

“Technology Enhanced Learning in Working Context”

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Abstracts

Monday, 13th

Richard Noss, Celia Hoyles, Phillip Kent, Arthur Bakker

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“Designing for complex modelling at work”

The most recent phase of our continuing research into techno-mathematical literacies (TmL) in the workplace has shifted from ethnography to intervention – designing learning scenarios and software tools in collaboration with workplace managers and trainers in order to foster the growth of relevant techno-mathematical knowledge. In each sector we have worked, our ethnographic work has highlighted different aspects of TmL, and we have accordingly designed distinctive tools for intervention. This design decision was based partly on the grounds of workplace authenticity and partly according to the type of techno-mathematical knowledge to be addressed. In this paper, we report on the design of a software simulation tool that we have co-developed with personnel at different levels in a large packaging company. We identified a common need for employees at several levels to gain an understanding of the complexity of the production system, to acquire knowledge of key variables and how they interacted. This was particularly needed amongst production operators, whose formal training about the process was narrow and mainly procedural, but we also found that process engineers, despite their superior technical knowledge, were stimulated in using the simulation, which served as an object-to-think-with of a type they had not previously encountered. We will summarise the rationale for our approach, based on attempting to strengthen and exploit the linkages between process knowledge and mathematical comprehension, describe the software simulation and outline the outcomes of the phases of our work with process engineers and production workers in the factory. Finally, we will situate our findings within a broader, epistemologically-oriented activity-theoretic framework.

Adélaïde Blavier

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“Impact of new technologies on the processes of learning in minimal invasive surgery: how define expertise?”

As in all work contexts, medical technology and techniques have been developed and most surgical operations are now performed by minimal invasive surgery. This surgical technique is performed with the help of a camera and long instruments introduced through small incisions into the body. Laparoscopic surgery brings a lot of advantages, particularly for the patient (very small incisions, smaller risks of infections, higher accuracy due to the magnification by the camera, fast recovery). As the tactile and force feedbacks are lost in minimal-access surgery, the video image plays the most crucial role in giving the surgeon information about the performance of the operation. However, surgical studies report

contradictory results about the impact of 3D and 2D images on performance in minimal-access surgery: some studies showing best performances with 3D vision (Taffinder, Smith, Huber, Russell, & Darzi, 1999; Van Bergen, Kunert, Bessell, & Buess, 1998; Peitgen, Walz, Holtmann, & Eigler, 1996; Dion & Gaillard, 1997; Birkett, Josephs, & Este-McDonald, 1994) while others failed to obtain difference of performance between 2D and 3D view (Hanna, Shimi, & Cuschieri, 1998; Crosthwaite, Chung, Dunkley, Shimi, & Cuschieri, 1995; Pietrabissa, Scarcello, & Mosca, 1994). In Birkett et al. (1994) study, only the complex tasks were performed more easily and faster with 3D view than with 2D view whereas no difference between 2D and 3D appeared in the easiest tasks. Divergence in all these results is partially because first-generation 3D systems, with their lower resolution, were compared with standard 2D systems (Falk et al., 2001). Actually, new 3D systems allow to retrieve a natural bi-dimensional view and suppress the bias met in anterior studies. Another bias in all these studies is that they used subjects with very different levels of expertise (medical students versus expert surgeons).

In this study, we used a new generation of 3D system, the da Vinci robotic system, in order to evaluate the impact of 2D and 3D images on surgical tasks performance according to their complexity level and to the subject expertise. We compared the performance of novices subjects (medical students, n=12) with the performance of expert surgeons in classical laparoscopy (n=12) and in robotic surgery (n=4). Subjects performed four motor tasks of increasing complexity.

Our results naturally showed that surgeons performed better than medical students. Moreover, they also emphasized differences between expert surgeons in classical laparoscopy and expert surgeons in robotic surgery. Indeed, our study showed that experts performed not only better than novice subjects but that their sensibility to the difference between 2D versus 3D view had evolved according to their specific expertise. If the performance of novice subjects was in general affected by the 2D images, experts in classical laparoscopy that are used to acting with 2D view were less affected by the 2D-3D view difference. Furthermore, we showed that performance of expert surgeons that are used to acting with both classical (2D view) and robotic (3D view) laparoscopy was affected again by the 2D-3D difference. However, the recovered sensibility to the 2D-3D view difference in this case was not the same as this of novice subjects: expert subjects in both classical and robotic laparoscopy performed in 2D as well as other expert surgeons but their expertise with robotic system allowed them to benefit from the binocular cues and to outperform other expert surgeons in 3D view.

These findings emphasized the impact of new technology use on the expertise. In this study, we observed a double expertise or an expertise with two levels that emerges: the expertise of a domain (surgery, with knowledge about the anatomy and gestures) and the expertise of the instrument (open surgery versus classical or robotic laparoscopy). These two levels challenge the definition of expertise and the training of residents.

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“Risk-free learning for obstetricians and midwives using a childbirth simulator”

This paper presents the advantages of an instrumented childbirth simulator, called BirthSIM, in the framework of training in obstetrics. This simulator has been developed to surpass the constraints linked to the traditional training in a childbirth ward. Simulator training is designed to complete the traditional training used in teaching hospitals. Such a training allows novices to acquire a beginning experience before training in a childbirth ward but it also allows instructors to improve the teaching gestures without constraints. A clinical study of the forceps blades placement gesture with several novices who trained on a childbirth simulator was conducted. The results clearly show the progress in the obstetric gestures of the novices after using the simulator.

Lucile Vadcard, Vanda Luengo, Dima Mufti-Alchawafa

**Laboratoire CLIPS-IMAG
CNRS, UJF and INPG, Grenoble, France**

“TELEOS, a Technology Enhanced Learning Environment for Orthopaedic Surgery”

This paper describes an interdisciplinary approach for the design of a technology-based learning environment for the learning of some pragmatic concepts in orthopaedic surgery. We present how the didactical analysis of teaching and learning in the workplace gives a framework to build the computational representation of knowledge. The TELEOS system comprises the following main components:

- a working environment, composed of a simulator which allows users to place a pin through the patient bone and to ask appropriate X-rays; an online course with semantic tagging and a database of medical cases
- a model of knowledge, describing relations between problems and knowledge in terms of actions and controls
- a model of diagnosis which interprets the users' actions in terms of knowledge, according to the previous model of knowledge
- a model of the didactical decision, which uses the diagnosis results to choose the more relevant feedback to provide users according to their problem solving process. This feedback can be another problem to solve, a part of an online course to consult, or a clinical case to consult.

We will detail all these components, and show through the example of TELEOS that the presented approach is efficient for other domain of vocational training. We will also present and discuss some perspectives of this work: its validations, and the extension of the work to the learning of perceptive and gestural knowledge.

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“The relation of co-designers' computer-mediated interactions to their knowledge dynamics”

In industry, the activity of design is increasingly composed of periods of synchronous collaborative work, oftentimes carried out at a distance. Researchers that study design in order to understand the activities and the reasoning of designers employ two main methodologies: ethnographic observation (Bucciarelli, 1996; Visser, 1990), and different types of experimental studies (Pahl, Badke-Schaub & Frankenberger, 1999; Thomas, & Carrol, 1979) some of which involve coding dialogue (Cardella, Atman & Adams, 2006; Parent, 1997; Baker, Detienne, Lund & Séjourné, forthcoming; Green, Kennedy & McGown, 2002; Prudhomme, Pourroy & Lund, submitted; Cross, Christiaans & Dorst 1997). However, merely understanding *how* designers work in teams of two or more can be seen as part of a larger research methodology such as the one proposed by Blessing & Chakrabarti, (2002) where the final objective is to improve the industrial design process in measurable ways, often by the introduction of improved guidelines, methods or tools.

Blessing & Chakrabarti (op. cit.) make two points, interesting for the research presented here. Firstly, while each discipline has its specific research methods, underlying paradigms and assumptions, many of these methods are either poorly or unsuitably applied in research on design. Secondly, transforming the findings of descriptive studies into implemented support for design is problematic because the findings characterize existing processes and not the hypothetically improved processes. If difficulties are uncovered in existing processes, the question becomes how to alleviate them in the new proposed process. It may not be immediately evident what to change, and proposed changes must be evaluated, signifying another study. This second study can never be strictly identical to the first, thus posing problems for cause and effect chains and validation in general (Salomon, 1991).

In this article we propose a first response to these two criticisms of research in design. Firstly, we will present the theoretical framework and assumptions underlying conversation analysis and interaction analysis. In addition, we will compare the notion of a design experiment in educational psychology and in research on design. This will lead us to present our methodology of interaction analysis. In this way, we hope to introduce a theoretically grounded method of computer-mediated interaction analysis to the field of research in design and respond to the first point of Blessing & Chakrabarti. Secondly, we will describe an initial empirical study during which interaction analysis was carried out on the computer-mediated interactions of student co-designers in a university setting. A second complementary analysis of an observational study at Volvo IT (Information Technology) is in progress. The results will show how interaction analysis can contribute to understanding co-designers' activities and reasoning. Finally, we will hypothesize about how these results could help us improve co-design and how this improvement could be measured.

Leif Lahn

InterMedia

University of Oslo, Norway

“Developing learning portals in working life. Experiences with participative design in industrial firms and the service sector”

Since the 1990ties “e-learning” and “learning portals” have become buzzwords that support the vision of a new working life where knowledge is needed, created and reshuffled. Very often e-learning systems are introduced in the work place as part of a larger initiative by companies to reorganize work and promote human resource development. Their success is usually dependent on active users providing input to databases, discussion groups etc, but often participation is quite low and short-lived. Thus these systems turn into somewhat impoverished learning environments, and finally the most eager users leave the arena.

In order to forestall these vicious circles of non-use several authors been favouring participative design when work-integrated e-learning systems are to be developed and implemented. In this paper I will present and discuss two research projects where these issues are addressed, and where the work contexts are quite different – in printing companies and gas stations. They also represent opposites in educational aims since the first case was a transformation of a subject called “colour management” into a web-based application, whereas the second would support informal learning and interactions with customers.

In my discussion of these two cases I will not make any strong claim about the general validity of the different versions of participative design that were used. My aim here is to be more modest – when specifying organizational and didactical contingencies that need to be addressed when we want to understand the development and implementation of work-integrated e-learning systems. First I will outline two traditions of participative design – one focusing on work redesign and the other on system development. These will be related to issues of e-learning at the work place and the institutional and cultural contexts that framed the way our projects were operationalised. Then I go into each of the cases with an eye on the differences in design strategies. This part of the presentation focuses on the methods used and their relative contribution to the processes and output. The concluding discussion will recapitulate some of the contrasts between different versions of participative design in working life and raise the issue of ecological fit between methodological repertoire, the object of development and contextual factors like work organisation and content.

Tuesday, 14th

Invited speaker – Janine Rogalski

University Paris 8, France

“Didactical transposition in vocational training”

After an overview of the notion of professional competence, the issue of the didactical transposition of work situations is developed. Some differences are underlined between « academic » training as analysed in disciplinary didactics and vocational training, object of research of vocational didactics. (in French: « didactique professionnelle »). Focus on knowledge and focus on competence are differentiated. A model of « twofold regulation of activity » (Leplat, 1997) is presented, which will be used for analysing the transposition process of target situations into didactical ones. The relationship between the objectives in terms of development of professional competence and the conservation of work situations functionalities is presented for an open conclusion.

Annie Bessot, Colette Laborde and Laure Metzler

**Laboratoire Leibniz and IAM
University of Grenoble, France**

“Designing a simulator for marking out in building trades and using it in vocational education”

This paper deals with the design, the production and the uses of a simulator for the activity of *marking out* on building sites from reading a marked plan. The main design principle of this simulator lies in that *it is not meant for reproducing accurately the real context* of the activity but *it should offer the possibility of posing problems of the work situation* through a prior conceptual analysis of the professional activity.

Bertrand David, René Chalon, Olivier Champalle, Guillaume Masserey

**Laboratoire ICTT
Ecole Centrale de Lyon, France**

“Mobile contextual cooperative learning - a step further to mastering professional and domestic appliances”

In this paper we describe our approach which objective is to apply MOCOCO concepts to e-learning. After a short presentation of MOCOCO (Mobility, COoperation, COntextualisation) and IMERA (Mobile Interaction in the Augmented Real Environment) principles we will discuss their use in a project called HMTD (Help Me To Do) which aim is to use wearable computer for a framework of activities of better use, maintenance and repairing of domestic and professional appliances. We will successively describe m-learning scope, contextualisation and cooperation advantages as well as learning methods. A case of configuration of wearable computer and its peripherals, taking into account context, in-situ storage, traceability and regulation in these activities finishes this paper.

Michelle Joab

**LIRMM
Montpellier, France**

“Simulation-based training : trends and challenge”

Today, Simulation-Based Training is currently used for vocational training. We will focus our talk on the design of the learning environment including simulation-based functionalities. First we will classify these learning environments according to different directions: the actors, the technical aspects, the learning design. Then we will present the difficulties to build generic solutions while abstracting learning contexts.

Aurel Messas

**Max Fourestier Hospital
Nanterre, France**

“An Online Video simulator to shorten and secure laparoscopic learning period”

Subject:

Laparoscopic learning period is correlated with a higher morbidity risk, and longer operative time.

Objectives:

To create a video simulator to confront the beginners to difficulties and complications occurring during the learning period

Materiel and Methods:

Between 1999 and 2006 we prospectively recorded laparoscopic procedures performed by 14 different surgeons in 6 different centers.

A retrospective step-by-step video analysis has been performed in order to identify difficult situation, mishaps, and ideal dissections.

Each difficult surgical situation has been classified as Anatomical, Instrumental, Strategical, Technical or in relation with the first assistant.

For each difficult situation, a second comparative video analysis was performed to identify « good reaction » of the surgeon leading to a resolution of the difficulty or « bad reaction » leading to complication or persistent difficulty.

Results:

1800 hours of surgery have been recorded.

Retrospective video analysis has been performed for 60 laparoscopic sacral colpopexy.

We created short cuts corresponding to each difficulty, complication, good or bad reaction.

A problem base learning model has been created: it is an interactive online video course: 1. A video shows a difficult situation, 2. A multiple-choice question is asked offering different options for reaction, 3. A good answer leads to watch the nice dissection and the next step with another question, 4 a bad answer leads to watch the complication or difficulty resulting of an inappropriate reaction to the difficult situation and to go back to another case at the same step of the procedure.

A web site allowing playing interactive video courses has been created.

Conclusion:

The online video Simulator is a problem base-learning model that can give safe and realistic

experience of difficulties and complications occurring during the learning period. Further studies will evaluate its ability to shorten and secure the learning period in surgery.

François Curnier

Digisens SA

Ferney-Voltaire, France

“Virtual reality simulator for hard tissue drilling : A dental application”

You see the tooth and you feel the necessary force to do an adequate drilling, only anxious patient is missing! This is a simulator allowing teaching dental gesture on virtual teeth. Dentistry has resolved the ethic, sanitary and shortage problems linked to use of extracted teeth for dental teaching purpose thanks to virtual reality. The system is PC based with a real time drilling software and a special hardware device: known as a force feed back arm.

This arm is a kind of dental hand piece which simulates tactile sensation. This hand piece give to computer its space location and the computer sends back orders to electrical motors to simulate material resistance. Thus, the computer can simulate a response to the force applied by the user hand, with criteria like tooth surface stiffness or the type of bur balancing this way the force the operator feel. Using teeth models generated by CT or μ CT, the learner immersion in this virtual visual and tactile world is very near from reality. The visualisation options include transparencies, slice mode and many others views that are not possible in the reality allowing a better understanding between anatomy and care. The software interactivity is problem solving oriented, with direct access to in line database. Last but not the least a self assessment tool is embedded and the simulator can be run on a laptop for a complete autonomous learning experience.

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**²Interaction Design Centre
University of Limerick, Ireland**

“Design Based Medical Training:

The application of design based method and embodied technology for training medical procedural skills”

This paper describes a series of studies intending to investigate the possibilities of introduction novel computer technologies in medical training to support effectively doctors' psychomotor learning. The design based approach refers to involving the end users (in this case medical trainers and trainees) in the design process of a teaching device or a curriculum. We focus on the application of these methods and embodied technologies to the training of anaesthetist doctors in the technique of spinal anaesthesia.

The research is carried out in collaboration between the Department of Anaesthesia and Intensive Care Medicine, Cork University Hospital (CUH) and the Interaction Design Centre (IDC), University of Limerick, Ireland.

Wednesday 15th

Invited speaker – Annie Luciani

ACROE-IMAG

INPG, Grenoble, France

“Professionnal gestures and multisensory interaction in computer mediated tasks performance and learning”

We will present first a conceptual framework allowing to answer to why and how introduce force feedback gestural interaction in performing and teaching manual or non manual tasks in a multisensory context with visual and auditory returns. We will introduce the concept of ergotic interaction and ergotic tasks. It will lead to some recommendations in technological systems and tasks analysis. In this context, we will present the haptic simulator developed by the laboratory and based on the flexible high fidelity Ergos technology.

We will illustrate such conceptual and technological issues with an exemplary case that is the understanding and learning of non-sensorial physical complex phenomena as those existing in nanophysics.

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“Collaborative Learning and Free Linguistic Resources Collecting for Technical English Vocabulary”

The collaborative construction of free lexical resources is hampered by the impossibility to obtain many small, free and voluntary contributions. IToldU (Interactive Technical On-Line Dictionary for Universities) is a light web service to be used for the collaborative construction of a bilingual lexicon by a small community (typically, a batch of students) in the context of learning a foreign language specialized in some technical or “pseudotechnical” (specific) domains. Contributions are thus freely offered but constrained, because part of the students’ English grade is computed by IToldU itself.

In the current version, the students contribute to their personal lexicon through the shared IToldU dictionary, each personal lexicon is only a selection of entries of the shared dictionary, which consists of the set of all the contributions. IN our context, we are building an English-French technical dictionary, but the system can be used for other pairs of languages. A dictionary entry contains:

- an English term (word or expression),
- a French translation
- an example of use in context
- a domain (from a list of about 20)

- a source (book/magazine reference, website, class/lab, invented, etc)

The use of IToldU for teaching second language learners that kind of technical vocabulary is a very good alternative to the usual exercises such as MCQ, cross-words, and other kinds of quizzes. It leads to a change in the learner's way of listening, as s/he begins to take notes for later contributing "cooperatively" to the collaborative dictionary.

In the last 2 years, IToldU allowed us to collect a sizable amount of "free lexical resources".

- During the first year, we had 180 students (15 classes, 6 teachers), who produced 17000 entries. About 95% of the translations were correct, but about 35% of the 'examples of use in context' contained English mistakes.

- During the second year, we had only 120 students (again 15 classes, 6 teachers) and we limited their production to 60 entries each (half technical, half general) while insisting on the quality of the "examples of use". They produced about 6000 new entries.

There are 2 scenarios of use:

- by students: each student has a considerable amount of texts to read, and is requested to build his/her personal dictionary in IToldU. As s/he encounters a term in English that s/he doesn't know, s/he can search the entire IToldU dictionary database, to check whether some other student has entered an entry for that term. If yes, s/he may import it in his/her personal dictionary, or create a new entry. IToldU gives him/her some points, and, in the case of import, also to the "giver".

- by teachers: the goal is to quickly evaluate their students' contributions. A teacher can display each student's personal dictionary, ordered by various criteria (domain, type of contribution: original work or adoption of another student's contribution), and statistics concerning his/her classes (and comparisons with other classes).

This year, we also have 120 students and we will try to integrate some improvements. This includes a better management of classes and their access rights, as well as the introduction of a simple marking and correction process: teachers should only highlight errors, and students should correct them themselves before a certain deadline.

Poster session

Mohamed Belgacem, Mourad Mars

Laboratoire LIDILEM

Université Stendhal, Grenoble, France

“Development of a morphological analyser for Arabic language, Tool for creation of educational activities of training of Arabic”

If a contribution of the Natural Language Processing (NLP) for the training languages system's development is not more to disassemble, this development requires a performing TAL tools and robusts and has a big language cover. For Arabic, the majority of these tools must be created. The work, that we present, concerns the creation of a morphological analyser for Arabic language. It will be integrated in the MIRTO platform developed by the LIDILEM laboratory. This tool will serve for automatic and semi-automatic creation of educational activities for the training of Arabic.

The morphological analysis of the Arabian language presents the difficulties due to this language word's structure. The omnipresent agglutination phenomenon makes delicate the creation of the morphological analyser and needs more treatments and specific tools.

For realization of our morphological analyser we achieved three labelled dictionaries: a dictionary of pre-bases, a dictionary of post-bases and a dictionary of Arabian bases. The two first dictionaries are structured in form of the morphology classes to facilitate the verification of each decomposition. Moreover, at the time of the carving we should be able to restore the good shape of the lexemes, because the concatenation of some pre-bases and post-bases with the corresponding base generates some transformations that must remain reversible, that pushed us to achieve a basis of the transformation's rules (Morphological constraints) to get the right lexemes. After the phase of decomposition, we apply the rules for reconstitution of basis and for validation of the morphemes. Finally, the phase of verification with the morphological classes allows a final validation of the analysis of this word to assign a final label to the graphic word as a whole, we repeat this treatment for all valid decomposition of this word.

Our research continues currently, by the creation of a module permitting to treat the morphological ambiguities and to arrive at a single solution for each word of an Arabic text.

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“Argumentation as support of the knowledge - dynamics analysis in a synchronous situation of co-design”

The present study takes place in the concurrent industrial design research field. We attempt to understand how designers in order to reach an agreement about a product to design are reasoning and sharing their knowledge. They have to succeed in building the same

representation of the product in order to find a common solution to the design problem. We therefore developed an experimental situation to study argumentative processes occurring during a design meeting. Three students were asked to design a mechanical piece using the collaborative platform called Drew which has the particularity of recording activity by tracing the interactions. Based on these traces, we conducted an analysis using two different types of graphical representations: a temporal graph and a relational graph. These representations allowed us to understand how the common solution was built through argumentative interactions. We propose here an original methodology to analyze interactions. Our main objective is the elaboration of a model of argumentative reasoning underlying solution elaboration in collaborative design.

Mohsen Maraoui

**Laboratoire LIDILEM
Université Stendhal, Grenoble, France**

“Automatic tagging system of the Arab roots for learning”

Within the framework of our research, which consists on the integration of the Arab language in platform MIRTO (Interactive Multi-trainings by Research on Texts and the Oral examination), we need a reliable analyzer and by consequence an electronic dictionary which is tagged and complete. For this purpose, we began the realization of a dictionary generated and tagged automatically, having, as starting point, the Arab roots and by using the patterns and the meanings. The first task consists on tagging these roots, which pushed us to carry out a label-maker for the Arab roots. We will present initially the architecture of our tool and afterwards its didactic utility.

Luc Maréchal, Christine Barthod

**SYMME Polytech' Savoie
Université de Savoie, Annecy, France**

“Characterisation and learning of the gesture for respiratory physiotherapy act on babies”

Bronchiolitis is a serious increasing disease that obstructs babies' respiratory tract. Respiratory physiotherapy is more and more used to provide cares. The aim for this technique is to generate forced respirations in order to improve bronchial pulmonary exchanges. It may be dangerous for the treated baby if not well executed. To date, there is no study about applied forces and induced displacements on baby during chest physiotherapy act. We will present the development of an instrumented glove for hand force and displacement measurement. Force Sensing Resistor sensors placed at relevant points on the glove provide distribution of mechanical pressures applied by the hands on baby's chest. Simultaneously, magnetic sensors give their relative space positions. Sensors' associated electronics are digitalized. A language G program (LabVIEW) was specifically developed. Collected measurements on babies will fulfil a data base and the characteristic parameters of the practitioner's gesture will be stressed on. Furthermore this data base will be used to design a “thoracic paediatric” simulator for improving the technique and the learning of the gesture in respiratory physiotherapy.

Kornelia Todorova

**Department of Information Technologies, Faculty of Mathematics and Informatics
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“Interactive multimedia course for teachers education in e-learning concept and its possible application in vocation training and educational process”

In this paper are described main characteristics of interactive multimedia systems and their advantages as tools for knowledge distribution and providing effective and high quality professional training.

Features of interactivity are discussed and advantages of interactive multimedia presentation are presented. Principles and assumption of two cognitive theories are overviewed and their application in development of digital learning materials is demonstrated.

Basic problems related to development of interactive multimedia digital learning content are discussed and possible solutions are proposed. Tests for evaluation of interactivity and quality of developed learning content are described and implemented for assessment of learning content effectivity.