services have to be selected according to the overall objectives of the learning activities, the previous knowledge and experiences of the learners, the curriculum, the schedule, etc.

The following selection criteria refer to multimedia-based learning materials from the end-user's/learner's perspective, Scenario 1-3. According to the learning principles this course is based on, the following selected evaluation criteria support the principles that learning involves knowledge construction where new knowledge is built upon existing knowledge and within meaningful contexts. According to different sources (MENON1; Binh Pham, 1998; van den Brink and Slack, 2000; Duarte, 2000) the following is selection criteria for Scenario 1-3:

**Target group/Appropriateness of the target group.** Is there a clear definition of the target group? Is the presentation of the content to be learned appropriate when concerning graphics, sounds, identification figures, etc?

**Pedagogical content.** Are the learning objectives defined? Is the knowledge content and its organisation appropriate for achieving the specified objectives? Are they pitched at the right complexity level for the users that the system attempts to reach? Do the tasks that are designed to convey this knowledge stimulate and enhance users' capacity for learning? How much content does the application contain? Is there a guide through the application? Does it give useful and correct information on the content to be learned? Does it ask questions or allows the learners to interact actively with the application for more than just navigation purposes? Does it fit to the (national) curriculum? Which learning approach does the application use? Does it support a deep approach to learning?

**Flexibility and Navigation.** How easy can users obtain knowledge or perform tasks following the links provided by the system? Does the information content provided in each node and its associated nodes facilitate relational understanding of the concepts? How do such links and navigation methods provide more effective ways to disseminate knowledge than traditional media? Do they stimulate creative ideas and commitment? How is the organisation's content structured? Is it possible for the learners to

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1 www.menon.org
2 This site provides a broad approach to the evaluation of educational multimedia. http://cleo.murdoch.edu.au/ajet/ajet14/pham.html
choose their own path through the material and have the flexibility to return to previously viewed work without returning to the start? Is it possible to modify the content of the application? Does it allow the presentation of different attainment levels? Is there an interactive assessment with selective feedback?

**User-friendliness.** Is the application easy to use and install from the CD-ROM and to remove? Does the application provide an introduction into the use of the application by explaining the symbols and descriptions of their use? Is it easy to survey? How easy is it for users to learn ways to operate the system and remember them? How well can users carry out the targeted application using the interface? How effectively and efficiently can users perform each of these specific tasks?

**Technical quality.** Slow, badly designed or unreliable systems will quickly lose the support of their users. Technical evaluation covers these main areas: interaction, speed, capacity, reliability and extensibility. How responsive is the system for interactive use? Is it fast enough to provide real-time response, and if not, is there any message to inform users of what is going on? How reliable is the system under extensive use by different types of users? Does it provide new functionalities or innovative way to perform a specific task? Are these capabilities implemented in such a way that they can be easily extended? What is the quality of multimedia elements such as graphics, animations, videos, sound, etc.? Are the symbols used clear and easy to see? Is the presented format (www, CD-ROM etc.) easy to use? Is the target platform used in the classroom i.e. Windows version x or higher? How is the hardware configured?

**Value for money.** The value for money can be considered by evaluating all listed criteria dimensions before, and if they got good grades, then the value might be appropriate.

Duarte (2000) gives a broad evaluation framework on the learner’s perspective, based on a somewhat more sophisticated evaluation method which includes many of the former listed processes. Duarte differentiates between general learning conditions to be considered within the evaluation and their sub-components. The dimensions are general learning conditions, educational goals, contents, educational methods and evaluation of the learning processes. His focus is mainly on the learner’s learning processes supporting a deep approach to learning. Learning aspects such as motivation, learning skills, and self-evaluation in the form of metacognition are considered in this evaluation approach.
Ethical Aspects and Copyright Law

Ethical Aspects: Social In- and Exclusion

When using multimedia in education important ethical aspect must be considered. Some important aspects are social in/exclusion and the development in the respect of copyright law. Thus, teachers need to be well informed and able to discuss these aspects with their learners in order to develop ethical rules referring to the use of multimedia in education.

- What is the potential role of the Internet concerning the access to information and the democratic processes?
- What is to be done when one lives in a disadvantaged community concerning the use of information technologies?
- What is the role of the Internet as a force for social inclusion/exclusion?
- How to decrease social exclusion with the use of multimedia?
- How to support ICT and information literacy for disabled people (blind, deaf, etc.)?

For an international survey see ‘Culture and the New Media Technologies’ by Sally Jane Norman, a presentation paper at the Intergovernmental Conference on Cultural Policies for Development. For further texts on social in/exclusion concerning new technologies and education, consider the link collection of the curriculum.

Copyright Law

Teaching with multimedia also implies a responsibility to deal with ethical question such as copyright law. Learners using multimedia need to know their rights and responsibilities. According to some authors, learners should not use technologies until they have demonstrated that they know and can apply ethical standards and school policies as to the use of multimedia. Teachers applying multimedia in school — in all scenarios — act as models for learners’ behaviour (Roland, 19964). Teachers have an important role of transmitting the underlying values which every society builds on. In schools nowadays the misuse of the capabilities of new technologies is rising, and often teachers show the behaviour of unauthorized copying of computer software. It is important that all users of software — in this case teachers as well as learners — are informed about what they can and cannot do under copyright law and software license agreement. There are national copyright laws and international treaty provisions. Often, most software licenses allow the purchaser to make one copy for archival reasons, i.e. for back-up purposes.
Teachers have a moral responsibility to inform their learners about ethical issues such as the correct use of software according to copyright law.

The following web sites provide further opportunities to discuss approaches to ethical aspects in the classroom.

*Ethics and Computers: Implications for Teaching Art* by Craig Roland, University of Florida. The paper was presented at the *National Art Education Association Conference* in San Francisco in March 24, 1996. Besides copyright law, questions concerning privacy, intellectual property, individual and institutional rights amongst others are discussed.

*Developing an Ethical Compass for Worlds of Learning* by Doug Johnson', Director of Media and Technology in Manketto Public Schools, Mankato, MN, USA. This site offers teaching strategies in how to use ethical approaches in primary and secondary schools. Questions concerning privacy, property, and the appropriate use of multimedia in education are discussed.

Other sources are included in the link collection.
Selecting criteria for evaluation: Let the participators develop their own criteria for selecting multimedia for educational reasons. Then, provide examples of criteria others have developed to evaluate multimedia. Moreover, discuss different approaches and relate them to the cultural environment of the course participants.

Furthermore, discuss the ethical aspects with the participators. Provide them with material (videos, papers, etc.) according to their country and their different cultures. Use the material provided — link collection — as examples. Give time for reflection.

<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Proposed didactical method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria for the selection of multimedia</td>
<td>Use methods from former modules — discussions, portfolio reflections</td>
</tr>
<tr>
<td>Ethical questions concerning the use of multimedia</td>
<td>Use the link collection as an example or as an integrated part of the sessions</td>
</tr>
<tr>
<td>— cultural aspects — social in/exclusion</td>
<td>Use different perspectives on the different topics</td>
</tr>
<tr>
<td>Copyright law</td>
<td>Give time for discussions</td>
</tr>
<tr>
<td>Reflection: content/own learning</td>
<td>Homework/portfolio assessment/group or class discussion</td>
</tr>
<tr>
<td>processes/didactics for use in schools</td>
<td></td>
</tr>
</tbody>
</table>
Multimedia in Education

SPECIALISED TRAINING COURSE

MODULE 6

Learning with Educational Multimedia
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>5</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>6</td>
</tr>
<tr>
<td>SESSION DESCRIPTION</td>
<td>7</td>
</tr>
<tr>
<td>SESSION 1</td>
<td>8</td>
</tr>
<tr>
<td>Approaches to Learning and Conceptions of Learning</td>
<td>8</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>12</td>
</tr>
<tr>
<td>SESSION 2</td>
<td>14</td>
</tr>
<tr>
<td>Previous Knowledge and Expert Knowledge</td>
<td>14</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>15</td>
</tr>
<tr>
<td>SESSION 2 (end)</td>
<td>17</td>
</tr>
<tr>
<td>Information Technology Fluency as a Previous Knowledge Requirement for the Specialised Training Course</td>
<td>17</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>17</td>
</tr>
<tr>
<td>SESSION 3</td>
<td>19</td>
</tr>
<tr>
<td>Motivation</td>
<td>19</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>22</td>
</tr>
<tr>
<td>SESSION 4</td>
<td>25</td>
</tr>
<tr>
<td>Learning Strategies with Multimedia</td>
<td>25</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>28</td>
</tr>
<tr>
<td>SESSION 4 (continued)</td>
<td>29</td>
</tr>
<tr>
<td>Active Learning and Interactivity in Multimedia: High vs. Low Learner's Control</td>
<td>29</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>30</td>
</tr>
<tr>
<td>SESSION 4 (continued)</td>
<td>31</td>
</tr>
<tr>
<td>Learning Strategies and Metacognition</td>
<td>31</td>
</tr>
<tr>
<td>DIDACTICS</td>
<td>35</td>
</tr>
<tr>
<td>SESSION 4 (end)</td>
<td>37</td>
</tr>
<tr>
<td>----------------</td>
<td>----</td>
</tr>
<tr>
<td>Self-Directed Learning with Multimedia</td>
<td>37</td>
</tr>
<tr>
<td><strong>DIDACTICS</strong></td>
<td>38</td>
</tr>
<tr>
<td>SESSION 5</td>
<td>39</td>
</tr>
<tr>
<td>Computer Supported Problem Solving with Hypermedia Games (Scenario 3)</td>
<td>39</td>
</tr>
<tr>
<td><strong>DIDACTICS</strong></td>
<td>42</td>
</tr>
<tr>
<td>SESSION 6</td>
<td>44</td>
</tr>
<tr>
<td>Social Interaction</td>
<td>44</td>
</tr>
<tr>
<td><strong>DIDACTICS</strong></td>
<td>46</td>
</tr>
</tbody>
</table>
This Module deals with theories on learning. In particular, the learning aspects such as learning conceptions, learning strategies and self directed learning, metacognition, social/collaborative learning, ICT literacy and motivation are deepened and experienced.

DURATION: 6 sessions/each session 2 hours
Module 6 covers the broad field of learning with educational multimedia. It embraces, among others, theories on learning, motivation as well as research findings concerning learning with educational multimedia.

This Module can be placed at the end of the curriculum as a final topic that takes the participators deeper into the processes of learning when learners use multimedia. Since it presents the important themes concerning learning with multimedia, the Module can also be placed in the beginning of the course, i.e. after the introductory note and the overview of the curriculum.

<table>
<thead>
<tr>
<th>Educational goals</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of declarative knowledge (knowing that – facts, theories, connections amongst theories)</td>
<td>Theories on learning and communication, on learning with educational multimedia, the prerequisites and the conditions for these types of learning and empirical results</td>
</tr>
<tr>
<td>Construction of procedural knowledge (knowing how)</td>
<td>The uso of Scenario model 4 for portfolio; the uso of multimedia application Scenario 1–4; competencies in dealing with hard– and software, metacognitions in learning, reflections on one’s own learning processes; non–hierarchical use of learning and teaching methods</td>
</tr>
<tr>
<td>Construction of strategio knowledge (knowing how to apply)</td>
<td>Development of learning strategies with the use of multimedia: learning strategies – implementing strategies, information management strategies, active discussion, problem solving, self–regulated learning, metacognitions in learning (theoretically Module 6, in practice all Modules); learning to learn within a group and collaboratively</td>
</tr>
</tbody>
</table>
SESSION DESCRIPTION

The “state-of-the-art” scientific theories about learning and the construction of knowledge does not provide a consistent theory for all the important aspects of learning. However, they provide a set of theories concerning important perspectives on this type of learning, and how these different perspectives can partially complement one another.

Module 6 covers the following themes:

Session 1: Approaches to Learning and Conceptions of Learning
Session 2: Previous Knowledge and Learning
Session 3: Intrinsic and Extrinsic Motivation and Multimedia
Session 4: Learning Strategies and Metacognition with Multimedia
Session 5: Computer Supported Problem Solving with Hypermedia Games
Session 6: Social Interaction

The sessions in this Module are divided into topics. Session 4 has a broad body of information and might be considered for two sessions.
Approaches to Learning and Conceptions of Learning

Conceptions of learning can be qualitative or quantitative (Marton and Säljö, 1994).

Quantitative conceptions
The following quantitative conceptions were found by empirical research:

A) Increasing one's knowledge (what: learning new things — content is unspecified; bits of information; how: absorbing, storing; process is unspecified, except increasing or absorbing).
B) Memorising and reproducing (what: facts — isolated but specified items of knowledge; how: rote learning; getting it right; repetition, memorising)
C) Applying (what: facts and procedures — similar to memorising and reproducing, but facts are broader and include procedural knowledge of rules and algorithms; how: make use of it in one way — the facts have to be adjusted to the applied context).

These three conceptions are concerned with isolated items and learned by restricted or lower order strategies such as rote learning or memorising. Applying these conceptions is at the level of simple math problems — applying the same algorithm to solve a standard type of task.

Quantitative conceptions are widespread. Many people holding this conception think that a good learner knows more than others. Nowadays, famous television quiz shows like 'Who wants to become a millionaire?' where the player has to answer questions such as "When was the foundation of UNESCO?" and the next one could be "Who won the gold medal in XY at the Olympic games in 2000?", mirror this quantitative conception of learning where rapid retrieval of unrelated pieces of knowledge — speed and accuracy of memory — is questioned.

Qualitative conceptions
Within this perspective learning is seen from a qualitative point of view as the change of the individual perspective on the world. This means — similar to the constructivist perspective — that learning implies a reinterpretation of knowledge and, therefore a reconstruction of the self (e.g. Marton and Booth, 1997).

Qualitative conceptions are the following ones:
D) Learning is understanding the meaning of content (what: ideas — what do words and sentences stand for; what does the author want
MODULE 6: LEARNING WITH EDUCATIONAL MULTIMEDIA

to say; how: grasping, understanding, seeing, relating it to previous knowledge, discussing, finding analogies).
E) Seeing something in a different way (what: a view of things, principles – learning here is a change in what is understood; the process of understanding is bigger than the ideas behind it – several understood ideas feed each other – the world is perceived differently; how: studying things in such a way that they become a pattern).

Of course, what the most educational systems call for, is a realisation of stage F for the pupils at school. The quantitative and qualitative levels of conceptions of learning feed each other – the quantitative levels are in many cases a prerequisite for the qualitative ones.

Schools' influences on learning and self-regulation. The ‘information/communication/learning’ society claims independent and self-regulated learners who are able to establish stage F.

According to Biggs and Moore (1993), one of the results of metalearning is that learners derive their individual ways of coping with the problem or the challenge of learning. According to an investigation done by Tayler (1984, cited in Biggs and Moore, 1993), pupils make a personal study contract with themselves: ‘This is what I want. In order to obtain it, I have to do this or that. If I don't do it, I would break my contract and lose.’ This contract can be divided in two important pieces – the will and the skill (Pintrich and DeGroot, 1990):

1) **Will**: What do I want out of this? Why am I learning this – what are my motives?
2) **Skill**: What can I do to get there? How do I do that, what are the strategies for achieving what I want?

According to Biggs and Moore (1993), motives tend to determine the applied strategies – motive and strategy together forming an approach to learning (Biggs, 1985; Marton and Säljö, 1976a, 1976b). The concept of approaches to learning (deep/surface approach) has been developed and investigated in an academic environment (school, university, professional courses), and it describes typical ways of pupils' metacognitions within these school/university environments.

**Approaches to Learning**
Marton and Säljö (1976a, 1976b), Biggs (1987a), Entwistle and Ramsden (1983) have subsequently developed the concept ‘approaches to learning’. In questionnaire surveys in several countries and investigations in all types and levels of schooling, three approaches to learning have been consistently found: the surface, the deep and the achieving approach to learn-
These approaches describe the intention to learn. The idea behind intention is similar to the concept of different types of motivation (intrinsic, extrinsic, social). The intrinsic motivation finds its complement in the deep approach, the extrinsic motivation relates to demands from outside the student's personality. For the social motivation clear strategies, which just fit in this conception, could not be found.

The surface approach
The motive in the surface approach is extrinsic, and the strategies used are usually based on rote learning. The pupils do not see the meanings, the implications of the content to be learned and the interconnections amongst the elements. Here, the use of metacognitions according to Brophy (1986, cited in Biggs and Moore, 1993) is less than in other approaches — the student wants to get the task out of the way.

The deep approach to learning
The motive in the deep approach to learning is intrinsic motivation or, more particularly, interest (Hidi, 1990; Schiefele, 1991). The learner's curiosity and interest are satisfied only when the content to be learned is understood. This kind of motivation corresponds to the felt need of solving a problem experienced in everyday problem-solving in personally important contexts. Deep learning involves a personal commitment to the current learning process which means that the student relates the content to be learned to personally meaningful contexts or to their existing prior knowledge concerning this topic.

Within the deep approach, the learner is totally involved in the content of the task. Learners with a deep approach to learning in a certain domain will (Biggs and Moore, 1993, p. 312):

- Possess a great deal of relevant content knowledge;
- Operate at a high, or abstract, level of conceptualisation;
- Reflect metacognitively on what is to be done using optimal strategies for handling the task;
- Enjoy the process;
- Be prepared to invest time and effort.

The achieving approach
Within the achieving approach, the motive is focused on the product and/or the ego involvement that comes from reaching high grades and winning prizes. The used strategies have to maximise chances of belonging to the bests, so the learner has to be involved optimally in the task (like the deep strategies), but this involvement is the means not the end (unlike the deep strategies) (Biggs and Moore, 1993). "The achieving strategy concentrates on cost-effective use of time and effort, a rather cold-blooded calculation involving organisational behaviours that characterise the model student such as keeping clear notes,
planning optimal use of time and all those planning and organisational activities referred to as 'study skills'. ... Like the deep approach, then, the achieving approach involves a high degree of metacognition, relating both to context (awareness of self, task and context with deliberate planning of time and resource allocation) and to content (optimal task engagement). While deep and surface are mutually exclusive at any given moment, an achieving approach may be linked to either: one can rote-learn in an organised or an unorganised way, or seek meaning in an organised or unorganised way. Surface achieving is the approach adopted by learners who want to obtain high grades and think that the way to do so is by using the surface strategy. ... Deep-achieving, a planned and cost-effective search for meaning, is however characteristic of many of the better learners ” (p. 314).

**Approaches to Learning with Multimedia**

In spite of the potential of multimedia in fostering deep approaches to learning, research has found contradictory evidence (Laurillard, 1993; Webb et al., 1994). Many applications do not integrate meaningful information processing (Jonassen, 1993 cited Gunn, 1995). Hart stated (1987, cited Ramsden, 1992) that multimedia users could become rich in information but poor in knowledge. Furthermore, even “well”-structured products would sometimes be used (by certain learners and in certain moments) on the basis of a surface approach to learning (see Webb et al., 1994 and Newman et al., 1998). In this respect the context in which user's learning takes place (i.e. users' skills and learning environment) is a key variable.

In other words, different types of conceptions of learning with multimedia become apparent (van den Brink et al., 2000): conceptions of learning with multimedia range from a quantitative view of learning to a qualitative one. This implies that pupils' conceptions of learning with multimedia stem from conceptions of learning in general. Some pupils can see multimedia as a way of acquiring more knowledge – this could be interpreted in terms of when pupils have a quantitative conception of learning (i.e. acquiring information); the computer is seen as a resource for actualising the conception. This happened unexpectedly even when pupils have demonstrated a deep approach to learning with multimedia (i.e. intrinsic motivation and comprehension learning strategies) which, in principle, would be more convergent with a qualitative conception of learning with multimedia (i.e. as a way of comprehending and transforming knowledge). This implies that multimedia can stimulate a more advanced type of learning than the one represented as proper by the pupils. Multimedia is represented as a way of improving learning effectiveness (e.g. by enhancing motivation), probably, because it promotes a greater involvement in the learning situation. The fact that pupils can represent multimedia as a way of speeding the learning process and reducing information overload can imply that this kind of learning could be also seen as a resource for surface learning.
Teachers in the study also obtained conceptions of learning with multimedia ranging from a quantitative view of learning to a qualitative one that replicates research on teachers conceptions of learning in general (Prosser et al (1994, cited Entwistle, 1997b).

**DIDACTICS**

Conceptions and approaches to learning is a good topic for discussions. The course participants might discuss their own approach to learning and their conception of learning in a reflective and critical way. Furthermore, the institutions and the cultural educational system, in which teachers work, provide certain conceptions of learning. What conclusions for further work in schools do course participants find? How can they use multimedia for changing approaches and conceptions of learning in the direction of deep learning?

For representing a qualitative conception of learning course participants can develop prior or parallel qualitative conceptions of learning by group discussions and confrontation with their own knowledge. Therefore, the introduction of multimedia in education is not a sufficient condition for an improvement to the quality of learning. Learning with multimedia can be organised in order to support its development from a quantitative conception of learning to a qualitative one.

The fact that course participants can see learning with multimedia as a self-regulatory process suggests that this type of learning can be introduced to autonomous learning and constitute a way to stimulate self-regulation.

By hinting that teachers can see multimedia as a resource to implement a type of learning previously defined (e.g. quantitative) suggests that they might need to develop a qualitative conception of learning in order to use multimedia as a resource for learning as a qualitative process.

Teachers can be aware of the conception of learning implicitly in the applications produced.
<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Proposals for didactical methods</th>
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<tbody>
<tr>
<td>Learning theories: conceptions of learning:</td>
<td>See Module 1, material and references</td>
</tr>
<tr>
<td>quantitative and qualitative; approaches to learning:</td>
<td>Use one of the questionnaires (Biggs, 1996) for identifying teachers' and course participants'</td>
</tr>
<tr>
<td>deep/surface/achievement</td>
<td>approaches and conceptions to learning</td>
</tr>
<tr>
<td>Conceptions and approaches to learning with</td>
<td>Use Scenario 3 and introduce the course participants to different conceptions of learning</td>
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<tr>
<td>multimedia in school</td>
<td>within the applications</td>
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<td>Use Scenario 4 and introduce the concept of the deep approach (organising content in hypertext</td>
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<td>structure according to own constructions) and the surface strategies (paste and copy, often</td>
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<td>without thinking)</td>
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<td>Reflection: content/own learning processes/didactics for</td>
<td>Give homework/support portfolio assessment/group or class discussion/hints to references about</td>
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<tr>
<td>use in schools</td>
<td>the topic</td>
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<td>Explain your didactics</td>
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Previous Knowledge and Expert Knowledge

Several studies have shown that previous knowledge is one of the best predictors for high cognitive performance — a better predictor than general intellectual aptitude in adults as well as in children (Weinert, 1996; Heller, 1997; Ceci and Liker, 1986). In general, previous knowledge means one person’s declarative knowledge (to know that) and procedural knowledge (to know how) within a specific domain (Renkl, 1996). According to Renkl (1996), many studies confirm that learning difficulties in children and adults are very often caused by missing or false previous knowledge (Renkl, 1996). Previous knowledge is always the starting point for an extended knowledge base or expert knowledge.

How do human beings acquire the many procedures required to construct an extensive knowledge base? It involves learning for a long time, and this learning never stops because the construction of the extended knowledge is based on modifying and reconstructing the previous knowledge with every learning process.

Development occurs as an increase in performance, especially, an increase in knowledge and in a more effective use of strategies. As children grow older, they are more likely to use strategies more effectively. For instance, in memory performance: older children's memory recall is more clustered — similar pieces of information are grouped together. One interpretation of this is that older children use strategies far more intentionally. Furthermore, they might have far more extended knowledge about the domain. When the knowledge base increases and the connectedness becomes stronger, knowledge is more accessible for the learner (Rabinowitz and McAuley, 1990). The connection between knowledge and using strategies effectively can be very close. Furthermore, it is to note that knowledge can replace the use of strategies, for instance, children sometimes use strategies because they do not have a sufficient knowledge base in several fields (Siegler and Shrager, 1984). Otherwise, knowledge can enable the use of strategies, because without an appropriate previous knowledge it is very difficult to carry out certain strategies (for instance, to understand the content of an Italian text certain, previous knowledge is necessary).

The interactivity in multimedia software is not an advantage in all learning situations for constructing a broad knowledge base. According to Viau and Larivée (1993) and Shaw (1992), learner’s control of instruction is most effective when the learner has some expertise in the domain. Learners with
little previous knowledge in the subject area are often unable to discriminate between critical and tangential information. The power of choice, which is given to them at a high level of interactivity, grants the learner with more responsibility and, thus, could generate cognitive overload. This could lead to a poor performance (Jonassen and Grabinger, 1990). Therefore, learning strategy training seems to be very useful.

**DIDACTICS**

Support course participants to activate their previous knowledge by proposing strategies which relates the knowledge they already know to information encountered or expected in the learning material. Provide summaries of what was learned before and try to relate the educational multimedia application to issues already known to the course participants.

Use educational multimedia which provide the learner with different navigation possibilities. Learners with a relatively limited previous knowledge need far more instructions. The offer of a guided tour supports learners with a limited knowledge base within the specific domain (Scenario 3). Besides, an open navigation path (Scenario 2) will be provided for the learners who have more knowledge within the domain or for the learners who do not need the guided tour anymore. Therefore, they can choose individually their own learning path according to their learning prerequisites.

Furthermore, cognitive tools (Scenario 4) as a tool for expressing and representing the learner's knowledge structure can support the connections amongst several knowledge domains within their own knowledge base. Moreover, according to the characteristics of educational multimedia, these applications can provide a flexible presentation of the information. Educational multimedia can provide several demand levels of the contents to be learned depending on the learner's level of previous knowledge. If multimedia software establishes different levels of information, weak learners will not suffer from taxing, and bright learners will not suffer from boredom. Furthermore, educational multimedia could also provide children with the offer of using different learning strategies according to the special tasks and demands and explaining how these strategies can be applied in a manner that is appropriate to the target group. In addition, further encouragement for using strategies and the construction of their own strategies could enhance children's performance.
### Content to be learned

<table>
<thead>
<tr>
<th>Learning theories: previous knowledge, expert knowledge / development of knowledge base / use of strategies / interactivity in multimedia and previous knowledge</th>
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### Proposals for didactical methods

| See Module 1, material and references |
| Homework before the session: let the course participants make summaries on their knowledge on previous sessions about learning |
| Use Scenario 2 or 3: for most course participants use an unfamiliar topic (physics/mathematics), guided tours, use multimedia with different levels of task difficulty |
| Use Scenario 2: every student chooses a very familiar topic according to his/her interests |
| Or use Scenario 4 and guide the ones with limited previous knowledge |

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<thead>
<tr>
<th>Reflection: content/own learning processes/didactics for use in school</th>
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| Give homework/support portfolio assessment/group or class discussion/ hints to references according to the topic |
| Explain your didactics |

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16
Information Technology Fluency as a Previous Knowledge Requirement for the Specialised Training Course

"The concept of literacy encompasses a complex set of abilities to understand and use the dominant symbol systems of a culture" (Andresen, 1999, p. 20). Nowadays, the concept of literacy is expanding to include the digital symbols in addition to other symbol systems (Andresen, 1999). "To be functionally literate means to be able to receive and produce the main symbols of the culture by versatile means including the multimedia computer. ICT literacy covers the ability to access, analyse, produce and evaluate information through a variety of these media. Included in ICT literacy is the ability to get hold of piece of equipment, know how to operate it, gather information, choose entertainment and understand the strengths and limitations of the messages on the screen" (Andresen 1999, p. 21).

According to Abbott (2001), "notions of literacy have been changed and developed as a result of ICT, and literacy is central to most definitions of education" (p. 11) and "... by the end of the twentieth century it was no longer possible to view literacy as based on the word or even on the word-based text. Literacy today is essentially multimedia, composed of an amalgam of words, pictures, sounds and the moving image" (p. 9).

Learners using multimedia have to obtain knowledge about technologies. People who use technology fluently have already acquired a lot of problem-solving strategies concerning the use of technology and do not run for help immediately when something does not work optimally. Papert (1996, in Andresen, 1999) demands an IT fluency which means that teachers and learners should be able to use technology like a foreign language fluently.

DIDACTICS

Course participants and teachers need to know how to use their knowledge effectively and to decide on which strategy to use when working with multimedia. Therefore, teachers need a lot of new competencies in order to monitor the progress of learning in this new situation – they must obtain their own IT fluency. Based on an individual analysis the learner can develop his/her own
effective learning strategies in the fields/domains in which he/she has deficiencies. They can revise and/or reevaluate the strategies they have already applied. This provides them with an opportunity of self-evaluation as well as self-monitoring that motivates them to learn.

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<tr>
<th>Content to be learned</th>
<th>Proposals for didactical methods</th>
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<tbody>
<tr>
<td>Learning theories: ICT-literacy</td>
<td>See Module 1, material and references</td>
</tr>
<tr>
<td>Reflection: content/own learning processes/didactics for use in schools – how to teach strategies</td>
<td>Give homework/support portfolio assessment/group or class discussion/ hints to references according to the topic Explain your didactics</td>
</tr>
</tbody>
</table>
Motivation plays an important role within the learning process, and its existence is essential in order to succeed in learning. Motivation is determined by a mix of learners' beliefs and perceptions regarding their learning processes, teachers' behaviour, educational demands, design of the learning material and classroom practices. Many studies have shown that working with multimedia at school increases student’s motivation. Educational multimedia can challenge the learners and evoke their curiosity and mental images and models. Therefore, the motivation is often high in learning activities with multimedia. Nevertheless, multimedia is not a panacea, and as every learning tool it will not reach all students at the same time.

Learners’ Role – Teachers’ Role
Results from investigations where learning of 17 Europeans with educational multimedia were videotaped during the class and the pupils interviewed afterwards (www.pedactice.com) showed that, in general, the observed pupils were very motivated when working with educational multimedia. During the interviews the pupils reported on how much they appreciated working with the multimedia software. Even when the pupils evaluated some multimedia software as quite bad, they liked working on the programmes. According to the pupils, learning with multimedia applications means learning on one's own, with far more freedom to decide what to do (compared with traditional lessons) and being able to learn at their own pace.

Many pupils in the study reported that the role of the teacher is changing when using educational multimedia in classrooms. The pupils appreciated working with teachers who can help them individually, support them in their learning and working strategies and who are more relaxed in the classroom situation. The pupils perceived that the learning situation with computers was different to the traditional ones: the relationship between pupils and teachers is less hierarchical and much more relaxed, and the centre of activities is on their own learning (van den Brink et al., 2000). Furthermore, the authors found that many pupils showed extrinsic as well as intrinsic motivation. First of all, most pupils wanted to know the content to be learnt for exams or presentations (extrinsic). Otherwise, most of the kids had so much joy when working on the multimedia applications that they did not want to have a break or they wanted to take the programme home to continue learning. Therefore, most pupils found themselves concentrating more in this class than in any other class where they did not use educational multimedia. Some pupils wanted to start with other related topics which are not needed for school, but which they found very interesting (van den Brink et al., 2000).
Although the investigated teachers established different teaching styles, all teachers adopted the facilitator/helper/guide role. Two teaching styles could be identified. When the pupils had to work on their own, the teacher had a tendency to intervene as little as possible. When the pupils had to get themselves involved actively in reflexive and/or critical processes, the teacher's had a tendency to intervene by provoking, questioning the pupil's decisions, suggesting alternative ways, etc. The teachers never repressed the intergroup interaction. This type of fluid and direct relationship reminds of the situation – or does not differ much from – when teachers work on projects or practical activities which require the active and collaborative implication of the pupils such as working on science.

The results of this European project showed that the pupils put a great deal of emphasis on three aspects which motivate them a lot: the active learning, the multimedia elements of the software and the teachers' behaviour in class. Furthermore, the pupils have plenty of fun when working collaboratively in pairs or in small groups, especially, with the combination of these two factors – a good educational multimedia programme and a teacher who is present in the background for giving support when needed – seems to be very motivating. Teamwork also motivates the pupils but it depends on the software programme and the tasks to be performed. If the software provides the opportunity of a critical confrontation with the content, then collaborative work is very welcome. In cases where only repetitions are demanded, the pupils prefer to work on their own (van den Brink et al., 2000).

Factors Influencing Motivation

Important influencing factors on motivation within the classroom situation are given as follows:

a) *Ego involvement* of some pupils – the feeling of success when outperforming others (Ames, 1984) also influences pupils towards the decline of their academic motivation, especially, on pupils who cannot be the “best”. The use of educational multimedia which provides specific feedback that includes learner's personal improvement is helpful.

b) *Pupils' perceptions or theories of intelligence* – whether intelligence is derived more from biology or more affected by environmental variables (Dweck and Leggett, 1988). Pupils who believe in biology are discouraged when they receive negative feedback, and they interpret failure as an indicator of low intelligence. Often, these theories of achievement can be heavily influenced by the behaviour of the teachers and by reward structures used in the classroom or in the multimedia application.

In order to avoid the biology thesis, teachers can make sure that pupils understand the work and they pay attention to whether pupils are improving or not. Moreover, they can give pupils a chance to correct mistakes, they emphasize that making mistakes is
an important part of learning, teachers support pupils in trying new things and in a hard working learning environment.

According to Ames and Archer (1988), children, who perceive themselves in this mastery-oriented classroom style and use more strategies and more effective strategies, are more open to challenging tasks, more positive about the class, more likely to believe that effort results in improvement. Using educational multimedia application which do not give negative feedback on failure but give the possibility to correct mistakes several times, requests the use of different learning strategies which could be appropriate to the tasks, fosters the mastery-oriented style.

The use of Scenario 4 tools especially supports the opportunity to try new things for a mastery-oriented approach, as long as the teacher's guidance is available (van den Brink et al., 2000).

c) **Intrinsic motivation**, which derives from feelings of satisfaction and fulfilment, not from external rewards, increases individual engagement in the learning process and learning results. One interesting finding is that rewards can undermine performance when initial interest in the rewarded activity is high and when the reward to performance is so obvious that it seems to be a bribe (Lepper and Hodell, 1989). When the initial interest is not so high, a reward might increase the interest and the performance of the task (Bandura and Schunk, 1981).

**Goal Setting**

The process of goal setting demands establishing goals and modifying them, if required. Specific and proximal goals tend to be more motivating and lead to more success within the learning process than general goals. According to Schunk (1990), this is due to the fact that specific goals are easier to gauge by the learners. In multimedia Scenario 2, the opportunity of 'getting lost in cyberspace' is quite high, especially, for inexperienced users. Specific goals can limit this 'danger' and increase the opportunity of success.

**Pupils' Self-Efficacy: the Challenge of Using Multimedia**

Pupils with high self-efficacy believe that they are able to reach a desired goal or attain a certain level of performance. Self-efficacy is domain-specific and very stable over the years (Bandura, 1977). High self-efficacy is influenced by former success in the domain, social models, opinions of others and feedback. Self-efficacy also depends on the individual's level of demand on his/her own performance. Challenging, but not too difficult tasks support self-efficacy. Many multimedia applications offer continuous help, selective feedback and different levels of task difficulty or different levels of navigation.

The classroom situation in which educational multimedia applications are used, provides opportunities for self-regulation and autonomous activities, high learner control with the programmes and others and multi-perspective
presentations of contents corresponding to the programmes. Teachers can support pupils in this situation by offering a counselling concerning the use of adequate strategies and by showing them the opportunity of more than one perspective, etc. The use of educational multimedia applications which provide characters with which the pupils can identify themselves—characters such as the same sex, age, race, and religion—can be supportive. The content should be based on life themes which are important to the learners, and depict intense action and feeling (Anderson, Shirey, Wilson and Fielding, 1987). The design should be user-friendly, well-structured and appropriate to the target group.

Furthermore, the use of productive tools (Scenario 4) where learners create actively a platform for knowledge representation or communication, etc., improves learners' motivation, if the teacher provides to the students continuous proper support (van den Brink et al., 2000).

**DIDACTICS**

Facilitate the use of interactivity within the multimedia application, provide different strategies for using it. Use applications which provide different levels and forms of interactivity for different needs of different learners (with different prerequisites such as speed, previous knowledge, interests, etc.).

Provide course participants with specific and proximal goals; respectively, let them develop their own specific and proximal goals while working with educational multimedia (when using Scenario 1, 2 or 4). Introduce them to multimedia which provide specific and proximal task goals within the application (Scenario 3).

Provide course participants with tasks which are challenging, but not so difficult that progress is impossible, as this is important for high self-efficacy. After a successful performance, course participants experience greater confidence and feel that they can make it. This increases self-efficacy. For example, in the case of learning with multimedia this means that course participants should have the possibility to work on multimedia applications which are neither too difficult nor too easy for them. Getting familiar with educational applications (how it works, what can be done with it, etc.) often takes time. The course trainer should be well prepared for working with a specific application. He/she should know the most important features (Scenario 1, 2, 3) or productive opportunities (Scenario 4) of
the application to avoid the course participants getting bored when using the application for the first time. Use educational multimedia applications which increase self-efficacy by offering different levels of difficulty within the tasks or opportunities. The increased level of interest in a subject content to be learned can be established by a varied design of the learning environment within the programme.

Use for motivation of the knowledge change. Ask course participants questions on topics to gauge their previous knowledge (photosynthesis, political geography in Africa, Asia or Europe, etc.). Let them discuss about their individual knowledge bases according to the topic. Find agreement and acceptance on definitions, formulations, and facts. Use the Internet and other media and support individual interests according to the tasks by discussing their responsibility for certain parts of the task (one student searches for methods, another one for history numbers and one is responsible for the representation of the results, etc.). In the end of the session, let them assess their knowledge change.

Encourage course participants to ask for help and to support each other within the learning situation.

Depending on the ego-involvement of some course participants, ask them to develop assessment measurements for their own performance assessment (connect to previous knowledge from Module 2). Introduce a multimedia application (Scenario 3) which gives them positive feedback or alternatively, use one with negative feedback to show the impact on their motivation. Afterwards, collect the results and give time for reflecting on the learning process. Ask about their motivation.

<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Proposed didactical methods</th>
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| Learning theories: activation/interactivity; learners' control; motivation for learning, motivation and multimedia, intrinsic motivation | See Module 1
Introduce different scenarios of multimedia to the course participants and let them experience different levels of interactivity. Be sure that they can get help in tricky situations |
<p>| Goal setting | Support course participants' goal setting: provide course participants with specific and proximal goals and, respectively, let them develop their own specific and proximal goals whilst working with educational multimedia (when using Scenario 1, 2 or 4). Course participants' should experience the difference between specific and general goal setting. Introduce them to multimedia which provides specific and proximal task goals within the application (Scenario 3) |</p>
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<th>Content to be learned</th>
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<td>Learners' self-efficacy</td>
<td>Challenging but not too difficult tasks, integrate Scenario 1-4</td>
</tr>
<tr>
<td>Course participants' perceptions or theories of intelligence</td>
<td>Make sure that course participants understand the work, pay attention as to whether pupils are improving or not, give pupils a chance to correct mistakes (making mistakes is an important part of learning) Support pupils in trying new things in a safe environment Request the use of different learning strategies, which could be appropriate to the tasks</td>
</tr>
<tr>
<td>Ego involvement</td>
<td>Assessment opportunities; show positive vs. negative feedback in Scenario 3 applications</td>
</tr>
<tr>
<td>Teachers' role/course participants' role</td>
<td>Task: familiar topic (biology, geography, etc.) and check and compare the knowledge base – get new information by using multimedia (Scenario 2), present your guide/facilitator's role and transform it into a topic to discuss – what should a teacher know? Knowledge and strategies to get the most recent and up-to-date information</td>
</tr>
<tr>
<td>Reflection: content/own learning processes/didactics for use in schools</td>
<td>Give homework/support portfolio assessment/ group discussion/ hints to references according to the topic Explain your didactics</td>
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</table>
Learning Strategies with Multimedia

Many theories on learning agree on the assumption that knowledge is actively built up by the learner, that knowledge does not exist independently from the learner and that knowledge is generated dynamically and not stored in a fixed way. Therefore, knowledge cannot be transmitted to other subjects without building up their own constructions (See Weinert, 1996; Papert, 1992). According to these assumptions, representations of the constructions are in a permanent renewal process concerning the interpretation of presentations of cognition, and there are no static symbols. Many of the new learning theories accept basic assumptions about learning such as learning is a constructive and active process, it is situated and has to be embedded in a relevant context (Weinert, 1996). Stebler and Reusser (1994; cited in Schulmeister, 1997) argue, an effective knowledge construction occurs in an active confrontation with learning content (active), within a certain context (situated), together with others (social/interactive). Within this process new information will be linked with existing ones, and structures will be built up in a new qualitative way. Learning is very effective, if the learner works in a goal-directed way referred to as the learning goal (goal-directed) and also if he/she monitors and regulates competently his/her activities by him/herself (metacognitive and self-regulated).

According to Biggs (1996), the most desirable outcome of learning is a metacognitive understanding of the subject. This means that the student is able to transfer the content to be learned, to reflect on one’s own (learning) activities, to evaluate decisions already made, to formulate an individual theory about the subject and to generate new approaches to the subject. Can we support pupils to learn in this way with the help of multimedia?

Multimedia as an Intellectual Tool

Education implies the empowerment of the learners with the intellectual tools of their culture. Multimedia can be seen as an intellectual tool in many cultures. According to Vygotsky (1978), tools can support learning at different levels. Multimedia as a tool, which means mainly the use of Scenario 4, is used especially in the following fields for:
1. Communicating ideas and information representation;
2. Handling information;
3. Modelling;

Multimedia provides the learner with tools which can assist communication and which permit the learner to develop creative ideas.
Ad. 1) Communicating ideas and information representation (Scenario 4). For communicating information, it is necessary to develop, organise and store ideas in visual and oral forms by desktop publishing.

Ad. 2) Handling information. Multimedia provides many possibilities for handling information. Information handling software can search, sort and represent information in graphs and charts, it can deal with a broad range of media including pictures and sounds. On the elementary level, databases in the manner of a card-index-archive can be used. However, this demands from the learner that he/she has to adapt his/her thinking to the structure of the database, and this is not always easy as it demands many different cognitive strategies. More supportive to learning are data structures such as “decision tree” software which helps the learner to sort or classify objects in relation to questions with YES/NO answers.

Ad. 3) Modelling. Multimedia based modelling provides support in learning to handle abstract concepts, especially, subject matters such as physics, mathematics and biology – all science subjects can use multimedia modelling very effectively. At the elementary level, spreadsheets are a useful tool which presents rows and columns in the form of a table. The software calculates and recalculates the data automatically and, therefore, the learner can concentrate on the presented scientific concepts and does not waste time in calculating. “Spreadsheets enable learners to operate high level of abstraction in setting-up the model and understanding the way in which a table with changing numbers represents a system in the natural world” (Davis et al. 1997, p. 19). Simulations, and more specifically modelling tools, have been generated by spreadsheets. Here, the learner can interact with the model by controlling factors which will have an impact on the programme. One limiting aspect is the fact that simulations can only represent a rule-governed system and are not able to handle unpredictable factors. However, the modelling demands the learners' critical confrontation within their own limits. Then, the simulation might stimulate the understanding of the presented model, and this decreases the possibility of misunderstanding. Modelling provides many possibilities for ‘What if?’ questions such as “What, if gravity was zero?”

Cognitive tools are a special form of modelling. The term ‘cognitive tools’ is used when the software application provides the possibility for constructing knowledge by the user by direct manipulation (Kommers, Jonassen et al, 1992). Jonassen (1992) terms cognitive tools as mindtools or problem exploration tools. According to Jonassen, the true potential of hypertext structures may lie in its capacity as a study aid or cognitive learning tool. “A cognitive learning tool is any activity (that may or may not be supported by computers) that fosters or facilitates a deeper or more meaningful level of information processing in learners. ... the act of creating the systems engages the learner in a level of analysis and depth of learning that is not elicited by other instructional or learning strategies. Having
learners created their own hypertexts, especially, if they develop hypergraphs, hypermaps, may provide learners with the most powerful learning aid yet provided. Research has shown that learning effects are greater for persons involved in developing materials than for those merely using the system. So, hypertext may function best as a study aid that provides multidimensional note-taking. The hypertext will not teach the learner. The learner will learn by creating hypertext” (Beeman et al., 1987, p. 37, cited in Jonassen, 1992). The user is able to create his/her own nodes and links amongst them. He/she can explore the topic to be structured, structure and restructure it and link the sub-structures together, etc.

Applications which provide the user with the possibility to create or construct objects by using graphic programmes or linking nodes together, are not only objects but also cognitive concepts or models which are dependent on the learners’ current knowledge base. An example is the programme KNOT-Mac (Knowledge Network Organizing Tool for Macintosh).

Ad. 4) Measurement and control. Multimedia can be used for demonstrating complicated processes such as the human circulatory system or the weather system (cloud development). Furthermore, the learner can use the software to take many more accurate measurements and explore creatively a phenomenon and consider additional factors than would, otherwise, have been possible. With the help of the IT-interactive feature, the learner is able to control the pace and the content of what will be seen on the screen. The learner can understand complex interrelationships. He/she can control the learning process.

Creative and Critical Thinking by Using Multimedia Productivity Tools
Critical thinking is a very useful skill in order to understand deeply the content to be learned. Critical thinking is essential to higher order thinking procedures (an overview in Jonassen, 1996). Jonassen (1996) presents an integrative model of complex thinking in which critical thinking plays an important part and is related to other thinking skills – content/basic thinking and creative thinking. These three thinking skills are highly interactive with each other.

Content/basic thinking deals with the skills, attitudes and dispositions required to learn and to recall accepted information such as academic content, general knowledge, etc.

Critical thinking means the dynamic reorganisation of knowledge into meaningful and usable ways, and it contains three general skills such as evaluating, analysing and connecting the information found.

Creative thinking demands going beyond accepted knowledge to generate new knowledge which is highly connected to critical thinking. However, in creative thinking personal and subjective skills for the creation of new
knowledge is used but not the analysing skills used in critical thinking. The main aspects of creative skills are synthesising, imagining and elaborating. Of course, the results of this thinking will be evaluated by critical thinking.

To succeed in the use of Scenario 4 applications, complex thinking skills are needed (see Module 4 for detailed information on the use of Scenario 4).

**DIDACTICS**

The goal of this session is the introduction of the potential of multimedia in education as learning strategies in the form of an intellectual tool and as a productive tool.

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<tr>
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<td>Learning theories: multimedia as a cultural tool and being productive</td>
<td>See Module 1, material and references Teaching the strategies</td>
</tr>
<tr>
<td>Communicating ideas and information representation</td>
<td>Apply different tools of Scenario 4 / course participants can choose one game Course participants work on it in a metacognitive way</td>
</tr>
<tr>
<td>Handling information</td>
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<tr>
<td>Modelling</td>
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<tr>
<td>Measurement and control</td>
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</tr>
<tr>
<td>Reflection: content/own learning processes/didactics for use in schools – how to teach strategies</td>
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Active Learning and Interactivity in Multimedia: High vs. Low Learner’s Control

Active learning is one of the most crucial demands of current learning theories. Active learning means to be engaged actively in the learning processes as an active agent and not by being a passive learner listening to the teachers or to the teaching tool — the multimedia application. Teaching and learning in schools are changing to this direction: the learners are gaining more and more control over their own learning processes and activities (Merill, 1980).

Multimedia in classroom situations provide learners and course trainers with a learning environment within which the learners are allowed to learn actively. Many studies have suggested that high learner’s control of the learning process in multimedia applications is associated with increased learning. This allows the student to study course material at a speed that suits his/her needs which helps to increase their knowledge retention. According to Gagné (1985), the learner’s control of the pace of instruction provides the learner with the opportunity to encode information. Furthermore, as learners control the content and the order in which the content is presented, motivation and learning are increasing; this, according to Keller (1983), is because the learning becomes more relevant to the learner. Moreover, the learner can choose the portion of the content’s material allowing the learners to freely select material at will. Laurillard (1984) found that learner’s control of instruction within multimedia applications allows them to follow a logical route through the instructional material that is meaningful to the student. The alternative — an instructor’s logical route — is less meaningful to them and, therefore, less motivational.

Multimedia as a productive tool (Scenario 4) could provide the learner with the possibility of high learning control instruction or interactivity during the learning process. Biggs’ (1979) research data suggests that intrinsically oriented learners need to feel a sense of control over the learning process — they prefer to control their own learning contingencies. He found that these learners perform better when empowered to control the learning process.

Entwistle, Hanley and Hounsell (1979) investigated the relationship between the learners’ motivation orientation and learning strategies. They found that extrinsically oriented learners tend to use “game playing strategies” where the goal is to reach a high grade. Intrinsically motivated learners used more global strategies where the goal is to try to understand the problem; they wanted to obtain a meaning of the problem. According to
Pintrich and Schrauben (1992) found that more intrinsically oriented learners are more cognitively engaged in learning and use metacognitive learning strategies. They concluded that the learner's goal orientation (intrinsic/extrinsic) might influence the self-direction of thought and behaviour and, thereby, their academic performance.

**DIDACTICS**

Introduce the course participants to the concept of active learning. Encourage discussions in the whole group about the advantages and disadvantages of active learning (see also advantages and disadvantages of multimedia in education, Module 1).

Ask about the participants' experiences and attitudes concerning active learning in interactive learning environments.
Learning Strategies and Metacognition

Besides being highly motivated and having an extended knowledge base, learning requires a big pool of learning strategies and metacognitions and the ability to use them.

Course trainers/tutors as operators/facilitators of the learning processes can provide learners with a pool of possible learning strategies and metacognition as a resource for active learning. Furthermore, learning strategies and metacognitions are only models of structures which must be adapted to the individual situation of the learner. Therefore, the learner constructs his/her own learning strategies and metacognition.

Cognitive Learning Strategies

Learning strategies are complex cognitive operations which are hierarchically placed over task-oriented procedures and they can be understood as sequences of activities for achieving learning goals (Baumert and Köller, 1996). One differentiates between several learning strategies.

a) Implementation strategies. There are several different levels of implementation strategies. Repeating information by rehearsal which is a surface learning strategy. A further strategy organisation which means the grouping of items depending on certain characteristics, is a deep learning strategy. Also elaboration which is the construction of a meaningful context either verbal or visual, can be seen as a deep learning strategy.

Simple rehearsal is usually less effective than other strategies, as it requires processing the material more actively by organising related ideas or elaborating new ideas by making connections to previous knowledge or, in other words, by reconstructing the existing knowledge base.

Children begin to use these types of strategies at a very early stage of development. Rehearsal strategies develop during the early elementary school. Organisation and elaboration strategies appear later in elementary school and secondary school. But elaboration strategies — making meaningful associations — require an extensive knowledge base which increases as the child gets older (Chan, Burtis, Scardamaglia and Bereiter, 1992).

b) Summarising strategies are effective strategies (Kintsch and van Dijk, 1978). Brown and Day (1983) and Taylor and Beach (1984) taught children to extract the main ideas and summarise text, and the consequence of this was improved comprehension and memory retention of text.
c) Self-questioning. Asking questions about the text or material to be learned can greatly improve learners' performance (What is the main idea? What is important to know? What do I want to know?). Learners who had lessons in generating and responding to inferential questions which required explanatory answers, understood and remembered the material to be learned better than learners without any training (King, 1989, 1990, 1994). Constructing questions for self-testing itself also improves the learning of the material (Dole, Duffy, Roehler and Pearson, 1991). According to Andre and Anderson (1978-1979), although poor learners may benefit even more than bright learners from self-questioning, they all need training to use it effectively. Armbruster, Anderson and Ostertag (1987) taught learners to ask for the problem-solution structure of a text. The learners learned to summarise the problem and to solve it.

d) Mental imagery. Mental imagery is an active construction of a concrete image.

e) Representational image. Rosenblatt (1978) indicates that an effective way to be a good reader is to construct images of the meanings conveyed by the text. Instructions for generating representational images facilitate learning of textual material in middle and elementary school years (Gambrell and Rales, 1986; Pressley, Symons, McDaniel, Snyder and Turnure, 1988). Many studies show that representational images support a deep understanding of what we read (Sadoski, 1983, 1985; Sadoski and Quast, 1990). Transformational imagery: well known in this field are studies about the keyword method which is effective in the school learning context when pupils have to construct connections between different types of information (Levin, 1982, 1986). This kind of memorising leads to an increase in content learning where a symbolic or a mimetic reconstruction of the content is obvious (Mastropieri and Scruggs, 1989).

f) Note-taking. Note-taking encourages learners to transform the material to be learned in a memorising way: learners select information relevant to the studies in a summarised form and construct a new form for their own knowledge base. Furthermore, good note-taking also includes organising and elaborating on the material. Generally, when note-takers are more active, they perform better and learn far more and in a deep learning way (Bretzing and Kulhavy, 1981). The format of note-taking influences the quality of later performance. Kiewra (1991) investigated three different forms of note-taking formats: conventional, outline and matrix. Conventional formats are often brief, disorganised and with verbatim accounts of the material to be learned. The outline format is appropriately organised in the topics of the material. The matrix format is organised in a two dimensional format where the main topics are listed across the top of the page and the subtopics along the left margin. The learners list the notes in the intersecting cells. The outline and matrix formats lead to a
much deeper understanding of the context than with notes taken in a conventional format. Other possibilities to take notes are mind-mapping, diagrammatic notes or other graphical models. If note-taking is meant to be effective, then learners should do it in an organised and elaborated form. However, the learners have to find their own way of structuring the content to be learned.

An important strategy when using multimedia in the Scenario 2 is knowledge management. It contains the following steps:
- Identifying exactly what information is needed;
- Selecting and evaluating the information found;
- Embedding the information into a context;
- Giving relevance to the information;
- Constructing knowledge from information and developing new knowledge;
- Linking knowledge and creating knowledge nets;
- Transmitting, transferring and distributing knowledge;
- Exchanging and adding knowledge;
- Applying and transposing knowledge;
- Evaluating knowledge-based actions;
- Developing new knowledge from the evaluated actions.

Additionally, teachers should support cooperative learning for the constructive knowledge exchange among the course participants (see the section concerning collaborative learning).

**Applying Strategies**
When learning with educational multimedia, pupils apply different learning strategies, but in many cases these strategies are not very effective and well worked out (van den Brink et al., 2000). The performance of the course participants in classes where the teachers strongly support them with knowledge about adequate strategies, is related to their satisfaction with the lessons and, according to the pupils and teachers, results in a better performance. This might lead to the assumption that training in information management strategies/learning strategies, respectively, in self-regulated learning improve learners’ performance when working autonomously and self-responsively. The learners would feel far more self-confident and would try learning strategies and experiment with this new knowledge enabling them to adapt these strategies to their own needs.

But, observations have shown that the different types of educational multimedia demand strategies according to the products: an encyclopaedia demands mainly searching strategies, whereas a learning programme demands more comprehension and elaboration.

The more meaningful are the associations that the programme offers, the more pupils use the elaboration strategies. Also, the level of interactivity...
had an influence on the implementation strategies: the more interactivity in an active way was possible (i.e., scenario 4: KidPix), the deeper the learning strategies (organisation, elaboration) were applied. Pure drill and practice applications (Scenario 3) do not invite per se pupils' pool of learning strategies. Here, the strategies are quite limited. The strategies most used are practising and memorisation. The more possibilities the programme offers (high interactivity, meaningful associations, different perspectives on one problem, different access to one problem, collaborative problem solving approach, Scenario 4 tools, etc.) and the more open the teacher's approach is, the more it leads to discussion, exchange and joint decision-making among the members of the small group that share the computer.

**Metacognition**

Effective learners monitor and control their own learning process during the process of knowledge construction. It means they plan, comment and evaluate their own learning process from a metalevel. The term “metacognition” refers to the knowledge and the experiences about their own cognitive processes and their conditions and prerequisites—to know and to understand why, when and where to apply learning strategies in an effective and useful way. Learners only establish deep learning, if they are able to understand why they use certain strategies (Pressley, Borkowski and O'Sullivan, 1984, 1985). Metacognitions are important for knowledge transfer and maintenance (Borkowski, 1985). According to Borkowski (1985), problems such as maintenance and transfer failures are caused by a lack of or deficiencies in metacognitions. Pupils who are informed about the utility of several strategies, are much more likely to maintain the strategy than pupils who are not provided with this information (Borkowski, 1985). Several studies have shown that pupils who are taught in metacognitions use learning strategies far more effectively than pupils who did not get the training (O’Sullivan and Pressley, 1984). Good results promise more studies in the field of self-directed learning.

Investigations on classes of compulsory school pupils in six different countries (van den Brink et al., 2000) found the following results:

a) **Reflections on one's own activities.** When using Scenario 2 (encyclopaedia/Internet), most pupils discussed the way through the Internet or the applications they had chosen again and again, often they tried out other ways, search terms, they also went in other directions.

b) **Comprehension, monitoring and checking.** In the use of Scenario 2 (e.g., The History of Portugal), signs of comprehension, monitoring and checking were found. The pupils tried to match new content with information they had already consulted and, in case of doubt, they turned back and rechecked it. Other pupils working with Scenario 3 (combination of Drill and Practice and adventure...
game, *German Grammar and Spelling* programme) recognised by themselves that they have had problems with spelling and setting comma. Then, they practiced more tasks, even if it was not required for getting the points for the spaceship. Pupils working with a Scenario 3 (*Le français facile, Drill and Practice*) recognised by themselves that they had problems with the pronunciation. So, they repeated to listen to the words again and again and asked for help from other pupils and the teacher who should also repeat the words to them.

c) **Feedback checking.** Most pupils using Scenario 3 checked the feedback function. In this application, using the feedback function is a voluntary decision. They did it because – as they said in the interviews – they wanted to know which words they wrote incorrectly. Some kids wrote down their mistakes with a pencil and wanted to practise these words at home.

**DIDACTICS**

Teachers/trainers can provide the course participants with appropriate strategies and request from course participants an individual shape of these strategies. Furthermore, the course participants can be invited to make conscious connections between the current task and their previous knowledge. The use of multimedia in Scenario 4 supports the organisation of objects in different ways or the elaboration of ideas in a way that helps them to visualise their ideas by drawing with a painting programme.

The course trainer can also encourage course participants to use word processors for summarising the activities (Scenario 4).

Moreover, the course trainer can encourage course participants to practice self-questioning. Use/produce educational multimedia which provides sections in which the application asks questions or encourages course participants to ask questions by themselves with/without the help of ICT (Scenario 3 and 4).

Provide the course participants with a huge pool of different strategies for modifying them into their own strategies, facilitate and support the use of these strategies. Use educational multimedia programmes which provide sections in which the learner can construct his/her own ideas of the content to be
learned or applications which invite learners to construct their own mind maps, diagrammatic notes, etc. (Scenario 2, 3 and 4, cognitive tools).

Teach the didactics in a metacognitive way; this means that the didactics should be reflected upon.

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<td>Implementation strategies</td>
<td>Scenario 1, 2, 3 and 4: support strategies</td>
</tr>
<tr>
<td>Information management strategies</td>
<td>Scenario 1, 2: support strategies</td>
</tr>
<tr>
<td>Self-questioning</td>
<td>Scenario 3, 4: support strategies</td>
</tr>
<tr>
<td>Note taking</td>
<td>Scenario 4 support strategies</td>
</tr>
<tr>
<td>Mental imaging</td>
<td>Scenario 4 support strategies</td>
</tr>
<tr>
<td>Metacognition: reflection on one's own activities</td>
<td>Scenario 4 support strategies and portfolio assessment</td>
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<td>Comprehension, monitoring, checking</td>
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Self-Directed Learning with Multimedia

Self-directed learning can be seen as a pool of metacognitive strategies in addition to learners' aspects. Having the ability to learn in a self-directed way enables the learner to confront deep learning material. Self-directed learning is a process in which the learner is a self-starter:

- Finding out about his/her own needs concerning learning;
- Establishing what to learn (learning goals);
- Identifying the necessary human and other resources;
- Choosing and applying learning strategies;
- Evaluating the results.

Self-directed learning is a competency which has to be learned and practised over a longer period of time. Studies have shown that the competency of self-directed learning is not well developed in most people. This method can be acquired with the help of direct training (Friedrich and Mandl, 1996) where the learner adapts his/her own way of self-directed learning and by influencing the design of the learning environment, in this case the educational multimedia application. A synthesis of both can be an effective solution (Friedrich and Mandl, 1996).

Successful users of self-directed learning are characterised by the following aspects (Pressley, Borkowski and Schneider, 1987).

They coordinate the use of task-specific and goal-oriented strategies — strategies with which they monitor the learning progress and plan the learning activities.

They have a structured knowledge about where, when and how to use these strategies adequately (metacognitive knowledge).

Additionally, they are convinced that successful learning demands effort, concentration and engagement (positive self-efficacy and high intrinsic motivation).

Furthermore, they have a bright domain-specific knowledge and a good general education (previous knowledge).

One important characteristic of self-directed learning is independent and active learning. The specific characteristics of multimedia such as interactivity, giving feedback, simulations of complex contexts, etc. have optimally supported for this type of learning. However, self-directed learning is most productive when the user already has a previous knowledge base (Hofer and Niegemann, 1990).
DIDACTICS

Provide the course participants with learning strategies and metacognition and invite them to construct their own self-regulation strategies. In some cases, the course participants can be invited to sketch a personal plan for self-directed learning.

Furthermore, facilitate the course participants' learning process by supporting their work and providing them with direct help within the concrete case. In some cases, one can use multimedia applications which provide selected feedback and help to the learner.

Moreover, provide the course participants with questionnaires for identifying their learning.

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</tr>
<tr>
<td></td>
<td>Teaching strategies</td>
</tr>
<tr>
<td>Finding out about his/her own needs concerning learning</td>
<td>Apply a questionnaire for identifying student's learning (Biggs, and Collis, 1982 – Evaluating the quality of learning: the SOLO Taxonomy)</td>
</tr>
<tr>
<td>Establishing what to learn (learning goals)</td>
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<td>Identifying the necessary human and other resources</td>
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<tr>
<td>Choosing and applying learning strategies</td>
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<tr>
<td>Evaluating the results</td>
<td>Give homework/support portfolio assessment/group discussion/ hints to references according to the topic</td>
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<td>Reflection: content/own learning processes/didactics for use in schools – how to teach strategies</td>
<td>Explain your didactics</td>
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</table>
Whitebread (1997) recommends the use of computer-based problems. In particular, he recommends the use of problem sets in the context of so-called “adventure games”. Multimedia adventure games can be seen as a set of information where the possible pathways have been predetermined and the questions, which can be asked, have been predetermined. The games vary in the number of possible pathways, in the level of difficulty and sophistication and in the complexities of the answers to the predetermined questions or problems.

The following aspects support the use of adventure games for problem-solving approaches:

a) **Help and Support.** Due to the interactive nature of this type of games the pupils get feedback, help and support by the computer. It is likely that children in this learning environment still need a teacher for some guidance.

b) **Coping with a variety of responses.** Well-designed games provide a broad variety of possible responses. The range of responses is one of the key elements in determining the level of cognitive demand within these games. Problems can be solved in many different ways. One advantage is that pupils are confronted with different response possibilities which means responding with different perspectives. From a more negative point of view, this prescribed feature of giving possible solutions can limit pupils’ creativity.

c) **Time effectiveness.** Most games are well designed and offer the possibility to save the data at any point and return to this point at a later time.

d) **Trial and error learning.** Computer games offer opportunities for boundless experimentation in the field of problem-solving. The pupils can experiment with the different possibilities in a very short period of time. In reality, it is difficult to provide this type of trial and error learning in an appropriate period of time, and very often it is not possible to try out these possibilities in the fields of science.

e) **Interest and commitment.** Children really like this type of games because the games place everything in the meaningful context of a compelling fictional world that seems to be real and living.

Problem-solving is a complex intellectual process involving the coordination of a range of demanding and interrelated skills which include:

1. Understanding and representing the problem and identifying what type of information is relevant for the solution;
2. Gathering and organising relevant information;
3. Constructing and managing a plan of action or a strategy;
4. Reasoning, hypothesis-testing and decision-making;
5. Using various problem-solving tools, monitoring solutions, and evaluating results.

These points will be worked out in detail because of its crucial relevance for learning:

Ad. 1) Understanding and representing the problem. Adventure games can support understanding and representation. The way in which a problem is understood and mentally represented, has a huge impact on the likelihood of its solution. A further major effect is the prior knowledge of the learner. The teacher can ask the pupils to use their prior knowledge and transfer it to a new context. The contexts of the games are often embedded into meaningful contexts, and this helps pupils to see what is important and what is irrelevant. Furthermore, adventure games provide the possibility of transferring knowledge by serving problems which seem to be very different because of their context but they have the same underlying structure. Many adventure games have a very similar structure and integrate common problem-solving skills which are presented visually and imaginatively in different environments. Whitebread (1997) suggests that pupils should use different adventure games for learning the skill of transferring. They learn to look for analogous problems or relevant things they already know. Furthermore, they learn to analyse the problems by considering the underlying structure rather than the superficial features.

Ad. 2) Gathering and organising information. What information is relevant for solving a problem? Children should learn the skill of gathering and organising information. Many games provide the learners with information on different levels. The simplest way is an explicit way of information presentation and, respectively, the learners are told to remember the information. In a further stage, the information has to be gathered in a more complex way. The pupils are searching for information in different locations, and the information needs to be remembered and used to correctly construct organised sequences of actions which are needed for solving a special problem.

Some games provide the learner with a total freedom in the order in which the information is gathered. Furthermore, within some games the user has to employ different search strategies to find relevant information.

Ad. 3) Planning and strategies. Adventure games can support the ability to plan ahead forming mental representations or models and making them explicit. The structure of most of the games is a plan: discovering a successful chain of actions through an environment which provides the necessary information in the correct order. Furthermore, many games de-
mand the development of strategies — for example, in the programme “lemmings” where a set of lemmings has to be guided safely from one door to another in a limited period of time. The user can transform the lemmings into different groups of lemmings, whereby each group can perform different tasks. The user has to decide how much lemmings he/she needs from each group to bring them safely to the other door. This procedure demands making a plan. By putting the ideas into actions the consequences become obvious immediately; if the user has forgotten to make a bridge over a gap, all the lemmings will fall into the gap. Therefore, the user has to work out a plan to deal with all the problems that have arisen. When the user has developed a safe route, he/she can decide for a higher level of difficulty.

These aspects of the adventure games enable pupils to develop metacognitive strategies which they have to adapt and coordinate together for developing a plan of action which they have to use appropriately in different contexts. So, adventure games can be powerful tools for learning planning and developing strategies.

Ad. 4) Reasoning, hypothesis testing and decision-making. According to Whitebread (1997), adventure games provide a broad spectrum of possibilities for developing these skills. The simplest level is to decide in which direction the user will go for his/her next move. Higher levels serve the opportunities of making predictions about what will happen after making a particular move, this is making a hypothesis and testing it. Exploring a less prestructured environment leads to making inferences and examining the cause and effect.

Whitebread pointed out that adventure games stimulate a playful approach to learning, place problems into meaningful contexts and inspire collaborative work and discussion. Play is one of the most powerful and effective learning mediums for pupils. According to Bruner (1976), the play is elemental to human learning. Play gives the opportunity to try out different possibilities, to combine elements of a problem or a situation in new and flexible ways, to see what would happen if... All these aspects take place in an adventure game in complete safety, which means that they do not try out these activities in reality. According to Whitebread (1997), research has shown that giving open-ended, exploratory and playful tasks enhances problem-solving ability rather than with closed tasks where one correct answer is needed.

According to Moyles, 1989 (cited in Whitebread, 1997), two different kinds of play are differentiated: unstructured and structured. Children play in an unstructured way when they simply play in any way they like to with the material available. However, playing in a structured way means being posed problems and being exposed to new possibilities, etc. A structured play enhances intellectual development, and an unstructured play enhances emotional and social development. Adventure games can be good examples of structured plays and, therefore, they enhance intellectual development.
Adventure games provide the children with fictional contexts which contain real human motivations and purposes. The child alone is able to “help” the king and the queen, to save their child or to find all relevant items to ensure the survival of the dragon. From this pupils understand the nature and meaning of problems. This enables them to increase their reasoning powers and, thus, learn from their own experience very effectively. Furthermore, meaningful contexts help to motivate the learner. Fairy tales excite pupils in the age group around 10 years old with witches, dragons and elves. According to investigations carried out by Whitebread (1997), the problem-solving elements in these types of adventure games really enthral pupils.

Ad 5) Problem solving. According to Vygotsky and Bruner, two key aspects play an important role in pupils’ understanding and solving of problems. First, problems are better understood by articulating them in social situations and, secondly, language is used in the social context for scaffolding, supporting and guiding problem-solving processes and procedures.

Children’s interactions while learning around the computer are dependent on the quality of the multimedia software used. According to Crook (1987, cited in Whitebread, 1997, see also van den Brink et al., 2000), the richest discussions take place while playing (and learning) adventure games. With his investigations Whitebread identified many discussions amongst the pupils (around ten years old) while using adventure games which provide a powerful environment that helps the user to develop his/her own problem-solving skills. Furthermore, this enables them to persevere at the task and to solve the various demands together. They remind one another of important information, develop a broader selection of ideas and strategies, they check one another’s reasoning.

**DIDACTICS**

Implement an adventure game for the course participants. To limit the time, the course participants might play a part of the game, if possible. Give enough time for reflecting what is going on concerning:

- Aspects of the problem solving and give them information on why it is useful, for what use, etc.;
- Motivation;
- Collaborative learning.

Provide the course participants with information in the form of papers/articles or the translation of what is written above.
<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Proposals for didactical methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning theories: problem-solving with Scenario 3 - adventure game</td>
<td>See Module 1, material and references Teaching strategies</td>
</tr>
<tr>
<td>Understanding and representing the problem and identifying what type of information is relevant for the solution</td>
<td>Apply different adventure games/course participants can choose one game Course participants work on it in a meta-cognitive way</td>
</tr>
<tr>
<td>Gathering and organising relevant information</td>
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<tr>
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</table>
SESSION 6

Social Interaction

Current theories on learning and knowledge acquisition consider the social and cultural side of knowledge as much as the cognitive side. According to Vygotsky (1978), learning begins in the social world. With this approach its development has to consider the social and cultural environment in which the individual developmental and learning processes occur.

Furthermore, this view builds on the assumption that social institutions, the specific culture and its tools such as technology and language, influence learning. "Learning is not only inside the person, but in his/her ability to use a particular set of tools in productive ways and for particular purposes" (Säljö, 1999, p. 147). The computer is one of these culture tools.

Collaborative Interactions around Computers

According to the complexity between variables such as group size, group composition and the nature of the task, it is impossible to establish causal links between the conditions for and the effects of collaboration (Littleton, 1999). This has led to a more process-oriented investigation style which considers the talk and joint activity of learners working together on a task: "talk and social interaction are a social mode of thinking" (Littleton, 1999, p. 180). Other authors focus more on a classroom as a community while working with computers (Crook, 1999), or on the important role of conflict which can help to increase pupils' individual understanding of science (Howe and Tolmie, 1999).

Brown et al. (1989), state that learning occurs through cooperative action and that cognitive concepts are progressively developed through action. According to Bruner (1985), learners' potential for learning is revealed by studying with others.

Additionally, the development of interaction between learners is highly influenced by the type of multimedia software which is used in the interaction. When using "trial and error" software, i.e. the large number of choices available, the pupils tend to adopt a risk-taking behaviour. In an investigation by Littleton (1999) the pupils did not reflect on their current situation and on what their next activities would be. They only focused on carrying out the work as fast as possible and obtaining good marks.

Mercer and Wegerif (1999) who investigated collaborative working while using educational multimedia, promoted a set of ground rules for col-
laborative talk which was accepted by the children investigated after small changes (aged 10-11). The rules were taught through modelling and learned through practice. The rules contained mutual respect, careful consideration of everyone’s ideas and opinions, and they finally reached an agreement on a group idea after discussion. By practising these rules the children were learning how to learn together, and they created a collaborative community.

The computer can support different forms of collaborative interaction depending on what form of collaborative activity is wished. When working productively on a specific problem at the computer in a group, the focus should be on a clear task structure and the provision of feedback on solutions made within the group (Howe and Tolmie, 1999, van den Brink et al., 2000). In this manner, it is recommended to support a collaborative community with the use of the unique opportunities of multimedia for the production and representation of shared classroom experience such as a common CD-ROM produced by all members of the class.

“Computer technology will never replace communication between learners, rather it holds the potential to resource their collaborative endeavour in new and exciting ways” (Littleton, 1999, p. 193).

Educational multimedia support pupils involvement in conversations with partners with whom they can exchange and articulate general conceptual issues about the presented subject. “The interactive character of modern technology can support reasoning by amplifying the nature and boundaries of scientific models of objects and events. But the full realisation of the potentials of such experiences will still rely on pupils’ access to conversation partners who carry on discussions in which these models and concepts are validated. The creation of knowledge is essentially a matter of learning to argue, and no technology will ever replace the need for learners to participate in ongoing conversations with partners sharing interests and commitments. Technology should not be seen as replacing such communication but rather as providing a resource for supporting it” (Säljö, 1999).

In accordance to socio-cultural theories, learners need support from responsive and more competent others to think through the many problems for enabling progress to be made (see also the results in van den Brink et al., 2000). In this sense, cognitive development increases largely, because the child gets hints, prompts and assistance from others when he/she needs it and can also benefit from social interactions. Others, in this sense, mean the teacher and classmates.

The teachers can support the students’ interaction around computers in different ways (van den Brink et al., 2000). They can encourage and enable learners to practise critical thinking in the classroom by exploratory talk (discourse talk). The teacher can act as a model — a discourse guide — “a crucial
mentor for pupils’ initiation into culturally based discourse practices” (Littleton, 1999, p. 191). According to Watson (1997), for teachers it is very difficult to build up a culture of collaboration in the classroom. This demands a working partnership between teachers and learners. Furthermore it requests from teachers a deep trust in the creative abilities of children and young people. According to Underwood and Underwood (1999), to feel safe in taking risks by opening up the thinking of the peer group in interactions around computers depends on a sense of trust and ease within the classroom situation.

**DIDACTICS**

Introduce the content to the course participants by following the methods used in Module 1. Connect course participants’ knowledge; build on their previous knowledge from Module 1 and 2. Give time for reflection, i.e. how we can assess these collaborative forms of learning, etc. Ask questions similar to: Why is it not possible — according to these theories — to transmit knowledge from one person to another? What does this mean for being a teacher? Use collaborative forms of learning around the computer. Reflect on different opportunities on the room and group organisation of the collaboration of working with multimedia. Provide course participants with quite easy tasks — let them search in small groups (2/3/4 course participants) for information on the Internet — according to the topic ‘Collaborative Learning in School’, and the task can be the content and search strategies. Reflection.

<table>
<thead>
<tr>
<th>Content to be learned</th>
<th>Proposed didactical method</th>
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<tbody>
<tr>
<td>Learning theories: constructive perspective on learning/ important aspects on learning/ social influence on learning/ computer as a cultural tool</td>
<td>Use methods from Module 1</td>
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<tr>
<td></td>
<td>Distribute material/references according to the topic</td>
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<td></td>
<td>Ask questions, collect ideas, refer to the last sessions and Module 1 and 2</td>
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<tr>
<td></td>
<td>Course participants develop ideas/models in groups</td>
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<td></td>
<td>Use link collection</td>
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</tbody>
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46
### Content to be learned

<table>
<thead>
<tr>
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<th>Proposed didactical method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative learning with computers/multimedia</td>
<td>Collaborative task with multimedia: search in the Internet or in an encyclopaedia in groups according to a topic – plan/monitor and evaluate your strategies</td>
</tr>
<tr>
<td>Reflection: content/own learning processes/didactics for use in schools</td>
<td>Material and references</td>
</tr>
<tr>
<td>Reflection: content/own learning processes/didactics for use in schools</td>
<td>Homework/portfolio assessment/group discussion</td>
</tr>
</tbody>
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