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THE REPRESENTATION OF PSYCHOLOGICAL CORRELATES OF LEARNING THROUGH INSTRUCTIONAL MULTIMEDIA TOOLS

Alessandro Antonietti

Cognitive Psychology Laboratory, Department of Psychology,
Catholic University of Sacred Heart, Milano (Italy)

The design of new instructional devices should consider what users trainees thinks about the opportunities that such devices might offer in order to improve learning processes and outcomes. A study was carried out to investigate, by means of a questionnaire, the psychological features that teachers and students associate to the use of multimedia, computer-supported, tools for educational aims. The questionnaire considered the following topics: motivational and emotional aspects of learning (e.g., attraction, involvement, boredom, tiredness), behaviour during the learning process (active participation, effort), mental abilities required (attention, language, logical reasoning), style of thinking preferred (intuition, visualisation, reflection), cognitive benefits and learning results (better understanding, memorisation, application, overall view), metacognition (planning). The questionnaire was administered to a total of 272 teachers and of 170 undergraduates.

Items reporting statements which describe possible limits and risks of multimedia had low mean values; the highest rates concerned properties which are not trivial. Factor analysis yielded consistent clusters of items, suggesting that the opinions investigated are coherent and organised into specific dimensions.

No significant differences were found by comparing female vs male respondents, humanities vs scientific students and junior vs senior students. Significant differences were found by comparing teachers vs undergraduates and by comparing respondents with high vs low expertise in multimedia educational software. In the teacher subsample, responses given to some items of the questionnaire were influenced by the kind of school (kindergarten vs primary vs secondary) and by the discipline (humanities vs scientific) teached.

The study indicated that undergraduates identified a large number of opportunities. It is worth noticing that not only the most blatant qualities were recognised, but also more sophisticated issues were appreciated. The overall picture that emerges from the investigation is that teachers and students have a well-defined and deep-rooted conception about what multimedia tools can introduce into a learning process.

DESIGNING METACOGNITIVE SUPPORT FOR HYPERMEDIA LEARNING

Maria Bannert

University of Koblenz-Landau, Landau, Germany

Recent research in hypermedia-learning points out the crucial role of learners' strategic and metacognitive behaviour (e.g. Foltz, 1996). Although metacognitive knowledge and skills are needed when learning without new learning technology, such technology makes more salient the students' reflective behaviour about their own way of learning. For example, in a hypermedia learning environment a successful learner has to decide continuously where to go next and to evaluate constantly how the information retrieved is related to his/her actual learning goal (Schnotz, 1998). Considering that many students have difficulties in strategic and metacognitive learning behaviour (e.g. Simons & De Jong, 1992) the aim of this presentation is to discuss appropriate scaffolding for metacognitive reflection when learning with hypermedia.

Based on relevant research it is assumed that prompting students to plan, monitor, and evaluate their own way of learning will allow them to activate their repertoire of metacognitive knowledge and strategies which furthermore will enhance hypermedia learning. This assumption was tested empirically. Experimental design, procedure, as well as results of the learning process and outcome will be presented and their implications for the design of metacognitive support will be discussed.

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ENCOURAGING THE ACTIVE PROCESSING OF INFORMATION DURING LEARNING WITH MULTIPLE AND INTERACTIVE REPRESENTATIONS

Daniel Bodemer & Rolf Plötzner

Knowledge Media Research Center, Tübingen

Computer-based learning environments commonly comprise various linguistic as well as static and dynamic pictorial representations, frequently combined with the possibility to modify them interactively. While multiple and interactive external representations have the potential to improve learning in specific ways, they also make specific demands on learners. For instance, learners have to process different representations, to control and evaluate their interactions with these representations and to construct a coherent mental representation. In many cases, learners are not able to meet these demands and suffer from cognitive overload. Taking advantage of cognitive load theory, we try to improve learning with multiple and interactive representations by reducing extraneous cognitive load and by increasing germane cognitive load which is directly related to elaboration and learning processes. To accomplish this, we encourage learners to actively integrate different representations and to interact with different representations in a structured and reflective way. We implemented these measures into the statistics learning environment VISUALSTAT and evaluated them experimentally with 84 students. An analysis of variance revealed (1) that the active integration of different representations improved learning significantly and (2) that the structured interaction with different representations especially increased verbal comprehension.

HOW INSTRUCTION GUIDES ATTENTION IN MULTIMEDIA LEARNING

Roland Brünken[1], Jan Plass[2] & Detlev Leutner [1]

[1]Erfurt University

[2]New York University

Based on cognitive load theories of multimedia learning we know that the visual-only presentation of verbal and pictorial learning materials in multimedia learning systems can result in serious problems of overloading the visual working memory. Compared to the audiovisual presentation of the same material, the visual only presentation results in decreased knowledge acquisition, which is known as modality effect in multimedia learning. However, what has not yet been investigated for this effect is the question as to how the guidance the learner receives through different instructional methods may affect the modality effect and, moreover, whether the instructional guidance of the learners' attention can compensate for the modality effect.

In 3 three-group experiments with 60 participants each, a visual-only, an audiovisual, and a visual-only + instructional guidance version of a multimedia system describing the functionality of the human cardiovascular system were compared. The experiments varied in the type of instructional guidance, realized in the third version of the system (Experiment 1: support on the textual information; Experiment 2: support on the pictorial information; Experiment 3: support on the integration of text and pictures). The results of our studies clearly show two effects: First, comparing the visual-only and the audiovisual version of the system, each experiment replicated the modality effect. Second, and of particular interest, each experiment showed for the third experimental group that learners' focus of attention was guided by the type of the provided instruction, which led to a partial compensation of the modality effect for those pieces of information that the learners' attention is directed toward.

The results of our studies indicate that cognitive load induced by a multimedia learning system is not only a function of the amount of presented information, but that it is also influenced by the instructional design of the presented materials.

CHILD-COMPUTER INTERACTION:THE EFFECT OF FEEDBACK

Afke Donker, Inez Berends, & Pieter Reitsma
PI Research – VU Amsterdam
Duivendrecht, The Netherlands

The purpose of this study was to determine the effect of feedback on the behaviour of children interacting with a computer-program.

Children with reading problems (n = 88) in the lower grades of elementary schools practised their reading skills with a computer program twice a week for a period of 8 weeks. During interaction with the program the children received different types of feedback. Some children were only informed whether their last response was correct. A second group of children received additional information about how many responses were correct in the current session. Others received additional information about the speed of their responses. Also, one group of children received all kinds of feedback. In the latter three conditions a speed and / or accuracy goal was set.

The attitude of the children towards the program was determined by time sampled observations. Recorded was whether and how meticulously the children attended to feedback, whether they reacted to feedback and how concentrated they were working. It was expected that children who received additional feedback together with a goal would be more engaged in the program than the children who were just informed about the correctness of individual responses.

The results showed that all children improved significantly on their reading skills. Also, over sessions the children became faster, more concentrated on the computer task and less responsive to feedback. The type of feedback the children received did not have any effect. It seems that once children become accustomed to a task, they abandon all behaviour that is not strictly necessary for completing it.

PYGMALION ON THE SCREEN: EFFECTS OF QUALITY EXPECTATIONS ON LEARNERS PERFORMANCE.

Stefan Fries, Holger Horz & Claudia Schremmer
Universität Mannheim

Developers of computer-based trainings (CBT) focus on the optimization of their teachware with respect to content and presentation. Usually, they neglect effects of didactic scenario and of learners expectations. Especially in settings of higher education, CBTs are often presented to students as newly developed ("ß-version"). Little is known about the effects of such quality attributions on the learning process with CBTs.

Two experimental studies will be reported in which students of computer science were given a CBT on compression methods. Different quality expectations were induced. In the first study, the CBT was presented to 21 students as "ß-version", to 20 students as "high-end" product (confirmed by a faked journal article from a well known computer technology journal), and to 21 students with no information about the quality of the programme. Results showed significant effects not only on the evaluation of the programme but also on learning. Students in the high-end version condition evaluated the CBT better and learned more than those in the ß-version condition and in the control one. In the second experimental study these results were replicated for a total of 95 students.

The results imply that quality attributions should be considered when implementing teachware in higher education. Similar to the pygmalion effect, students learn more when they believe that they are working with an high-end product. Therefore teachware should not be announced as ß-version.

INSTRUCTIONAL EXAMPLES IN HYPERTEXT-BASED LEARNING AND PROBLEM-SOLVING:COMPARING TRANSFORMATIONAL AND DERIVATIONAL APPROACHES TO EXAMPLE DESIGN

Peter Gerjets, Katharina Scheiter[1] & Stefan Kleinbeck[2]

[1]*Universität Tübingen,* [2]*Universität Freiburg*

The aim of the presented research is to explore how different approaches tothe design of instructional examples may help to improve computer-based skill acquisition in mathematical problem solving (e.g., in learning how to solve word problems the domain of probability).

Two instructional example formats were compared with regard to their impact on example processing and on subsequent problem solving.

The transformational example format is consistent with a "structure mapping view" of analogical problem solving and schema induction and focuses on conveying abstract structural problem features which are the basis for problem categories and for category-specific solution procedures. This information allows for a categorization and mapping strategy when solving a problem that is similar to the instructional example. The derivational example format is inspired by AI models of derivational analogy. The main idea of these models is that instructional examples may be more useful to guide later problem solving when they are not designed to convey abstract knowledge on structural problem features and problem categories.

Instead examples should be designed in order to convey the rationale of deriving solutions for problems - independent of the problem category they belong to- by explaining how individual solution steps can be constructed and justified. This type of example format should especially support the construction of solutions to novel problems that require the adaptation of known solution procedures.

We conducted two experimental studies that compared transformational and derivational example formats within a hypertext-based learning environment. It could be empirically demonstrated that the derivational example format was associated with better problem-solving performance - as well as with less time demands for example study and for the re-examination of instructional examples during problem solving - than the transformational example format.

THE ISPFP VIRTUAL LEARNING PLATFORM: A NEW SPACE FOR DISTANCE-LEARNING

Chiara Giorgi

ISPFP

Lugano (Switzerland)

The development of Information and Communication Technologies and their progressive introduction into the learning field have led, recently, to a new way of providing education: distance-learning.

Technologies, therefore, are not merely working tools any more, but become artefacts allowing humans to interact with each other.

The ISPFP virtual platform aims at being an innovating learning environment where personal, social and formative dimensions are tightly connected; this lets the learner leave the role of a passive "receiver" of online contents and achieve the one of actor/author in his/her own learning process through the co-construction of shared meanings with other learners.

The peculiarity of ISPFP platform consists of a new concept of space: it is not just a place where to meet the others, but it's also a symbolical one reproducing the cognitive processes. Besides, the organization of space makes these processes visible to the learner allowing him/her to position himself/herself along the learning course.

A particular care has been taken about the form of the learning contents, that have been developed by integrating various languages (texts, images, movies) to respect the different cognitive styles.

In conclusion, the ISPFP platform has to be considered a complex artefact, where the flexibility in relation to the formative requirements has been one of the main development key-points.

The presentation will show the virtual environment created by ISPFP, focusing on the questions that have driven its development and on the adopted solutions; a second part will deal with the applications of the prototype in the Swiss professional vocational schools.

THE AUDIOVISUAL CHANNEL IN DISTANCE EDUCATION

Maddalena Grassi, Carlo Galimberti, Dieter Schürch

ISPFP

Lugano (Switzerland)

This presentation aims to offer a possible contribution to the analysis of the consequences of potential applications of new communication tools in adult education

This phenomenon stimulates interest in, as well as confusion and questions about, what might be the value and the educational potential of the new communication environments created through use of these technologies.

The need to extend the educational model in order to include the cognitive, expressive and communicative skills associated with these new media is borne out by extensive theoretical reflection, which reveals their socio-cultural as much as their purely educational character.

Recent research on network communication and distance education has shown how the emergence of information technology is changing the ways in which people interact with computers, and has gradually shifted the focus of attention from computers as strictly technological objects with their own internal functionality to artefacts serving as mediators between people, their processes and their actions on the world around them.

At issue here are psycho-social-technological changes involving not just the world of communication but also, and especially, the world of education. In particular, ther is increasing support for the idea that different media have different potential for developing different cognitive skills and therefore of achieving different pedagogical objectives.

In light of these general considerations, the presentation will develop a series of reflections with two main goals:

- to respond to the need to show which skill is developed by a particular medium, such as videostreaming; and

- to speculate on what might be the most effective ways of implementing videostreaming applications.

Using suitable examples of the application of the audiovisual channel in distance education (through the analysis of interfaces we have built), the presentation will show how various media used in the educational process, while manifesting a substantial convergence in the content they convey, assume and develop different skills in users.

DIGITAL GAMES AND MULTIMEDIA DESIGN

Begoña Gros

University of Barcelona

The main goal of this paper is to describe a research based on the intersection of multimedia design and digital games.

New media are introducing important changes in the nature of learning that not always are present in the design of educational settings. There is an important gap between the way that people has learnt in the last century, and the way that new generations are approaching to information and knowledge.

Our research is based on the idea that virtual learning is central in current society, and this kind of learning is less about technology than the interaction of the learner with the technology. Virtual learning environments provide a lot of advantages: flexibility, distribution, adaptability, and so on. However, there is another domain that can help learning to maximise its potential to reach, to motivate, and to fully involve learners. For this reason, we consider that the most interactive multimedia phenomena in our culture today is to be found in the world of gaming.

Digital games are the direct enter of children to the world of digital culture. Our main hypothesis is that the main digital literacy is adopt by the kids in an informal way through the use of the games, and neither school or other educational institutions is taking into account this important aspect. Moreover, we consider that multimedia design for training and education should extract the design principles that will incorporate the most powerful features of interactive multimedia design with the most effective principles of technologically mediate learning.

In our contribution we will describe the main theoretical assumptions in which our research is based, and we will discuss the main conclusions obtain in our research that has been done with students in secondary school and pre-graduate students.

STUDYING WITH LINEAR OR NON-LINEAR HYPERMEDIA CBTS DEPENDING ON LEARNERS' CHARACTERISTICS

Holger Horz

Universität Mannheim

Some research picked out the different reactions and kinds of learning success with network-based hypertexts or linear texts, but there is a lack of research, if the results of hypertext research are applicable to hypermedia learning environments. A meta-analysis of Chen and Rada (1996) showed little advantages in learning results for hypertext whereas Dillon and Gabbard (1998) pointed out the limited pedagogical values of hypermedia. Urahne (2000) found that students of a web-based training learned more by using a non-linear hypermedia CBT, but there did not take computer-related characteristics of learners into account. Therefore a learning experiment was conducted to show the influence of computer-based training's (CBT) hypermedia structure into consideration of learners' computer-related skills, attributions, self-schemes, and emotional state. 212 participants learned with one of two versions of a CBT. Both versions contained the same information and identical hypermedia presentations. One version had a linear link structure and the possibilities were limited to choose individual ways through the CBT. The second version based on a network-structure with higher degrees of choices for self-regulated navigation. In general students (212 Ss) valued on the network-based version worse than the linear CBT, but they had a better mood after the learning session. Variance analysis showed significant differences of the navigation behaviour and self-schemes between computer-experienced learners and novices depending on CBT's structure. Experienced students navigated in a linear CBT more often than in the network-based CBT or novices in both conditions. They explored first the CBT and after that, they went back to single interesting topics. Besides, novices' self-reported extraversion and intellectual self-schemes dropped significantly after working with the network-based structured whereas the values of computer-experienced learners increased in that case.

DESIGNING A WEB-BASED LEARNING SPACE WITH VIRTUAL REALITY COMPONENTS

Fanny Klett

Technische Universität Ilmenau

The new opportunities for interactivity and flexible media access challenge the established experience in shaping learning environments. The crux of the matter is the adequate design of learning environments so the final application enhances the motivation and the result, and serves the communication between author and learner most advantageously.

Currently, deficiencies in learning environments concern concepts, consistency, screen layout, interface design, navigation strategies, low-level of multimedia based interactions. In order to enlarge the communication capabilities in a learning environment, it is essential to focus on two fundamental aspects in the user interface: information presentation and information access. Pursuing this aim, this paper discusses first the design of hypermedia systems in its own unity of concept and design modeling for learner-beneficial support by the user interface. In relation to these explanations, it presents a learning system that benefits from the research about both the consideration of human visual and acoustic perception in the user interface for learning and the sufficient visualization of multidisciplinary contents for engineering educational activities, especially by 3D models, 3D animations and simulations, which facilitate the learner's immersion in a hidden world.

The proposed paper points out the significance of designing hypermedia contents for mastering online educational activities with Virtual Reality components and interactivity features, which support event synchronizations and dynamic course changes of scenarios by user interactions.

Furthermore, the paper discusses an approach of learner-centered web design, particularly with respect to consideration of 3D real-time presentation and advanced navigation. These aspects help to guide the learner in his navigation and orientation tasks in the learning space.

EMPIRICAL VALIDATION OF THE CONCEPT 'MULTIMEDIA LITERACY'

Joost Lowyck & Steven Utsi

CIP & T, Catholic University of Leuven

Insight in children's multimedia learning skills underpins any design, development and suitable implementation of educational ICT environments. Multimedia learning explicitly frames skills in a context of emerging new literacy. Indeed, literacy as a plural concept comprises both traditional reading and writing literacy and visual literacy. Visual literacy pertains to skills indispensable to work effectively and efficiently with educational multimedia. The multimedia learning framework also takes into account more general media and digital literacy as well as more specific electronic and multimedia literacy.

Multimedia learning envisages to trace specific skills that account for successful interaction with multimedia programmes. Two empirical studies, carried out with a multimedia strip story, yielded results that provide input for designing, developing, and implementing educational ICT environments for children. Both studies reveal a cognitive load built up by multimedia layers in the strip story with the linear succession of pictures in accessing historical background information.

The integration of traditional and visual literacy into prescriptions for designing educational ICT platforms is discussed. The overall structure of a platform is either (semi-)linear or a-linear. This structure determines the trade-off between different content and media layers in the platform and influences the consequent learning performance of the end user. To cope with this trade-off effects the configuration of task/content, media, and learner characteristics need to be embedded in the instructional design cycle.

THE PARALLEL INSTRUCTION THEORY FOR OPEN LEARNING, WORKING AND DOING ENVIRONMENTS ON THE WEB.

Rik Min
Researcher and simulation specialist

Faculty of Educational Science and Technology
University of Twente

The last 10 years we did a lot of research at the University of Twente with multimedial web-based prototypes in all kinds of education and training. All prototypes were a part of empirical experiments with tasks and exercises. We found that good and well designed instruction is very important to use open learning environments on the right way (for the users). We developed a concept for arranging and designing such situations on a screen: parallellism. Later on we found some clarification in the cognitive psychology and the sort term memory of most of the users. That leads to a design theory:

the 'Parallel Instruction theory' we found. It seems that our foundings are based on some aspects of the splitt attention theoriy and the cognitive load theory. We want report our experiences to the audience.

Reference:

http://projects.edte.utwente.nl/pi/Papers/Papers.html

http://projects.edte.utwente.nl/pi/teksten/parallellismeRef.html

HOW TO DESIGN INFORMATIVE TUTORING FEEDBACK FOR MULTIMEDIA LEARNING

Susanne Narciss & Katja Huth

Psychologie des Lehrens und Lernens

Technische Universität Dresden

The implementation of feedback is often more based on intuition than on well-founded design principles. Hence, the purposes of this paper are (a) to outline psychologically well-founded principles for the design of informative tutoring feedback forms, (b) to show how informative tutoring feedback for written subtraction tasks can be implemented in a multimedia learning environment, and (c) to present results of a study examining the impact of informative tutoring feedback forms on learning and motivation.

Principles for the design of informative tutoring feedback forms were derived from the existing knowledge on cognitive task and error analysis of written subtraction tasks. These principles were applied to develop an algorithm presenting three levels of feedback with increasing informational value. This algorithm was implemented in an adaptive way: additional information was only presented if the learner did not find the correct solution on his own. In contrast to widely used computer-based training algorithms presenting knowledge of the correct result (KCR) immediately or after the second failure, our adaptive bug-related feedback algorithm provides not only KCR, but also strategically useful information for the correction of the systematic errors.

In a learning experiment, with 38 forth-grade students and 15 sixth-grade students with learning disabilities, cognitive and motivational effects of the bug-related feedback algorithm were compared to the effects of a standard KCR-feedback-algorithm. Results indicate that bug-related feedback has a significant positive effect on learning and motivation especially for students with learning disabilities.

ANIMATION AND SIMULATION IN BIOLOGY INSTRUCTION

Claudia Nerdel & Helmut Prechtl

Leibniz-Institut für die Pädagogik der Naturwissenschaften

Universität Kiel (IPN)

Modern educational technology offers the opportunity to visualize dynamic processes with the help of computer-based animations. Furthermore, computer-based simulations invite learners to investigate actively causal relations whithin complex systems. In this study the effects of computer-based animations and simulations on the understanding of complex biological processes were examined. The biomembrane and its dynamic features was chosen as a basic concept for instruction, because of it´s importance for a variety of biological phenomena such as information processing and metabolism.

The major focus was on the interrelations of learners´ prior knowledge, their visual and verbal learning preferences, cognitive load, and the computer based learning environment. Special attention was payed to the importance of instructional aids aiming to support learning with simulations. The theoretical background is derived from cognitive psychological models and research work whithin the field of computer-based learning.

11th-graders of German Secondary Schools were instructed in the topic of biomembranes in groups working with different kinds of computer-based learning environments. These contained animations or simulations (interactive animations with parameter choice) either with or without special instructional aids. In a pretest individual visual and verbal learning preferences as well as subjects' domain specific biological knowledge were examined. Following the treatment factual knowledge and conceptual understanding was examined again and individual cognitive load was registered.

Quantitative data analysis revealed that, contrary to our hypotheses, prior knowledge was much more important for learning results than the different learning environments. Furthermore, no consistent interaction patterns between prior knowledge or visual/verbal learning preferences and the learning environment could be found. On the other hand, the correlation between individual cognitive load and learning results was highly significant. Qualitative analysis of data will follow, aiming at an identification of special types of learners. Results will be discussed considering the interactions of treatment and learner features.

RE-CONSTRUCTING ID-MODELS: DEVELOPING HEURISTIC ADVISORY SYSTEMS AS TOOLS FOR ID-RESEARCH.

Helmut M. Niegemann, Dirk Hochscheid-Mauel & Silvia Hessel

Institute for Media and Communication Studies, Technische Universität Ilmenau

Wolfgang Schnotz, Anke Eckhardt, & Markus Molz

Institute for Psychology, Universität Koblenz-Landau at Landau

Advising instructional designers how to design multimedia learning environments it seems not always the best way to recommend the adoption of a specific ID model. Instead it may be more appropriate to blend elements from different ID models. Necessary prerequisites for any serious recommendation of this kind is (a) a functional analysis of current instructional design theories (cf. Molz et. al., 2002), and (b) a technological theory which relates elements or modules from instructional design models to combinations of instructtional objectives and internal and external conditions of learning. Such a theory does not yet exist.

The Landau-Ilmenau working group aims to construct such a theory which will be represented by a kind of expert system (knowledge based advisory system). The idea of representing a technological theory by an expert system is analogous to the representation of a descriptive theory by a simulation system (e.g. J.R. Anderson's ACT-model). A software system representing a technological theory has to prove it's worth by providing suggestions that are in the average (a) for the short term not worse than decisions made by practicians of ID and (b) in the long run not worse than recommendations given by ID experts.

Such a theoretical framework – we call it a "ID hypertheory" (Niegemann, 2001) – ideally should contain an integration of empirically founded knowledge relevant for the solution of instructional design problems.

This is clearly a rather ambitious project and there will be continuously new knowledge to be integrated. We don't think we can make it alone after some pioneer work. Thus, the philosophy is to invite researchers to submit their results to be admitted and integrated into the ID hypertheory. Proposals for admittance will be peer-reviewed analogous to the reviewing process for papers to be published in scientific journals. An admittance into this system should be a prove of the practical relevance of a project.

The advantages of building an ID hypertheory are in the beginning more on the side of the theory: Like simulation models representing descriptive theories of memory and thinking, theory makers are forced to formulate unambiguous statements, con-

tradictions between different statements will necessarily be uncovered and lacks of knowledge become evident.

Recommendations produced by the system will not be directive. Rather like a good business consultant the system will successively show for every design level the appropriate design options, connected costs and possible consequences. Similar to expert systems in medicine it should be a decision support system, i.e. the final decision is never made by the software but by the human instructional designer.

In our paper we will show the state of the work, especially the design of the questioning part assigned to assess the information necessary to make any recommendation.

Reference

Niegemann, H, (2001). ID Hypertheory. Paper presented at the Conference of the European Association for Research on Learning and Instruction 2002, Fribourg (Switzerland).

THE EXERCISE FORMAT EDITOR:

A MULTIMEDIA TOOL FOR THE DESIGN OF MULTIPLE LEARNING TASKS

Antje Proske, Hermann Körndle & Susanne Narciss
Psychologie des Lehrens und Lernens,
Technische Universität Dresden

An important precondition for efficient multimedia learning is that the learner takes an active part in using the material to be learned. One possibility to initiate active learning and intensive information processing is to provide learning tasks of multiple complexity and difficulty. Hence, the question of how to support the design and construction of multiple learning tasks for multimedia learning environments in a systematic way is of critical interest for instructional designers. The purpose of this paper is therefore to present the Exercise Format Editor (ef-editor), a multimedia tool for the systematic construction of a large variety of learning tasks. The development of this ef-editor was based on psychological findings on cognitive task analysis and on self-regulated learning with multimedia learning environments.

In order to support the construction of a large variety of learning tasks the ef-editor allows

- to integrate various learning contents, materials and media (e.g. text, audio, video, www-links),

- to prepare different response modes (e.g. all types of multiple-choice formats, all types of assignment formats),

- to specify the expected correct and incorrect responses in order to assess the individual responses automatically,

- to provide informative tutoring feedback types for typical errors.

Results of different applications of the ef-editor in different multimedia learning contexts will be used to illustrate the functions of the ef-editor.

MODEL-BASED LEARNING AND THE PROGRESSION OF MENTAL MODELS

Katharina Schenk, Bettina Couné, Norbert M. Seel

University of Freiburg, Germany

In accordance with the basic understanding of Instructional Design as a suitable technology for the development, implementation, and evaluation of learning environments we developed "Dynamic Systems of economics", a multimedia learning environment based on a constructivist understanding of learning and model building.

In order to enable students to construct feasible mental models this multimedia environment was designed in accordance with the principles of the "Cognitive Apprenticeship" approach (CA). Here, *modeling* is the central way of guiding the learning process, and model relevant information as well as conceptual models were presented. Aiming at the formative evaluation of the learning environment, we accomplished five replication studies. As a result of these studies, we realized the methods of CA in the multimedia program in the following manner: In modeling, a virtual expert demonstrates his approach of problem solving and communicates his procedure. The students should adapt a conceptual model of this process by observing the expert. In coaching, the students were supervised and provided with result-orientated help to find solutions to given tasks. In scaffolding, a special problem-solving heuristic was taught. The metacognitive methods articulation and reflection were implemented in the form of a teach-back procedure in which two students had to articulate and compare their solutions and problem solving strategies. The final part of the program was exploration, where students had to solve transfer problems on their own.

Besides the implementation of CA principles into a computer-based learning program and the verification of its practicability, another important aim of our research was to investigate the learning-dependent progression of mental models. For that purpose a specific diagnostic instrument was developed and tested.

This presentation will introduce our main results and discuss the consequences for the design of model-based learning environments.

DECONSTRUCTING ID-MODELS: TOWARDS AN INTEGRATIVE CONCEPTUAL FRAMEWORK FOR ID RESEARCH.

Wolfgang Schnotz, Anke Eckhardt, & Markus Molz

Institute for Psychology, Universität Koblenz-Landau at Landau

Helmut M. Niegemann, Dirk Hochscheid-Mauel & Silvia Hessel

Institute for Media and Communication Studies, Technische Universität Ilmenau

We will suggest a tentative dimensional framework for instructional design. It results from a meta-analysis of instructional design models which are frequently implemented with support of educational technology.

The field of instructional design is currently characterized by the co-existence of dozens of instructional design models. Unfortunately little work has yet been invested in systematic comparative analysis of their fundamental assumptions, their basic concepts and their empirically proven strategies for learning and instruction. Rather, most of these models are promoted to be a unique bundle of widely applicable instructional approaches. If there is any debate it often takes the form of opposed ideological camps, like the battles between the defenders of direct instruction and the constructivist movement.

A closer look on instructional design models, however, reveals that:

- there are quite heterogeneous approaches in each camp.

- there is considerable similarity of instructional strategies in seemingly opposed models.

- there is little conceptual contradiction if different design levels, learning objectives and target groups were more thoroughly considered.

Accordingly, it seems possible and necessary to unbundle instructional design models and to situate them in an overarching conceptual framework. The picture behind the strange patchwork of current instructional design models is probably one of relative relevance and complementary harmony.

LEARNING IN MULTIMEDIA ENVIRONMENTS – WHICH KIND OF LEARNING AND HOW TO DO RESEARCH ON IT?

Franz Schott, Sabine Al Diban, Dirk Hillebrandt, Thomas Schubert,

Nora Heyne & Udo Herrmann,

Institut für Pädagogische Psychologie und Entwicklungspsychologie,

Technische Universität Dresden

We try to explore the status of research on competence acquisition by multimedia learning and information systems by means of a request analysis and whereupon to develop an own approach, basing on that analysis. We investigated the features of different learning situations. This supplies the material for a debit analysis of learning research and an actual state analysis regarding the research results of the competence acquisition. The debit analysis examines, which type of learning research is needed, the actual state analysis, which relevant approaches we find here. A starting point is an analysis of a practical course for studying electro-technology whose learning object is the process automation of large industrial plants. This practical course is a complex, multimedia learning setting, consisting of a model system, which can be regulated and controlled by a computer program. The different media for learning were the model system, PCs, text documents, a lecturer and a small group of students. The results of the debit analysis, the actual state analysis, reactions of colleagues to our analysis and the conclusions drawn by us, will be discussed, especially the consequences for the instructional design for multimedia learning.

LEARNING IN SYNCHRONOUS AND ASYNCHRONOUS VIRTUAL TEAMS

Karin Schweizer, Manuela Paechter & Bernd Weidenmann

University of the Federal Armed Forces, Munich

In a study on the communication of knowledge in virtual teams we observed and recorded data from 96 students who participated for 10 weeks in an off-campus online seminar. Students formed learning teams consitsing of 4 members. Instruction about certain topics of general psychology took place via 5 virtual rooms (pages) on the internet (lecture hall, electronic bulletin board etc.). All learners received two types of material: (a) joint material, (b) additional information that was different (unshared knowledge) for each group member. After a period of two weeks of individual learning the learning teams met as asynchronous newsgroup, as synchronous chat group as synchronous videoconference group, or in a control condition as face-to-face group. In these learning teams students were requested to cooperate on four different tasks:

- a simple repetition task which refered to joint knowledge,

- a transfer task based on joint knowledge,

- a repetition task based on unshared knowledge,

- a so called jigsaw task on unshared knowledge.

Among other variables we analysed students' online activities (e.g. number of logins) and their task performance. Altogether students logged in 4246 times (without group activities). Students in synchronous virtual teams performed much better than students in asynchonous teams. Only in repetion tasks on joint knowledge newsgroups achieved the same level as all other teams. We discuss these results with reference to media synchronicity.

IMPORTANCE OF THE ORGANIZATION OF THE CONTENTS IN A HYPERMEDIA DEDICATED TO SOUND TEACHING IN FIFTH FORM ACCORDING TO THE LEARNING HYPOTHESIS AND CONSTRAINT DATA-PROCESSING

Arnauld Séjourné

Université de Lyon 2

Lyon (France)

This article presents a research in Science Education, whose mains aims are first to design hypermedia software dedicated to sound teaching at upper secondary school level (15 years old), then to analyse student's activity (20 dyads) in order to answer one of our research questions : the role of organisation of the contents in constructing of the meaning of related knowledge.

Our intention is to emphasize the importance, at the time of the conception of a hypermedia, preliminary scenarisation of the contents of teaching. This scenarisation consists in organize contents by taking account of the difficulties of the students and their needs. As described in this text, our theoretical framework includes learning hypotheses related to the knowledge to be taught. These hypotheses are used both the design of the hypermedia "Labdoc Son et vibrations" [Sound and Vibrations] and the analysis of students' activity using the hypermedia in a classroom situation.

Thus, starting from these assumptions, we have elaborated a method to organize the contents that is supposed to help them to carry out the tasks in an autonomous way (feed-back, evaluation system, …) and to exceed their difficulties (different representations semiotic of the knowledge to be taught, informational ressources, …). This method takes into account also the data-processing constraints (space and density of information to the screen, navigation,…). For example, we consider that the knowledge to be taught cannot be introduced in a disordered way ; so, that implies a linear navigation between each task.

Finally we analyse students' activity whilst using the hypermedia in order to answer one of our research questions. The analysis related on the one hand on data resulting from the automatic transcription of the actions from the users (data-processing trace) and the other hand on the dialogues (only 4 dyads). The first analysis provides results on the 20 dyads, and enables to observe the tasks giving the difficulties to the students, the importance of the informational resources, the implication of the students (up to 27 bad answers and 20 minutes).

The second analysis shows that for more than 70% of the tasks the students construct the meaning of knowledge. Thus, this organization according to our theoretical framework is decisive to lead the students to select information necessary to carry out the tasks suggested.

One of the results presented here shows that enabling students to have successive failures leads them to look for other information, and to realise that they use parts of knowledge that are not the expected ones.

INTERACTIVE LECTURE: TEACHING AND LEARNING IN WIRELESS NETWORKS

Anja Wessels, Stefan Fries & Holger Horz
Universität Mannheim

Conventional lectures are connected with fundamental didactic problems. Particularly in large meetings, it is difficult for the lecturer to deal with individual questions or re-marks. Furthermore it is difficult to maintain the users attention permanently and also enable deeper cognitive processes. From the students point of view, communication with the instructor is highly restricted as well in mass meetings. In this paper a new learning scenario of the Interactive lecture is introduced, which is supported by Wire-less Local Area Network (WLAN). The use of WLAN allows through a bi-directional synchronous communication between students and lecturer interactivity and adapta-tion in lectures.

A first experimental investigation of the new scenario was conducted. A so-called quiz service was implemented for the use on mobile computers. This tool allows an online posting of questions, immediate evaluation of the student answers and a graphical presentation of the results. In the experimental study, conducted in a com-puter science lecture (N=44), the students participated either in an interactive or a conventional lecture session. The groups were compared regarding to acceptance and success in learning. With respect to acceptance the interactive condition was evaluated significantly better than the conventional one. Besides, students in the in-teractive condition reported higher levels of assumed self effectiveness as well as at-tention, activity and estimated learning success. By objective measuring there is an indication for better learning results in the interactive condition, which is unfortunately not significant. The results highlight potential of the interactive lecture with respect to didactic improvements in higher education.

HOW TO SUPPORT SELF-ORGANIZED LEARNING IN INTERNET- BASED LEARNING COMMUNITIES

Karsten D. Wolf

Lehrstuhl für Wirtschaftspädagogik

Otto-Friedrich-Universität, Bamberg

This paper discusses the design, the implementation and the future development of learning community systems.

First, an implementation of an web-based learning community system is described. The main focus of the environment is to engage students in the key activities of constructivist learning: creation, construction, communication, cooperation, and collaboration.

Second, the results from an evaluation of a pilot study in a post-graduate level course are reported. The environment has been evaluated to test the basic assumption of constructivist learning theory, that the knowledge construction process of students enhances their learning.

The main results are:

- the most import functions according to the users were email, discussion and the joint creation of commented link lists, presentations and hypertexts;

- the students reported a high level of support for self-organized learning (compared to several benchmark studies);

- intensive processes of communication and creation supported self-organized learning;

- the students reported higher levels of self-determined types of motivation;

- the system supported a high level of autonomy;

- the intensity of active usage correlated with the level of interest;

- the creation of content correlated with the gain in problem-solving competency.

Third, the consequences of future internet-based learning for the rebuilding of the educational system are discussed. Location based services, wireless Evernet access, P2P technologies and wearables can be combined into ubiquitous learning infrastructures which will dramatically enhance and change the educational landscape.