Multimedia in Education

SPECIALISED TRAINING COURSE

GENERAL INFORMATION

UNESCO INSTITUTE FOR INFORMATION TECHNOLOGIES IN EDUCATION

TABLE OF CONTENTS

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 of 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.

3 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.

4 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 participators 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 theses 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 participators 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-learing 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 particiapators 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-

plication 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 participators' 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 mulitimedia 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 participators' 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 participators 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 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, 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 (Andresen, 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.

11 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

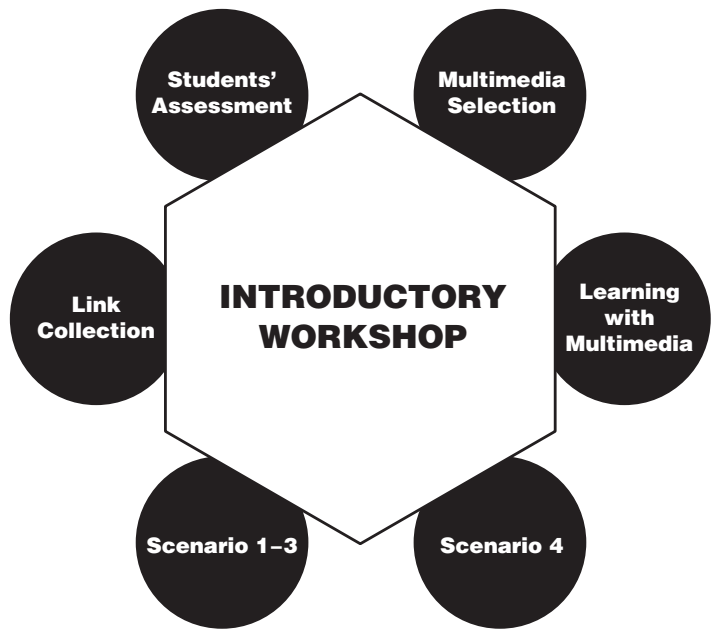

Figure 1. Organisation of the Specialised Training Course 'Multimedia in Education'

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.

12 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 continous 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 mentionend 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 *inspirer* 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.

13 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.

REFERENCES

Abbott, C. (2001). *ICT: Changing Education*. London: RoutledgeFalmer.

Alessi, S. M. and Trollip, S. R. (2001). *Multimedia for Learning: Methods and Development* (ed.). Boston: Allyn and Bacon.

Ames, C. (1984). *Competitive, Co-operative and Individualistic Goal Structure: A Motivational Analysis. In R. Ames and C. Ames (eds.), Research on motivation in education* (Vol. 5, pp.117-207). New York: Academic Press.

Ames, C. and Archer, J. (1988). *Achievement Goals in the Classroom: Students` Learning Strategies and Motivation Process. Journal of Educational Psychology*, 80, 260-270.

Andre, T. and Anderson, T. (1978-1979). *The Development and Evaluation of a Self- questioning Study Technique. Reading Research Quarterly*, 14, 605-623.

Anderson, R. C., Shirey, L. L., Wilson, P. T., and Fielding, L. G. (1987). *Interestingness of Children's Reading Material. In R. E.* Snow and M. J. Farr (eds.). *Aptitude, learning and instruction: Vol. 3, Cognitive and Affective Process Analyses* (pp.287-299). Hillsdale, NJ: Erlbaum.

Armbruster, B. B., Anderson, T.H. and Ostertag, J. (1989). *Teaching Text Structure to Improve Reading and Writing. The Reading Teacher*, 43, 130-137.

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, Roayal Danish School of Educational Studies Research Centre for Education and ICT.

Barton, J. and Collins, A. (eds.) (1997). *Portfolio assessment: A Handbook for Educators.* Menlo Park, CA: Addison-Wesley Publishing Co.

Baumert, J. and Köller, O. (1996). *Lernstrategien und Schulische Leistungen*. In J. Möller and O. Köller (Hrsg.), Emotionen, Kognitionen und Schul-Leistung. Weinheim: Psychologie Verlags Union.

Bandura, A. (1977). *Self-efficacy: Toward an Unifying Theory of Behavioural Change. Psychological Review*: 84, 191-215.

Bandura, A. and Schunk, D. H. (1981). *Cultivating Competence, Self-efficacy, and Intrinsic Interest Through Proximal Self- instruction. Journal of Personality and Social Psychology*, 41. 586-598.

Beemann, W. O. (1987). *Computers and Human Consciousness.* In: Schauer H./Schmutzer, M.E.A. (Hrsg.): *Computer und Kultur.* Wien, München: Oldenbourg, S. 9 - 20.

Biggs, J. B. (1987). *Student Approaches to Learning and Studying.* Hawthorn, Vic: Australian Council for Educational Research.

Biggs, J.B. (1996). *Enhancing Teaching through Constructive Alignment. Higher Education* 32, 347-364.

Biggs, J.B. and Collis, K.F. (1982). *Evaluating the Quality of Learning: the SOLO Taxonomy.* New York: Academic Press.

Biggs, J. B. and Moore, P. J. (1993). *The Process of Learning.* Third edition. New York, London, Toronto, Sydney, Tokyo, and Singapore: Prentice Hall.

Bolon, C. (2000). *School-based Standard Testing. Education Policy Analysis Archives. Volume 8 Number 23.* http://epaa.asu.edu/ epaa/v8n23/

Borkowski, J. G. (1985). *Signs of Intelligence: Strategy, Generalization, and Metacognition.* In S. R. Yussen (ed.) *The Growth of Reflection in Children.* (pp. 105-144). Orlando, Fl: Academic Press. Psychology, 73, 242-250.

Bransford, J. D., Brown, A. L., and Cocking, R. R. (1999). *How People Learn: Brain, Mind, Experience, and School.* Washington, DC, USA: National Academy Press.

Bretzing, B. H. and Kulhavy, R. W. (1981). *Notetaking and Passage Style. Journal of Educational Psychology*, 73, 242-259.

Van den Brink, K., Gómez Alemany, I., Prat Pla, A., Duarte, A., Ericsson, L. and Slack, R. (2000). *Empirical Investigations on Children's Learning with Educational Multimedia.* Official Deliverable of the PEDACTICE Project supported by the EC. www.pedactice.dk

Van den Brink, K. and Slack, R. (2000). *Evaluation of Teaching Using Educational Multimedia and Teachers' Assessment and Validation Criteria.* Official Deliverable of the PEDACTICE Project supported by the EC. www.pedactice.dk

Brown, J.S., Collins, A., and Duguid, P. (1989). *Situated Cognition and the Culture of Learning. Educational Researcher* 18(1): 32-34.

Brown, A. L. and Day, J. D.(1983). *Macrorules for Summarizing Texts: The Development of Expertise. Journal of Verbal Learning and Verbal behaviour*, 22.1-14.

Bruner, J. (1976). *The Process of Education*. Cambridge: Harvard University Press.

Bruner, J. (1985). *Vygotsky: A Historical and Conceptual Perspective*. In J.V. Wertsch (ed.) *Culture, Communication and Cognition: Vygotscian Perspectives*. Cambridge: Cambridge University Press.

Butler, R. and Neumann, O.(1995). *Effects of Task and Ego Achievement Goals on Help-seeking Behaviours and Attitudes. Journal of Educational Psychology*,87 (2),261-271.

Ceci, S. J. and Liker, J. K. (1986). *A Day at the Races: a Study of IQ, Expertise, and Cognitive Complexity. Journal of Experimental Psychology: General*. 115, 255-266.

Chan, C. K., K., Burtis, P. J., Scardamalia, M., and Bereiter, C. (1992). *Constructive Activity in Learning from Text. American Educational Research Journal*, 29,97-118.

Cole, D. J., Ryan, C. W., and Kick, F. (1995). *Portfolios across the Curriculum and Beyond*. Thousand Oaks, CA: Corwin Press.

Collins, A. (1992). *Portfolios for Science Education: Issues in Purpose, Structure and Authenticity. Science Education*. 76 (4), 451-463.

Crook, C. (1999) *Computers in the Community of Classrooms*. In: *Learning with Computers*. Littleton, K. and Light, P. (eds). Routledge, London and New York.

Davis, N., Desforges, Ch., Jessel, J., Somekh, B., Taylor, Ch., and Vaughan, G. (1997). *Can Quality in Learning Be Enhanced through the Use of IT?* In: Somekh, B. and Davis, N. (eds.) *Using Information Technology Effectively in Teaching and Learning. Studies in Pre-Service and In-Service Teacher Education*. (pp. 14-27). Routledge, London and New York.

Dole, J.A., Duffy, G.G., Roehler, L.R., and Pearson, P. D. (1991). *Moving from the Old to the New: Research on Reading Comprehension Instruction. Review of Educational Research*, 61, 239-264.

Duarte, A M. (2000). Psycho-educational evaluation & design of multimedia – some guidelines based on the "approaches to learning" perspective. *Tecnologias em Educação – Estudos e Investigações. Comunicação em actas do "X Colóquio AFIRSE Portugaise"* (pp. 770-782). Lisboa: AFIRSE.

Dweck, C. S. and Legget, E. L. (1988). *A Social-Cognitive Approach to Motivation and Personality. Psychological Review*. 95, 256-273.

Entwistle N., Hanley, M., and Hounsell, L. (1979). *Personality, Cognition Style and Student Learning.* In: R.e. Redding (Ed.) *Individual Differences and Training Program Development. Proceedings of the Human Factors Society 34th Annual Meeting*: Vol. 2. (pp.1391-1395). S. Monica. Human Factors Society Inc.,1990.

Entwistle, N. and Ramsden, P. (1983). *Understanding Student Learning.* London: Croom Helm.

Friedrich, H. F. and Mandl, H. (1996). *Analyse und Förderung Selbstgesteuerten Lernens.* In: Weinert, F. (Hg.) *Enzyklopädie der Psychologie*, Bd. III, *Psychologie des Lernens und der Instruktion.* Göttingen: Hogrefe.

Gagné, R. M: (1985). *The Conditions of Learning.* (4th Edition). New York: Holt.

Gambell, L. B., Bales, R. J. (1986). *Mental Imagery and the Comprehension- Monitoring Performance of Fourth- and Fifth-Grade Poor Readers. Reading Research Quarterly*, 21, 454-464.

Gunn, C. (1995). *Usability and Beyond: Evaluating Educational Effectiveness of Computer-Based Learning.* In G. Gibbs (Ed.). *Improving Student Learning through Assessment and Evaluation*. Oxford: The Oxford Centre for Staff Development.

Hambleton, I. R., Foster, W. H., and Richardson, J. T. (1998). *Improving Student Learning Using the Personalized System of Instruction*. *Higher Education*, 35, 187-203

Hasebrook, J. P. (1997). *Wem nützt Multimedia und warum? - Lebenslanges Lernen mit Multimedia*. In R. Pfammerer (Hrsg.) *Multi-Media-Mania. Reflexionen zu Aspekten neuer Medien*. (101-124). Konstanz: UVK Medien.

Heller, R. S. (1990). *The Role of Hypermedia in Education: A Look at the Research Issues. Journal of Research on Computing in Education*, 4 (22), 431-441.

Hidi, S. (1990). *Interest and its Contribution as a Mental Resource for Learning. Review of Educational Research*, 60, 549-571.

Hofer, M. and Niegemann, H. M. (1990). *Selbstgesteuertes Lernen mit interaktiven Medien in der betrieblichen Weiterbildung. Medienpsychologie*, 4, S. 258-274.

Howe, C. and Tolmie, A. (1999). *Productive Interaction in the Context of Computer-Supported Collaborative Learning in Science*. In: *Learning with Computers*. Littleton, K. and Light, P. (eds). (pp. 24-45). Routledge, London and New York.

Jonassen, D. and Grabinger, S. (1993). *Applications of Hypertext: Technologies for Higher Education. Journal of Computing in Higher Education*, 4(2), 12-42.

Jonassen, D. H. (1992). *Hypertext/Hypermedia. Educational Technology Publications.* Englewood Cliffs, New Jersey.

Jonassen, D. H. (1996). *Computer in the Classroom. Mindtools for Critical Thinking.* Englewood Cliffs: Prentice Hall.

Keller, J.M. (1983). *Motivational Design of Instruction*. In: Reigeluth, C.M. (Ed.) *Instructional Design Theories and Models. An Overview of their Current Status.* Hillsdale: Erlbaum.

Kiewra, K. A. (1989). *A Review of Notetaking: The Encoding Storage Paradigm and Beyond. Educational Psychology Review, 1, 147-172.*

King, A. (1989). *Effects of Self-questioning Training on College Students` Comprehension of Lectures. Contemporary Educational Psychology.14, 366-381.*

King, A. (1990). *Enhancing Peer Interaction and Learning in the Classroom through Reciprocal Questioning. American Educational Research Journal*. 27, 664-687.

King, A. (1994). *Guiding Knowledge Construction in the Classroom: Effects of Teaching Children How to Question and How to Explain. American Educational Research Journal*, 31 (2), 338-368.

Kintsch, W. and Van Dijk, T. A. (1978). *Toward a Model of Discourse Comprehension and Production. Psychological Review, 85, 363*-394.

Lamon, M., Chan, C., Scardamalia, M., Burtis, P. J. and Brett, C. (1993, April). *Beliefs about Learning and Constructive Processes in Reading: Effects of a Computer Supported Intentional Learning Environment (CSILE)*. Paper presented at the annual meeting of the American Educational Research Association, Atlanta (http://www.csile.oise.on.ca/abstracts/beliefs.html)

Laurillard, D. (1984). *Interactive Video and the Control of Learning.* Educational technology. 24,7-15.

Laurillard, D. (1993). *How Can Learning Technologies Improve Learning?* Paper presented at the *Higher Education Transformed by Learning*

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

Lehrer, R. (1993). *Authors of Knowledge: Patterns of Hypermedia Design*. In S. P. LaJoie and S. J. Derry (Eds.), *Computers as Cognitive Tools*. Hillsdale, NJ: Lawrence Erlbaum.

Lepper, M.R. and Hodell, M. (1989). *Intrinsic Motivation in the Classroom*. In Ames, C. and Ames, R. (eds.), *Research on Motivation in Education: Vol.3, Goals and Cognitions,* (pp. 73-105). San Diego: Academic Press.

Levin, J. R. (1982). *Pictures as Prose-Learning Devices.* In Flammer, A. and Kintsch, W. (eds.) *Discourse Processing*, (pp.412-444). Amsterdam: North-Holland.

Levin, J. R. (1986).F*our Cognitive Principles of Learning Strategy Research. Educational Psychologist*, 21, 3-17.

Lissmann, U. (2000). *Beurteilung und Beurteilungsprobleme bei Portfolios.* In Jäger, R. S. (Ed.) *Von der Beobachtung zur Notengebung – Diagnostik und Benotung in der Aus-, Fort- und Weiterbildung.* (284-329). Landau. Verlag Empirische Pädagogik.

Littleton, K. (1999). *Productivity through Interaction: An Overview*. In: *Learning with Computers*. Littleton, K. and Light, P. (eds). (pp. 179-194). Routledge, London and New York.

Littleton, K. and Light, P. (1999). *Introduction: Getting IT Together*. In: *Learning with Computers*. Littleton, K. and Light, P. (eds). Routledge, London and New York.

Marton, F. and Booth, S. (1997). *Learning and Awareness.* Mahweh, NJ: Lawrence Erlbaum Associate Publishers.

Marton, F. and Säljö, R. (1976a). *On Qualitative Differences in Learning –I: Outcome as a Function of the Learner's Conception of the Task. British Journal of Educational Psychology*, 46, 4-11.

Marton, F. and Säljö, R. (1976). *On Qualitative Differences in Learning –II: Outcome as a Function of the Learner's Conception of the Task. British Journal of Educational Psychology*, 46, 115-127.

Marton, F. and Säljö, R. (1994). *Approaches to Learning.* In Marton, F., Hounsell,D. and Entwistle, N. (eds.) *The Experience of Learning.* Edinburgh: Scottish Academic Press.

Mastropieri, M. A. and Scruggs, T. E. (1989). *Constructing More Meaningful Relationships: Mnemonic Instruction for Special Populations. Educational Psychology Review*. 1, 83-111.

Mayer, R.E. and Sims, V.K. (1994). *For Whom is a Picture Worth a Thousand Words? Extensions of a Dual-Coding Theory of Multi-media Learning. Journal of Educational Psychology*, 86, 389-401.

Mercer, N. and Wegerif, R. (1999). *Is 'Exploratory Talk' Productive Talk?* In: *Learning with Computers.* Littleton, K. and Light, P. (eds). (pp. 79-101). Routledge, London and New York.

Merill, M.D. (1980). *Learner Control in Computer Based Learning. Computers and Education*, 4, 77-95.

Newman, D. R., Johnson, C., Webb, B. and Cochrane, C. (1998). *Evaluating the Quality in Computer Supported Cooperation Learning.* http//:www.qub.ac.uk/myt/papers/jasis/jasis.html

Nicholls, J.G. (1989). *The Competitive Ethos and Democratic Education.* Cambridge, MA: Harvard University Press.

Nicholls, J.G. and Throkildsen, T. A. (October 1987). *Achievement Goals and Believes : Individual and Classroom Differences.* Paper presented at the meeting of the Society of Experimental Social Psychology, Charlotsville VA.

O' Sullivan, P. J. and Pressley, M. (1984). *Completeness of Instruction and Strategy Transfer. Journal of Experimental Child Psychology*. 38, 275-288.

Papert, S. (1980). *Mindstorms. Children Computers and Powerful Ideas.* Harvester Press.

Papert, S. (1992). *Rethinking School in the Age of the Computer*. Basic Books.

Pintrich, P.R. and DeGroot, E. (1990). *Motivational and Self-Regulated Learning Components of Classroom Academic Performance. Journal of Educational Psychology*, 82, 33-40.

Pintrich, P.R. and Schrauben, B. (1992). *Student Motivational Beliefs and Their Cognitive Engagement in Classroom Tasks.* In Schunk, D.H. and Meece, J. (eds.). *Student Perceptions in the Classroom: Causes and Consequences,* (pp. 149-183). Hillsdale. Erlbaum

Pressley, M., Borkowski, J. and Schneider, W. (1987). *Cognitive Strategies: Good Strategy Users Coordinate Metacognition and Knowledge.* In Vasta, R. and Whitehurst, G. (eds.) *Annals of Child Development.* Vol.5, pp.89-129. Greenwich, CT: JAI Press.

Pressley, M., Symons, S., McDaniel, M. A., Snyder, B. L. and Turnure, J. E. (1988). *Elaborative Interrogation Facilitates Acquisition of Confusing Facts. Journal of Educational Psychology*. 84, 231-246.

Pressley, M., Borkowski, J. G. and O`Sullivan, J. T. (1984) *Memory Strategy Instruction is Made of This: Metamemory and Durable Strategy Use. Educational Psychologist*, 1994- 107.

Pressley, M., Borkowski, J. G. and O`Sullivan, J. T. (1985).*Children's Metamemory and the Teaching of Memory Strategies.* In Forrest-Pressley, D. L., MacKinnon, G. E. and Waller, T. G. (eds.), *Meta-cognition, Cognition and Human Performance,* pp. 111-153. New York: Academic Press.

Ramsden, P. (1992). *Learning to Teach in Higher Education*. London: Routledge

Rabinowitz, M. and McAuley, R. (1990). *Conceptual Knowledge Processing: An Oxymoron?* In Schneider, W. and Weinert, F. E. (eds.), *Interactions among Aptitudes, Strategies and Knowledge in Cognitive Performance,* pp. 117-133. New York: Springer – Verlag.

Reimann, P. (1997). *Bildung mit neuen Medien*. In: Heidelberger Club für Wirtschaft und Kultur (Hrsg.), *Ausgebildet?* (p. 251-265). Heidelberg: Springer.

Reimann, P. and Rapp, A. (in preparation). *Expertiseforschung*. In: Renkl, A. *Pädagogische Psychologie*. Bern: Huber. http://paeps.psi.uni-heidelberg.de/ reimann/Publications/expertise/Expertise.htm

Reimann, P. and Zumbach, J. (in press). *Design, Diskurs und Reflexion als zentrale Elemente virtueller Seminare*. In: Hesse, F. W. and Friedrich, H. F. (Hrsg.) *Partizipation und Interaktion im virtuellen Seminar* http://paeps.psi.uni-heidelberg.de/reimann/Publications/ ddr.pdf.

Reigeluth, C. M. (Ed.). (1999). *Instructional Design Theories and Models.* Vol. II. Mahwah, N.J.: Erlbaum

Renkl, A. (1996). *Vorwissen und Schulleistung.* In Möller, J. and Köller, O. (Hrsg.), *Emotionen, Kognitionen und Schulleistung.* Weinheim: Psychologie Verlags Union.

Rogers, T. B. (1995). *The Psychological Testing Enterprise*. Pacific Grove, CA: Brooks/Cole Publishing Co.

Roland, C. (1996). *Ethics and Computers: Implications for Teaching Art*. http://grove.ufl.edu/~rolandc/ethics~paper.html

Rosenblatt, L. M. (1978). *The Reader, the Text, the Poem: The Transactional Theory of the Literary Work*. Carbondale: Southern Illinois University Press.

Sadoski, M. (1983). *An Exploratory Study of the Relationship between Reported Imagery and the Comprehension and Recall of a Story. Reading Research Quarterly.* 19, 110-123.

Sadoski, M. (1985). *The Natural Use of Imagery in Story Comprehension and Recall: Replication and Extension. Reading Research Quarterly*. 20, 658-667.

Sacks, P. (1999). *Standardized Minds.* Cambridge, MA: Perseus Books.

Säljö, R. (1999) *Learning as the Use of Tools: A Sociocultural Perspective on the Human-Technology Link*. In: *Learning with Computers.* Littleton, K. and Light, P. (eds). (pp. 144-161). Routledge,London and New York.

Schafer, W.D. and Lissitz, R. W. (1987). *Measurement Training for School Personnel: Recommendations and Reality. Journal of Teacher Education*. 38(3), 57-63.

Schiefele, U. (1991). *Interest, Learning and Motivation. Educational Psychologist.* 26, 299-323.

Schoenfeld, A. H. (1999). *Looking toward the 21st Century: Challenges of Educational Theory and Practice. Educational Researcher*. 28(7), 4-14.

Schrage, M. (1994). *Beware the Computer Technocrates. Hardware Won't Educate our Kids.* In Ely, D.P. and Minor, B. B. (eds.) *Educational Media and Technology Yearbook 19*, Eglewood, CO: Libraries Unlimited.

Schulmeister, R. (1996). *Grundlagen hypermedialer Lernsysteme. Theorie, Didaktik, Design*. Bonn: Addison-Wesley.

Schunk, D. H. (1990). *Goal Setting and Self-Efficacy during Self-Regulated Learning. Educational Psychologist*, 15, (1), 71-86.

Sewell, M., Marczak, M. and Horn, M. (1998). *The Use of Portfolio Assessment in Education*. http://ag.arizona.edu/fcr/fs/cyfar/ Portfo~3.htm

Shaw, J. E. (1992). *An Evaluation of Cooperative Education Programs in Information Technology*. DEET, AGBS, Canberra.

Siegler, R. S. and Shrager, J. (1984). *Strategy Choices in Addition and Subtraction: How Do Children Know What to Do?* In Sophian, C. (Ed.). *Origins of Cognitive Skills,* pp. 229-293. Hillsdale, NJ, Erlbaum .

Taylor, B.M. and Beach, R.W. (1984). *The Effects of Text Structure Instruction on Middlegrade Students' Comprehension and Production of Expository Text. Reading Research Quarterly*. 19, 134-146.

Underwood, J. and Underwood, G. (1999). *Task Effects on Cooperative and Collaborative Learning with Computers*. In: *Learning with Computers*. Littleton, K. and Light, P. (eds), pp. 10-23. Routledge, London and New York.

Viau, R. and Larivée, J. (1993). *Learning Tools with Hypertext: An Experiment. Computers and Education*, 1993, 11-16.

Vygotsky, L. S. (1978). *Mind in Society*. Cambridge, MA: Harvard University Press.

Watson, M. (1997). *Improving Groupwork at Computers*. In: Wegerif, R. and Scrimshaw, P. (eds.). *Computers and Talk in the Primary Classroom*. Clevedon: Multlingual Matters.

Webb, B., Newman, D. R. and Cochrane, C. (1994). *Towards a Methodology for Evaluating the Quality of Student Learning in a Computer Mediated Conferencing Environment*. In G. Gibbs (Ed.). *Improving Student learning Theory and Practice Assessment and Evaluation*. Oxford: The Oxford Centre for Staff Development.

Weinert, F. E. (1996). *Lerntheorien und Instruktionsmodelle*. In Weinert, F. (Hrsg.), *Enzyklopädie der Psychologie, Bd. III, Psychologie des Lernens und der Instruktion* (S. 1-48). Göttingen: Hogrefe.

Weinert, F. E. (2000). *Lehren und Lernen für die Zukunft – Ansprüche an das Lernen in der Schule*. Paper presentation at the Pedagogical Centre of Rhineland Platine, Germany, 29 March, 2000.

Witfeld, C. (2000). *Multimedia for Learning. About Using Educational Multimedia in Compulsory School*. Paper of the PEDACTICE Project supported by the EC. www.pedactice.dk

Whitebread, D. (1997). *Developing Children's Problem Solving: The Educational Uses of Adventure Games*. In: McFarlane, A. (Ed.) *Information Technology and Authentic Learning. Realising the Potential of Computers in the Primary Classroom*, 13-37. Routledge, London, and New York.

Winograd, P. and Jones, D. L. (1992). *The Use of Portfolios in Performance Assessment. New Directions for Educational Reform*, 1 (2), 37-50.

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:

Windows	Macintosh
Windows 95, 98, NT4, 2000 or later	MAC OS System 7.5.3 or later
400 MHz processor	400 MHz processor
64 MB available RAM	128 MB available RAM
CD–ROM drive	CD–ROM drive
Colour monitor capable of 800 x 600 resolution	Colour monitor
Windows compatible sound card	
100 MB of available disc space	100 MB of available disc space
Internet Explorer or Netscape (latest version)	Internet Explorer or Netscape (latest version)
Word processor	Word processor
Graphic software to process and produce images in proper formats	Graphic software to process and produce images in proper formats

APPENDIX 3: Examples of Tools for Multimedia Production

Program	mPOWER 4.0	HyperStudio 4.0	Web Workshop Pro
Publisher	Tom Snyder Productions 800–342–0235	Knowledge Adventure 800–545–7677	Sunburst 800–321–7511
Platform	Mac/Win	Mac/Win and online	Mac/Win (requires a Web browser)
Price	$79.95 Lab packs, site licenses and network versions available	$199.95 Lab packs and site licenses available $89.95 Lab packs, site licenses and network versions available	$89.95 Lab packs, site licenses and network versions available
Target User	All school grades	All school grades	Grades 6–12
Targeted Skills	Language arts, computer literacy	Language arts, computer literacy	Language arts, computer literacy, web page design
Special Features	• One–button HTML conversion for web publishing • Plays streaming video right from the web • Plays animated GIFs	• Comes with Morph 2.5, an animation tool kit • Lots of support, curriculum materials and project ideas • Supports HyperLogo scripting language • Users can scan or import digital materials directly into the program • Drag–and–drop support • HyperStudio Web Ring for instant access to other users over the Internet • Download a HyperStudio 4 Player to view HyperStudio 4 projects without the program	• Sunburst will host your Web Workshop page; publication can take 5–7 days

Program	mPOWER 4.0	HyperStudio 4.0	Web Workshop Pro
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