ICTE Journal

http://periodika.osu.cz/ictejournal/

Publication Platform for Ph.D. Students

We were pleased to be able to publish this second issue of the electronic periodical named ICTE Journal and we believe it will be a source of quality information and inspiration for your own work. This issue contains three articles and their focus shows that the topic of ICT in education is truly wide.

The first paper, Adaptive Forms of eLearning, deals with individualised forms of education that put emphasis on respecting the differences of individual students and their specific learning styles. These forms can also be used in traditional class teaching, but the use of ICT tools and adaptive eLearning truly opens the wide field of their full potential.

You will find the second article, Optimizing Video Clips in Educational Materials, highly interesting and practical. As the author claims, the use of videos from digital cameras has become a standard part of education, yet the issues with this format, especially the video quality, remain. The video quality often gets degraded in the final phases of implementation into educational courses, which is rather unfortunate. For this reason, the author of the paper offers general explanations and practical procedures to create high quality videos in regards of their content and technical aspects.

The third article called System for Creation of a Dictionary: Icelandic-Czech Students' Dictionary introduces a truly original and fresh topic. The article describes the history of developing the application Dictionary System, and the methods of programming and creating a lexicographic tool for compiling dictionaries and encyclopaedias. This system was used to create the Icelandic-Czech Students' Dictionary.

As usually, our publication finishes with the appendix that deals with the possibilities and tasks of the Ph.D. students of Information Technologies in Education at the ICT Department of the Pedagogical Faculty of University of Ostrava. The Ph.D. studies are connected with the offer introduced in the title of this editorial. We believe this periodical is aproper publication platform for Ph.D. students, who are required to publish during their studies anyway. ICTE Journal meets the essential criteria for a quality publication (received articles must pass a standard editorial and reviewing process and the publication has international reach); at the same time, a well written and quality paper has a high chance for timely publishing. Therefore we have a message for all talented Ph.D. students out there: Start publishing now!

Pavel Kapoun
Executive Editor

ADAPTIVE FORM OF ELEARNING

Kateřina Kostolányová, Jana Šarmanová, Ondřej Takács
Department of Information and Communication Technologies, Pedagogical Faculty,
University of Ostrava, Fráni Šrámka 3, Ostrava-Mariánské Hory, Czech Republic
{katerina.kostolanyova; jana.sarmanova; ondrej.takacs}@osu.cz

Abstract

Among classic and electronic forms of education, a new type is being considered – the individualised form of education. The main reasoning behind individualised education is to respect differences of individual students. This individualised form of education in connection with the ever-present ICT devices leads to a new form of education – adaptive eLearning: a form of educational process that is in harmony with individual needs of students. This article deals with the basic principles of creating adaptive learning environment; with the current conditions of this issue in the Czech Republic and abroad; and with the outline of possible solutions to the adaptive electronic teaching process. In the second half of the article, the structure of adaptive study aids is described in detail.

Keywords

learning style, teaching style, virtual teacher, learning framework and layers

A Little Excursion into History of eLearning

Towards the end of the last century, eLearning has become a new modern trend in education. The development and definition of eLearning has been shaped by the struggle between the pedagogical and the technological approach to eLearning and the development of new technologies. Most authors agree that the basis of eLearning can be seen in the computer based training (CBT) – utilising computer and managed (programmed) teaching with the use of multimedia. What can be said about that period, from today's perspective, is that it did not have the characteristic „study anytime, anywhere" flavour. This type is still prominent nowadays with the significant development of multimedia.

Year 1999 is connected with the „birth" of eLearning in the sense of LMS = learning management system, which enables distribution of various courses through the web, with the well known „anytime, anywhere" concept of education, also known as 24/7/365, i.e. 24 hours a day, 7 days a week, all year long! The LMS brings forth completely new ways of administration and help to students, teachers and administrators.

Current LMSs are being constantly improved, which, together with the development of hardware, software and even the internet, shows a bright future for eLearning. Pedagogical approach, which has become more prominent since 2002, together with professional management and blended learning, as well as unequivocally positive results of some

universities and companies, these all show that eLearning has its advantages and can be effective not only for distant and combined forms of studies, but for full-time studies as well.

Need for New Forms of Teaching

The educational process is currently being more and more affected by new technologies and new pedagogical & psychological approaches. In today's information society, new ever increasing requirements are being created constantly for improving the educational process. At the same time, the need for and necessity of long-life learning is rising. Requirements put on teachers are gradually transforming; according to modern experts, teachers should become „guides" through education and empathetic partners to students. Their role is shifting from former directive status „closer to students". Use of modern methods in education is therefore expected more than ever.

eLearning is utilised in many ways, from the simplest form of providing students with study materials on the web or in electronic form in PDF format to using modern applications that manage teaching and many related activities of both the teacher and student (LMS). Student can take either passive or active role. For the time being, students cannot really impact the teaching process of which they are part of. Published works provide various recommendations, rules or theories that aim to make learning better and easier. This generalisation, however, suppresses the individuality of students. Known and used theories are often based only on already gained knowledge of students and do not take into account their individual learning characteristics and needs, the use of which would help them to understand the subject matter better and more effectively (Mareš, 1998).

In traditional education, teacher teaches all students in the same way. Even though they are aware that each student is a unique individual (has their own preferences, input knowledge, learning style, etc.), it is not possible to approach every student individually during classes. Teachers can only adapt their teaching to accommodate the majority of their students. Different situation arises when the teacher or tutor and the students are not in direct contact, i.e. face-to-face. In such a scenario, teacher must prepare all study materials and organisational guidelines for students in order for them to have minimal problems while going through their studies. This form of education is nowadays most frequently organised with LMSs. This form is called the eLearning education managed by the LMS.

Yet not even this form provides teaching approach that would be adapted to the specificity of each individual. Subject matter is provided in a unified compact form with precisely planned milestones throughout the course. This path is not suitable for everybody. Modern information and communication technologies, the possibilities of vast databases, multimedia tools, the internet and other means for the individualisation of studies make the individualisation possible.

Current situation

Foreign solving of the issue of adaptive learning is fairly frequent, but not always complex enough from the pedagogical-psychological-informatical viewpoint. We introduce the newest researches done in this field, and summarise some of the results later on that will be taken into consideration during our own research.

Peter Brusilovsky has been dealing with the issues of adaptive systems for more than 20 years. He has published several works and edited a few books on adaptive hypermedia and adaptive web. Bibliographic search of his work will be the basis for orienting in adaptive systems.

Brusilovsky published an article called Methods and Techniques of Adaptive Hypermedia that summarises that time knowledge of adaptive hypermedia (AH), and adaptive systems created up till then. In order for a system to be called adaptive, it needs to be hypertextual and hyper-medial, it should have a user model and should be able to adapt hypermedia according to this model. Adaptive techniques have been divided by Brusilovsky to adaptive navigation and adaptive presentation. Adaptive presentation is based on the idea of different adaptive presentation techniques that would adapt the content of the pages for the user on the basis of their current knowledge, goals and other characteristics. Adaptive navigation helps users to find their way through hyper-space by adjusting the design of the presentation with links to goals, knowledge, qualities and other characteristics of individual users (Brusilovsky, 1996).

From his publications (Brusilovsky, 2001a, Brusilovsky, 2003a), it is obvious that the field of adaptive hypermedia systems has moved towards learning styles. The author ponders the problem of systems that try to adapt to learning styles without actually being aware which aspects of the learning styles are worth being modelled upon, and what can be done differently for users with different learning styles (Brusilovsky, 2001b). Besides adaptation in navigation and presentation, adaptation in content selection has been added.

Web adaptive systems now already have several generations. First generation was based on the mentioned adaptation of presentation and on supporting adaptive navigation. It focused on users' knowledge and on modelling their aims. Supporting adaptive navigation can speed up the navigation and learning, while adaptive presentation can improve the understanding of the content.

Second generation of adaptive webs expanded adaptive hypermedia with research on adaptive content selection and adaptive recommendations based on the model of users' interests. The third, „mobile" generation incorporated adaptation of added models of content (place, time, device platform, bandwidth) to the classic user model and examines the use of known technologies in adapting teaching to individual users but also to the context of their work (Brusilovsky, 2003b). Authors of adaptive web systems also examine how to organise storage of users' information, how to fill in the data and how to retain user's current status (Brusilovsky, Millán, 2007).

The following articles (Brusilovsky, 2008, Sosnovsky, 2009, Hsiao, 2011) deal with partial issues. The articles deal with, e.g. the possibility of unifying student's profile for integration into different web-based adaptive systems; creation of the adaptive system guide; and creation of communication interface for students.

The field of adaptive teaching is also touched in the article called *Behaviour Based Adaptive Navigation Support* (Holub, M., Bieliková, M., 2010). The authors introduce a method of supporting adaptive navigation and link recommendation. The method is based on the analysis of user's navigation structure and their behaviour on web pages when browsing through a web portal. Interesting information is chosen from the web portal and recommended by the system. The used criterion is not user's rating of pages and their contents but their preferred choice of pages.

Another article by the same authors, *On the Impact of Adaptive Test Question Selection for Learning Efficiency*, presents a method of adaptive selection of test questions in a web-based education system according to students' needs. The aim is to choose a question from a set of existing ones that is most suitable for the student, together with its content. Authors recommend an adaptive approach to question selection using three methods that are applied step by step as selection filters.

Principles of Creating Adaptive Environment – Module Creation

Current LMSs contain study aids, manage teaching, keep student records, their activities and results, but they do not work with learning styles. The curriculum is provided to all students in a same manner, without taking their learning styles and levels of knowledge into consideration. When students are not in direct contact with their teacher, they learn from textbooks. Textbook authors try to construct topics in a way to be accessible for the majority of readers, leaving some students and their specific learning styles behind. The question is if the progress through electronic study course can be modelled in such a way to be convenient for every student. We are trying to find methodology and algorithms to search for optimal progress that would respect differences among students on the basis of discovering their learning styles and in accordance with their knowledge and skills as they change during the course of study. Identifying learning needs of students and providing suitable and appropriate study materials for them accordingly. The result of our efforts should be an adaptive eLearning environment that is able to automatically adapt to specific requirements of students through created expert system.

The structure of the newly created electronic adaptive environment comprises of three modules – student module, author module and adaptive module.

Module Student

As the name suggests, this module is intended primarily for students. Generally speaking, students have different motivation to learning, different family background, different habits of when and how to learn, different preliminary knowledge of the currently studied subject, different degree of talent for different fields, diverse learning styles, types of memory and memory training, they need different depth of knowledge, understanding, use and application of obtained knowledge, they can be focused or tired, etc.

If we combine the previously mentioned characteristics, we obtain the learning style of the student. Currently there are many sub-categories of learning styles by various authors. By analysing and studying the already published classifications, the following characteristics have been selected as suitable for consideration in eLearning. The characteristics are divided into several groups:

1) Sensory perception – describes the form student prefers for receiving (offering) information. Visual type prefers diagrams, pictures, charts and graphs. Auditive type prefers spoken word and contact with other people. Kinaesthetic type likes practical examples, models and practical information. Verbal types prefer using textual form of information (Fleming, 1992 in Kostolánayová, 2010).

2) Social aspects deal with what kind of company students enjoy while learning, whether with other students, with teacher or alone (Mareš, 1998 in Kostolányová, 2010).

3) Affective characteristics deal with the emotions and attitudes of students that impact learning. The most important characteristic of this category is motivation, which can be examined in two components – external and internal. While the source of external motivation can be found in external conditions, e.g. working requirements, parents, etc. internal motivation comes from within the student (Mareš, 1998 in Kostolányová, 2010).

4) Learning tactics describe the way (methodology) in which the student learns. Systematicness of learning describes whether the learning is done in successive logical

steps (order) or somewhat randomly, without any obvious connection in great leaps (freedom) (Felder, 1998 in Kostolányová, 2010).

5) The way of learning divides tactics into theoretical deduction, which characterises students that prefer in-depth contemplation over the newly gained knowledge, and into experimental tactic used by students who like to actively try the newly learnt (Felder, 2009 in Kostolányová, 2010).

6) The progress of learning divides tactics into detailistic, which focuses on minute details of specific information that gradually create the whole image, and into holistic, which focuses on big parts of abstract information, making its way to details afterwards (Sternberg, 1999 in Kostolányová, 2010).

7) Student's learning can be divided into three levels: in-depth learning, in which student's main interest is to understand the subject matter; strategic, in which the student wants to effectively achieve the best possible results; and superficial, in which the student aims to simply pass the minimum requirements (Entwistle, 2000 in Kostolányová, 2010).

8) Self-regulation of learning shows the degree to which the student is able to independently manage their studies. This then determines the amount of external control during studies; on one end there are students needing precise guidance, on the other end there are students who like to manage their studies on their own (Mareš, 1994 in Kostolányová, 2010).

Module Author

In order for the student to be able to learn on their own, they need to have learning material at their disposal. If the provided curriculum is to be adapted to the corresponding learning style of the student, their personality, depth of knowledge and other characteristics, the teaching material needs to be created in different versions, with different details and various multimedia elements.

Each chapter of each thematic whole presents the curriculum in a structured form – chapters are divided into sub-chapters, paragraphs, etc. The smallest compact unit providing information will be called frame. The frame corresponds with the lowest level of numbered or otherwise marked paragraphs or with one web page including all multimedia elements.

It needs to be noted that the structure and form of each frame is individual. Students with abstract thinking and solid theoretic background will appreciate curriculum distributed in different way than those students who, in order to understand the issues better, need to try everything hands on, understand the meaning and importance of new information and only then will they be willing to accept a given theory. Similarly, students who enjoy written information will appreciate different kind of frames than students with acoustic memory, or students with visual memory, etc. Each frame can be presented with different information depth – from superficial frames with basic information to complex sets of knowledge of the given topic (Kostolányová, 2009).

It has been decided beforehand that each frame will be discriminated by the form of instruction, level of detail and progression of the lecture. Each frame is always divided into an instruction part and a testing part. The instruction part is further divided in accordance with traditional teaching into individual layers – theoretical, semantic, fixation part, practical and motivational. Interactive combinations of these layers will create different progressions of lectures. The testing part consists of various types of questions, tasks to be solved, practical exercises, etc. For clear characterisation of each frame version it is crucial to describe it with adaptive

algorithm – metadata. Creating this type of „adaptive textbook" is much more demanding than the creation of classic teaching texts or textbooks (will be discussed further).

Adaptive Module

If we prepare adequate study materials (module author) while accepting personality characteristics of the student (module student), we acquire the basis for creating the last module – the adaptive module. This module will be targeted on a specific student, or rather a group of students with shared personality characteristics. Creation of the adaptive module is the most difficult one – the most crucial part is to describe rules that will govern the optimal selection of suitable frame versions. The frames will then be presented to the student, continuously checked with theoretic questions and exercises, and if the student passes the frame, they will be able to continue with the course. In the opposite scenario, if they fail the frame, they will be explained the curriculum in a different, more comprehensive way, with additional exercises for revision, and thus be able to pass the frame.

Creation of the adaptive module requires a team of experts from different areas:

- pedagogical experts creating the professional aspect of the frames;

- psychologists collaborating on the student's personality aspect;

- information specialists implementing the created materials into the teaching environment of the authorial database and monitoring all activities of specific students that use the adaptive eLearning.

The aim of the above mentioned team is to guide the student to the defined targeted state, i.e. knowledge of specific thematic unit.

The principle of adaptive learning environment can be schematically depicted by the following diagram:
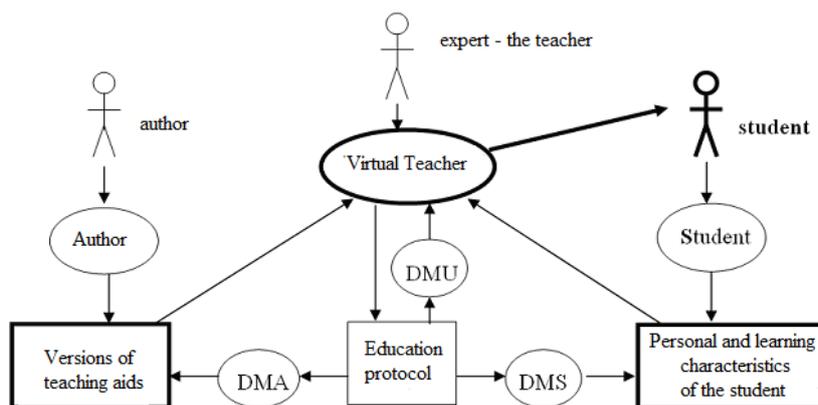
Fig.1: Model of adaptive learning environment
(DMA, DMU, DMS = datamaning from autor, teacher, student)

The key figure is the student, for whom the whole system is being built. We need to know enough information about the student, so that the system can adequately react to their current knowledge and learning characteristics. Through the Student Module (right part of the diagram) the system can test each student or use suitable questionnaire to find out and save their characteristics in student database.

The second supportive module is the Author (left part of the diagram). It serves for saving or modifying teaching aids in the authorial database. The database contains not only texts, pictures, multimedia, etc. for teaching, but also enough information about them, the so-called metadata. This data contains information about every part of every teaching aid, e.g. whether it's a definition, motivation for students, independent task, etc.

The actual managing programme Virtual Teacher (ellipse in the middle top section) will then load all the required information about the student, all the information about the structure of the given teaching material, and determine – on the basis of this information – optimal education method. To do this, it requires the pedagogical-psychological knowledge mentioned in the previous chapters and with this information it creates detailed plan of the education process. It comprises of a certain expert system that contains basic pedagogical rules, which it then uses to create optimal teaching style for a specific student with an optimal guidance through specific teaching material.

Adaptable Teaching Aids

To know the learning style of a specific student is not enough. In order to individually adapt the educating, the teaching aid needs to be created differently. It must be adaptable, changeable. What does adaptable teaching aid mean then?

The structure of the textual part of eLearning teaching aids is usually identical with the structure of classic textbooks. ELearning aid is usually supplemented with multimedia elements, tests, organisational and communication tools, etc. Because every author has their own style of instruction and knowledge testing, the structure of their textbooks usually corresponds with their teaching style. Authors often create precise theories without describing them more loosely and demonstrating them on practical examples of their applications; others will focus on many practical examples without thorough definition of the theory and its terminology, etc.

In order for the eLearning system to be able to adapt education, it has to have variably created teaching aids at its disposal and be able to present them to each student differently. One of the approaches is for the author to create several textbooks on the same topic, while using different teaching style each time; this method is not very suitable, however. Firstly, author with their own specific teaching style will have hard time using completely different teaching styles; secondly, there are numerous types of students – creating new teaching style for each learning style is completely unrealistic.

The basic difference between the teaching aid forms will be based on the sensory perception of the student. Therefore, each frame will have different sensory versions: one with a prominent text section (for the verbal type of student), one with numerous pictures, graphs, charts and animations (for the visual type), one with spoken word, audio-tracks, communicating and discussions (the auditive type) and another with creative tasks, constructions, etc. (for the kinaesthetic type). Creating these 4 versions according to the sensory form will not be a problem for the author.

Another suitable division of the versions will be by student's conception – in-depth, strategic, superficial, i.e. by the level of „understanding". Experienced teacher will know that some students will only need regular instruction, while others will need slower, more comprehensive instruction rich with examples. Other types will require yet additional information, connection with other subject, so that they do not get bored. Creating 3 versions with different depth of the instruction should not be a problem for the author. Each version needs to be done for the different already mentioned sensory versions.

The learning style of the student is affected by many other characteristics. The study material, however, cannot be multiplied and differentiated infinitely. Let us ponder how the instruction differs for these other characteristics.

Theoretically well prepared study type of student will prefer the classic instruction in the order of: lecture (theory – explanation – examples) – confirmation (control questions – exercises). *Unmotivated* student will be needing motivation to study, for example in the form of motivational practical examples being solved – followed by the explanation of the solving principles – then by theory – and control exercises. Student without *self-regulation* will be needing detailed directions, guidance, what to do or study first, what next. *Holistic* student will need brief overview of the whole chapter before anything else, and only then will they move to detailed information.

Let it be noted that the instruction for different types of students differs mainly in the sequence of delivery of partial information in each version. We will call these partial portions **layers** and analyse the types of occurring layers. This reasoning is in accordance with the definition of the term *teaching method* (Průcha, 1998).

Teaching method: *Procedure, journey, way of teaching. It characterises the activities of the teacher leading the student to set education goals. There are several classifications of the methods, e.g.:*

- *by the phase of teaching process (forming, consolidating, examining knowledge);*

- *by the way of presenting (verbal, visual, practical);*

- *...*

This definition's two classifications formulate the phases of the teaching process, which we further structuralise by layers, and also introduce way of presenting that is in accordance with our combination of sensory forms and layers.

Adaptable Structure of Teaching Aids

Teaching aids need to be structured in a similar fashion, which will allow adapting the teaching style to fit the student's needs by selecting suitable versions of instruction and sequence of individual layers.

Structure of aids and their individual elements will be characterised in detail below:

Subject is the highest unit of a teaching aid; subject is understood as a semestral whole at the university; subject is further divided into lectures.

Lecture is a education unit equal to the classic class/lesson. It does not have to reflect chapter from a textbook, scope of chapters can vary. Lecture divides into frames.

Frame is the elementary part of lecture comprising of single unit education information; this level is analysed for its versions and layers. The so-called basic frame defines the teaching aid's content; the versions of frames differ only in form or depth of instruction, not in content.
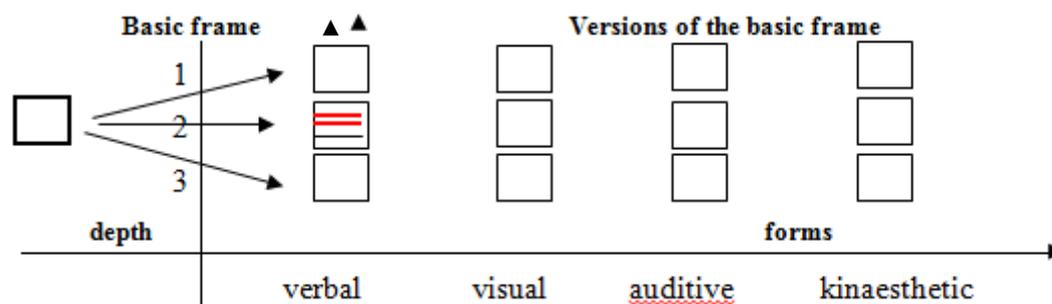
Fig. 2: Variations of framework

Frames versions are different ways of instruction and examination of the same subject matter (Kostolányová, 2010).

Based on the reasoning in the previous paragraph, we propose up to 4 versions by the preferred sensory perception of the student (called also 4 sensory forms of the versions) and up to 3 versions of different depth of instruction. This gives us the total of 4×3 = 12 versions in two „dimensions".

It is not necessary to always utilise all 12 versions. It is left at the discretion of the author of the aid to create those versions that they feel are relevant and leave those that are not needed.

- **Frame versions by the sensory form**

  From the form point of view, we divide version into the four already mentioned types (columns in the chart above):

  Verbal – this version is mostly textual,

  Visual – this version contains many pictures, graphs, animations, etc.

  Auditive – this version contains a lot of spoken word, sounds, videoconferences, etc.

  Kinaesthetic – high number of interactive educational programmes, etc.

  It is rare for any version to be done purely in one form. It is usually a combination of forms and then the author decides on the percentage ratio between each form. The dominant form will drive the categorisation of the version and its place in the „version matrix" above.

- **Frame versions by the depth of instruction**

  Depth of instruction represents the complexity of instruction, specifies the detailedness of provided educational information. So far, we recognise 3 levels of depth.

  Basic level is the depth no. 2. This is the most common type of instruction in terms of detailedness. Its content and scope is decided by the author. Each version can also contain questions or exercises. They can be used by the system to verify that the student understands the subject matter. If the answers are correct, the system provides additional information (additional part of the frame, or next frame) with the same level of depth.

  If the student answers incorrectly, the system can offer more detailed instruction in the 3rd depth level with simpler exercises that are gradually getting more difficult. There are also more questions in smaller units.

  For excelling students who understand quickly, the system can offer additional information, interconnections and relation to other field, etc. within the 1st depth.

- **Layers of the frame versions**

  Variants with different form and depth of instruction would not be enough to cover the necessary differences of the teaching styles. The instruction has to reflect other different personal traits of students. By analysing these students' characteristics we found out that the instruction also differs in the sequence in which partial information and continuous examination is delivered, as well as organisational information.

  Adapting the teaching style of the frame will be enabled by dividing the frame into partial segments – layers (Kostolányová, 2011). The **layer** of the frame represents a homogenous part of the frame in terms of the teaching process (theory introduction; explanation; forming, consolidating & examining knowledge; motivation; managing education).

Types of layers:

- **Explanatory** – group of layers that contain the actual instruction of the given subject matter. It comprises of:

  T **Theoretical** – containing the theory: definition, terms, rules, algorithms, etc. The most important layer from the teaching point of view.

  S **Semantic** – explaining existing terminology, formally describing theory, additional information to the theoretical layer, explains the consequent interconnections of a theory, etc.

  F **Fixating** – to help remember the theory better by using repetition, different wording and alternative terms, explaining the broader context.

  R **Resolved exercises** – contains examples that use the theory, solved „school" examples. They serve as example for solving other exercises delivered to the student.

  P **Practical** – contains solutions to practical, real-life, exercises that use the taught theory.

- **Testing** – group of layers for continuous testing of obtained knowledge; tasks that serve for fixating the knowledge and obtaining practical skills. They comprise of:

  Q **Questions** – questions concerning the given curriculum. They can serve the student only, or they can be used by the adaptive algorithm to manage further instruction.

  E **Exercises** – „School" exercises for solving.

  X **Practical tasks** – real-life tasks.

- **Other layers**

  M **Motivational** – motivational information about the subject, lecture or frame that explain the contribution of this study to the unmotivated student

  N **Navigational** – didactic information, organisational; a certain kind of guidance through the lecture or subject matter and recommended progress through the studies, etc.

Information on the form and depth of the instruction and type of layer must be stored in the metadata. Metadata enables the system to correctly choose and manage the education.

In order for the authors to be able to focus fully on the structuring of the aid and its actual content and not waste time with how to create several versions of it with several layers, the following MS Word form has been created. Authors simply fill it in with their teaching texts. Each version of each frame (sensory and depth) is recorded in an independent form. The left column serves for the actual text of the aid, teaching and testing (i.e. components of the aid); the right column is filled with metadata, i.e. supplementary information about the version type and its parts. The author deals with the actual content of the textbook and they are minimally bothered by recording its classification and metadata (Kostolányová, 2011).

Structuring of the teaching aid helps the author and students to structure their knowledge, discriminate important new terms, understand their interpretation, place them in context of previous knowledge, understand the importance of new knowledge in real-life application, separate pedagogical comments, etc.

Subject: title of the subject

Uni: title of the unit

Framework: title of the framework		
Variant – depth	MFDep= 1-3	
Variant – form	MFor = vis, ..., kin	
Content of the T layer		MVrs = T
...		MVrs = S
		MVrs = F
		MVrs = R
		MVrs = P
		MVrs = M
		MVrs = N
		MVrs = M
		MVrs = L
Title of the question 1_1		MVrs = Q
Text of the question 1_1 xxxxxxxxxxxxxxxx		
var 1		
var 2		
…		
Type of evaluation (absolute, percent)		
Points for a matching answer		
Text of non-typical verbal response to the answer		

Tab. 1: Form for adaptive textbook

Conclusion

The described principles of intelligent teaching clearly demonstrate that the project is wide-ranging and requires cooperation between several types of experts. This brief overview of the whole system of individualised teaching does not mention many partial related problems, both theoretical and practical.

Currently, the Student and the Author subsystems and the majority of the Virtual Teacher subsystem are, concerning the theoretical point of view, solved. The Virtual Teacher subsystem is currently dealing with ambiguous and conflicting situations during the student's teaching style creation and with the theoretical model of protocols and their analyses. Theoretically established subsystems have already been created. The original learning management system (LMS) Barborka – that has been extensively developed and used at the partnership university of the project: VSB-TU Ostrava – has been used for the implementation of the whole system. The Barborka 3 version already has the Student and Author subsystems implemented together with the new Virtual Teacher subsystem that enables adaptable teaching.

Its adaptable version will be launched and pilot tested in real-life teaching.

Individual versions of the teaching material, as has been described above, are needed for the testing. The creation of the teaching materials is being done in parallel with the research on the system. Several subjects from different professional fields have been chosen for teaching aids creation: informatics, foreign language, natural science subject, social science subject, technical subject. In that way, the suitability of the proposed theoretical principles of the structure of the teaching aids will be tested for different types of subjects, therefore showing their usability for adaptive teaching.

In the following development of adaptive process, several other related tasks will have to be solved:

- further analyse and specify the set of characteristics that define learning style of the students;

- formulate additional pedagogical rules that assign a teaching style to its learning counterpart, solve their combinations, or possible conflicts of the rules;

- in connection with the previous point: enlarge current metadata of education elements (frames, versions, layers) with metadata that would enable combinations of elements of different frames, or even lectures or subjects;

- create feedback by analysing the student protocol with statistics and data mining methods and integrate it with the set of virtual students as well as personal traits of the actual students;

- create feedback by analysing the student protocol with statistics and data mining methods and integrate it with the teaching aids of specific subjects and recommend their improvements;

- create feedback by analysing the student protocol with statistics and data mining methods and integrate it with the expert rules of the Virtual Teacher and recommend their modification.

References

BRUSILOVSKY, P. Methods and techniques of adaptive hypermedia. *User Modeling and User Adapted Interaction*. vol. 6, iss. 2–3, 1996, p. 87–129. ISSN 0924-1868.

BRUSILOVSKY, P. Adaptive hypermedia. *User Modeling and User Adapted Interaction*. vol. 11, iss. 1–2, 2001a, p. 87–110. ISSN 0924-1868.

BRUSILOVSKY, P. Methods and Techniques of Adaptive Hypermedia. *User Modeling and User – Adapted Interaction – Special issue on adaptive hypertext and hypermedia*. vol. 6, iss. 2–3, 2001b, p. 87–129. ISSN: 0924-1868.

BRUSILOVSKY, P. Developing adaptive educational hypermedia systems: From design models to authoring tools. In *Authoring Tools for Advanced Technology Learning Environments*. Kluwer Academic Publishers, Lancaster, 2003b, p. 377–409. ISBN 978-1-4020-1772-8.

BRUSILOVSKY, P. and E. MILLÁN. User Models for Adaptive Hypermedia and Adaptive Educational Systems. In *The Adaptive Web*, 2007, p. 3–53. ISBN 978-3-540-72078-2.

BRUSILOVSKY, P. Adaptive Navigation Support for Open Corpus Hypermedia Systems. In *Lecture Notes in Computer Science*. Springer-Verlag Berlin: Heidelberg, 2008. ISBN 978-3-540-70984-8.

FELDER, F. M. and L. K. SILVERMAN. Learning/Teaching styles in engineering education. In *Journal of engineering education*, vol: 78, iss. 8, 1998, p. 674–681. ISSN 0949-149X

HSIAO, I-H. et al. Open Social Student Modeling: Visualizing Student Models with Parallel Introspective Views. In *Lecture Notes in Computer Science*. vol. 6787, 2011, p. 171–182. ISBN 978-3-642-22361-7.

KOMENSKÝ, J. A. Nejnovější metoda jazyků. In *Vybrané spisy Jana Amose Komenského*, sv. III. Praha: SPN, 1964.

KOSTOLÁNYOVÁ, K., J. ŠARMANOVÁ and O. TAKÁCS. Learning styles and individualized e-learning. In I*nformation and Communication Technology in Education*. Ostrava: Ostravská univerzita, 2009, p. 123–127. ISBN 978-80-7368-459-4.

KOSTOLÁNYOVÁ, K., J. ŠARMANOVÁ and O. TAKÁCS. Adaptable Educational Supports. In *Information and Communication Technology in Education.* Ostrava: Ostravská univerzita., 2010, p. 117–121. ISBN 978-80-7368-775-5.

KOSTOLÁNYOVÁ, K. Design of study materials structure for adaptive instruction. In *Information and Communication Technology in Education.* Ostrava: Ostravská univerzita v Ostravě, 2011, p. 193–201. ISBN 978-80-7368-979-7.

MAREŠ, J. Diagnostika stylů učení na počátku vysokoškolského učiva. *Školský psychológ*, č. 3/4, 1994, p. 2–10.

MAREŠ, J. *Styly učení žáků a studentů*. 1. vyd. Praha: Portál, 1998. 239 p. ISBN 80-7178-246-7.

MAREŠ, J. a P. GAVORA. *Anglicko-český pedagogický slovník*. Praha: Portál, 1999. ISBN 80-7178-310-2.

PRŮCHA, J. WALTEROVÁ a E. MAREŠ. *Pedagogický slovník*. Praha: Portál, 2009. ISBN 978-80-7367-647-6.

Optimizing Video Clips in Educational Materials

Aleš Oujezdský
Department of Information and Communication Technologies, Pedagogical Faculty,
University of Ostrava, Fráni Šrámka 3, Ostrava-Mariánské Hory, Czech Republic
ales.oujezdsky@osu.cz

Abstract

The use of videos from digital camcorders has become a standard in education in recent years. The curriculum is easily accessible and appeals to a wider audience. The lessons use videos of various physical processes and chemical experiments. However there can be problems with this format. The video quality is often degraded in the final stage when the video is being prepared for placement in education. These include teaching materials in the form of web pages, e-learning courses or flash multimedia objects. The final product of editing video from a digital camcorder is a DVD video. However, if we want to transfer this to the Web or other educational material, it is necessary to remove non-square pixels, interlaced video and choose the appropriate compression. For these operations, there are many interpolation algorithms (nearest neighbour, bilinear interpolation, bicubic interpolation), filter deinterlacing (wave, bob, blend), and compression tools. By selecting appropriate settings for these parameters, the video material can be optimized while maintaining the highest possible image quality. The final step before publishing the video is its conversion into one of the used codecs. Codec's settings will largely impact the final quality and size of the video-clip.

Keywords

optimizing video (resolution, interpolation, interlace, deinterlace, compression)

Introduction

Videos have become an integral part of educational materials, courses and multimedia objects. They are found in e-learning courses, they are part of courses in LMSs. The advantage of videos is their clarity. If they are accompanied by an audio track, or even interactive elements, they can better explain the teaching substance and they affect additional senses. Video illustration is much more effective than the same problem being described by text and images.

Video can be obtained in several ways. One method of creating educational videos is screen capturing; when you scan activity on the computer screen and store everything in a video file. This way we can create effective video tutorials for working with various software applications, or describe other computer activities. Some applications for screen capturing allow you to insert text captions and buttons into an already scanned video. This way the video is enriched with interactivity, learners themselves control individual steps of the video. The advantage of these videos is that they are usually saved into a suitable video format, without interlacing.

Another option is to obtain a video recording using digital camera. This way, we can create our own videos of various physical processes and chemical experiments, or even a documentary video describing various places which students couldn't visit themselves. Video is saved into one of the standard formats that are used by digital cameras.

However, if we want to use this video on the web, it must be optimized, especially in terms of resolution, interlacing and compression. To do this we need to learn some methods and procedures. Although optimization methods are demanding on computer's processing power, current desktops and laptops have sufficient power to process them. The optimization can even be done on low performance machines, with the duration of optimization being inversely proportional to the computer's power.

Optimization Methods

Digital video recorded using a digital camera in standard definition (SD) has parameters in accordance with the PAL system that was used for analogue television signals. Nowadays, this video has resolution of 720x576 pixels, frame rate of 25 frames per second, the ratio of 4:3 or 16:9 at the same resolution through non-square pixels and the video is interlaced.

It is the non-square pixels what causes problems during the conversion. The cameras record video in the resolution of 720x576 pixels, both in the ratio of 4:3 and 16:9. However, this resolution does not correspond to either ratio. If we keep the video at this resolution and do not address the aspect ratio, it will result in a distorted video and especially the aspect ratio of 16:9 would be a remarkable distortion.

In an interlaced video, the image is stored in individual half-frames, where the entire frame consists of two fields. The first field contains the odd lines of the overall frame, the second field contains the even lines of the total frame. Computer monitors, however, display video in full frames (progressive), and when you play interlaced video, two fields are displayed simultaneously. This is not so apparent in slow scenes, because the difference between the two fields is 20 ms. In faster scenes however, there are the so-called comb artefacts that need to be removed.

The last step in the video optimization is video compression with a suitable, correctly adjusted codec. One of the important conditions when choosing the codec is its availability and usability in various devices. The aim of compression is to create a video file that is as small as possible with the highest possible quality. It cannot be generalised that the smaller the video file is the worse the quality. Current modern codecs use sophisticated algorithms for video compression, which allow to create small video files that retain high quality of the image.

Several software products are available for video optimization. Video editing software used for editing digital camera videos does not allow our desired setting of the output format. It is therefore desirable to just export the video with the lowest possible compression without losing quality and use another application for the optimization. Virtual Dub is an example of a suitable application. It is a freeware that can not only be used for compressing, but it also handles basic editing, use of a series of filters for resolution change, deinterlacing and video compression.

Optimizing Resolution

If you want to change the resolution of a video, you must first calculate the required resolution in the correct aspect ratio in order for it to be displayed correctly, as shown in Figure 1.

Fig. 1: Incorrect video resolution on the left, resolution after conversion on the right

Video from a camera has the resolution of 720x576 pixels. To have the video displayed correctly after conversion into appropriate format, it is also necessary to convert the resolution. After conversion, the final resolution is as follows:

- for the ratio of 4:3 it is 768×576 pixels;

- for the ratio of 16:9 it is 1024×576 pixels.

The use of the interpolation method is a very important setting element that plays a significant role in the final quality of the recalculated video. It is necessary to use interpolation because by changing resolution the previously non-existent pixels have to be added. Interpolation is actually finding the approximate (most accurate) values of the RGB pixel that is artificially created. There is a wide range of interpolation methods and they are used in the processing of digital photos (reducing or enlarging images), in processing digital video, and also in a large variety of mathematical problems.

Interpolation methods are classified as non-adaptive and adaptive. Non-adaptive methods process the entire image regardless of its content. Adaptive methods attempt to understand the character of different areas in the image and choose the most suitable interpolation methods. When converting a video, these types of interpolation are used most often:

- Nearest Neighbour – is the simplest interpolation method, which creates a new pixel by copying the neighbouring pixel. This method retains the sharp edges, but the image is aliasing (jagged edges). This method is least computationally demanding.

- Bilinear interpolation – this interpolation method is based on the fact that the new pixel is created by a weighted average of the surrounding 4 pixels (2×2 matrix). This method suppresses aliasing but the final image is blurry and needs to be sharpened. This method is computationally more demanding than the nearest neighbour.

- Bicubic interpolation – is based on the fact that the new pixel is created from the surrounding 16 pixels (4×4 matrix); when calculating the weighted average, closer pixels weigh more than distant pixels. The method does not produce aliasing and produces very smooth transitions. The image must also be sharpened. The disadvantage is a large computational complexity.

Deinterlace

Interlaced video was originally used for analogue broadcasting and was created to save half the bandwidth by transmitting only half of the information. It did remain to be used in TV however. Even today's digitally broadcasted televisions still use interlaced video. LCD and plasma TVs

display video image progressively, and therefore they must include filters to remove comb artefacts of an interlaced video. Figure 2 shows how interlaced video is displayed on the computer screen. Static objects (in the background) are fine and sharp. With moving objects and dynamic scenes however, visible deformation occurs due to interlacing.

Fig. 2: Interlaced video

While watching a DVD movie with interlaced video on a computer, software players automatically filter interlacing in real-time. The problem occurs while converting the video into a different format such as MPEG4 in order to place this video on a web. This video needs to be much smaller but its quality has to be maintained. In this case, interlacing would be saved into the final video file and it would not be possible to remove it with filters while playing. Therefore it is necessary to deinterlace the video before such a conversion. There are many methods used for deinterlacing:

- Weave – a method based on including an alternation of even and odd lines from both fields into one frame. There is no image conversion and therefore this is a very fast method. It is mainly used for static scenes with little movement. There are significant comb artefacts.

- Blend – a method that uses the averaging of individual fields. Both fields are put over each other and the pixel values are averaged. There are no comb artefacts but „ghosting" is formed.

- Duplicate – a method that uses only one field, the second one is dropped. There is a loss of continuity because by dropping one field, half the time information is lost.

- Bob – a method when both fields are duplicated in order to avoid half time information. However, there is an artefact of hopping that is caused by duplicating the lines in both fields.

- Adaptive deinterlace – a method based on comparing two fields or frames and looking for changes in the image. Static scenes use weaving, dynamic scenes use blending. This method is fast and has good results.

- Motion compensation – the most advanced method, but also computationally most demanding. This method watches the dynamic scenes between two fields and tries to compensate for them in the entire frame.

Various applications for video editing and conversion use various methods for video deinterlacing. Often it is impossible to choose the used method or to set other parameters, such as interpolation method used for deinterlacing and calculating pixels.

Compression

The size of an uncompressed video is enormous and it would be difficult to place such a video on the web. It needs to be compressed. Codec is used for video compression. It is a blend of two words – coder and decoder. Coder takes care of the video compression while decoder decompresses the video when it is played.

There are numerous codecs in existence and every video is compressed in one or other way. The used codec and its setting will greatly impact the size and quantity of the final video. A poorly chosen codec can completely degrade the resulting video quality. The compression can be lossy or lossless, similarly to graphic and audio formats.

From the additional video usage, codecs can be divided into two categories. The first category consists of codecs that are used with videos designated for further editing. Their aim is to lower the size of the video while retaining the best possible picture quality. All lossless codecs and the DV codec used by DV cameras with magnetic tapes belong to this category, as well as the MJPEG codec (compressing each frame of the video separately). The second category is made of codecs designated for video finalization. These videos are then used on the web, or saved on DVDs and BDs or put into learning multimedia objects. The picture quality is close to the original, mild picture degradation does not matter as it is imperceptible by naked eye. All MPEG codecs belong to this category as well as the DivX and Xvid codecs. Further editing of these video is problematic, however, because the video is made of key frames, and the remaining frames are computed of them.

One of the most used is the Xvid codec that follows the MPEG4 ASP standard. This codec uses frequency conversion for compression, with the highest coefficients being deleted. The picture is divided into smaller blocs, usually the matrix of 8×8 points. These blocs are then converted using discrete cosine transformation (DCT). Similar principle is used with the JPEG format.

The DCT compression method alone is not sufficient, however, and additional methods and complex algorithms are used for bigger compression while retaining the picture quality. The main idea is that individual frames of the video are very similar. That is why all that needs to be encoded is the change between individual frames and not the frames themselves. Obviously, this method has its disadvantages. Encoding takes longer times and several previous frames need to be decompressed simultaneously to calculate the frame being currently played. The codec uses the following three types of frames:

- I (intra coded) the frame is compressed independently and does not require other frames for its display.

- P (forward predicted) the frame requires one previous frame of the I or P type.

- B (forward and backward predicted) these frames are based on the previous as well as the following I or P frame.

The reasoning behind the whole algorithm is the assumption of motion picture. The whole group of frames is called Group of Pictures (GOP). While decompressing a specific P-frame, we need

to find the previous I-frame and then decompress all the following P-frames until we hit our specific P frame. With B-frames both adjacent P-frames need to be decoded. The sequence and interdependence of individual frames is depicted in the Figure 3.
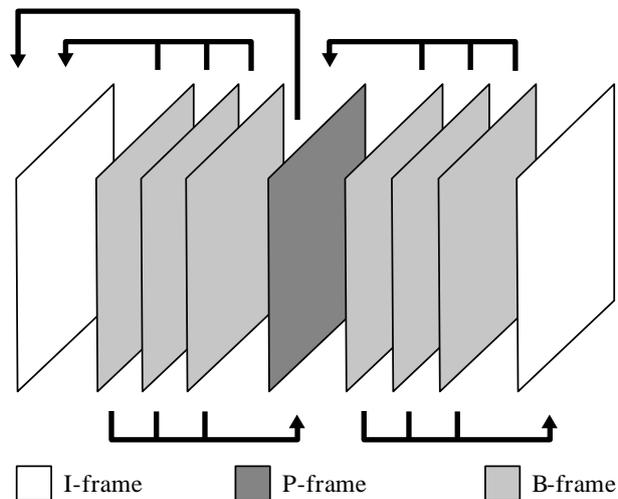

Fig. 3: Sequence and interdependence of individual frames

When configuring the codec, there is a large number of settings that can be used to optimize the resulting size and quality of a video. These are the most important parameters:

- Target bitrate – enables to set the bitrate of the video. Another option is to set the required size of the video and the codec will automatically calculate appropriate bitrate.

- Encoding type – enables one- or two-way encoding. Two-way encoding has better results, but takes significantly longer.

- Motion – choice affecting the subsystem for motion evaluation. The higher the value, the more precise the evaluation will be. Better evaluation saves more bits.

- VHQ – higher VHG value enables to decrease the quantisation value and increase the quality. The compression will be significantly higher, but the encoding time will rise dramatically. Low value (1) should be used for high bitrates, and higher values (2-4) should be used for low bitrates.

- Cartoon Mode – choice for better encoding of cartoon movies.

- Greyscale – choice for better encoding of black and white movies.

- Max B-frames – this setting determines how many B-frames can be used in sequence. Generally speaking, values between 0 and 2 are suitable for „natural" movies and higher values are used for animated movies with a high volume of single-coloured surfaces.

- Quarterpel – Xvid uses half-pixel accuracy for motion detection but can use quarter-pixel accuracy. The idea is to find better motion vectors to reduce the bitrate while retaining picture quality.

- GMC – methods helping with objects that are zooming in or out, or are otherwise in motion without actually changing. This covers frequent zooming or handheld camera work. Applies mostly to amateur films from holidays, etc.

Options for Xvid codec settings are shown in the Figure 4. User can select from many parameters or let the codec calculate the bitrate based on the requirements on the video size.

Standard bitrate of the Xvid codec is around 1000 kbps. The issue of proper codec setting is much more complicated and complex however and the results are often based on empirical methods.
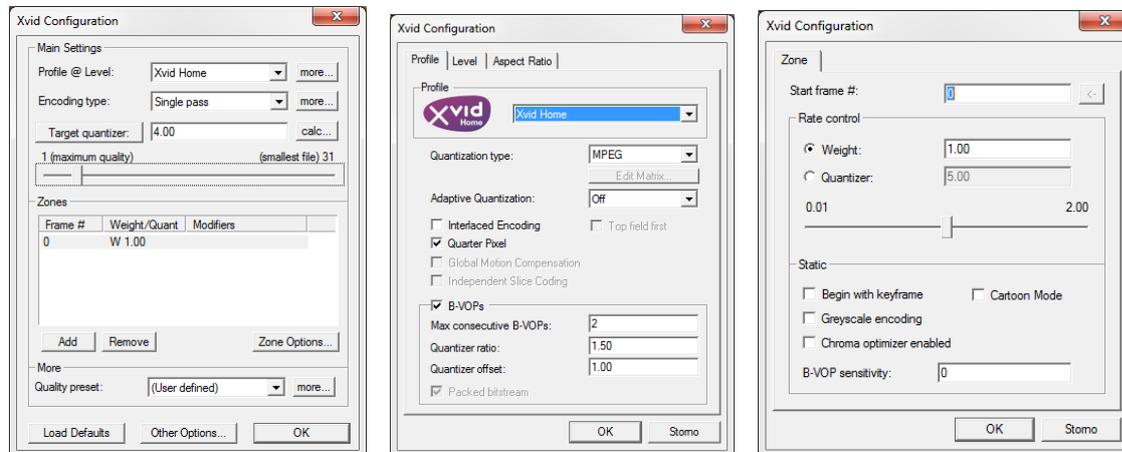

Fig. 4: Xvid codec settings

Optimization Results

Several methods for conversion of video resolution and deinterlacing can be tested. For example, in Virtual Dub, video from a digital camera Panasonic SDR-H250 HDD is a source material. Video resolution is 720x576 pixels, frame rate is 25 frames per second, the aspect ratio is 16:9 and the video is interlaced.

Virtual Dub also enables compression in a codec of choice, in our case the Xvid codec.

The Change of Resolution

Three methods of interpolation have been chosen to change the resolution of the original video: nearest neighbour, bilinear and bicubic interpolation. Video has been optimized in the Virtual Dub application. Resize filter setting is shown in Figure 5.
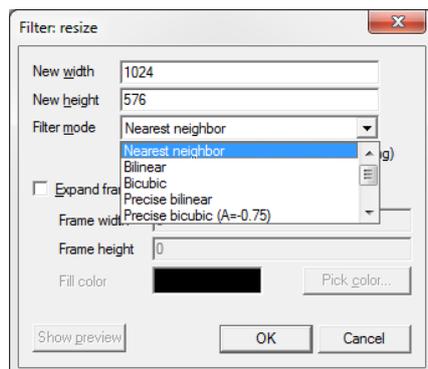

Fig. 5: Basic choice of interpolation method in Virtual Dub

The results of the interpolation methods are shown in Figure 6. It is a detail cut from the same video frame. The original video, with the incorrect aspect ratio, is on the left. The following is

the result of the nearest neighbour interpolation method, bilinear interpolation and bicubic interpolation on the right.
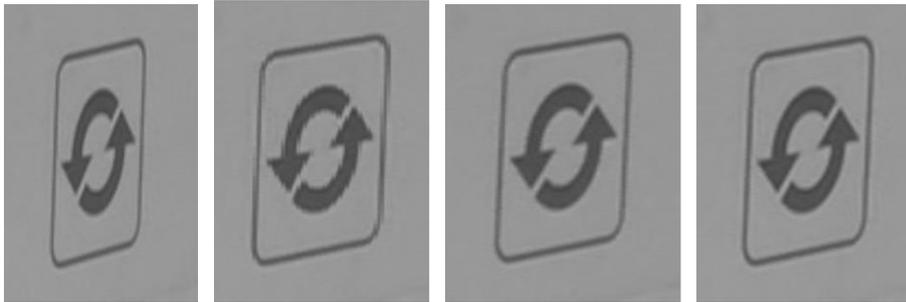
Fig. 6: From left: Original video, nearest neighbour, bilinear, bicubic interpolation.

Deinterlace

Four methods have been chosen for deinterlacing: Weave, Blend, Duplicate, and Smart deinterlacing, which is an adaptive method with motion detection.
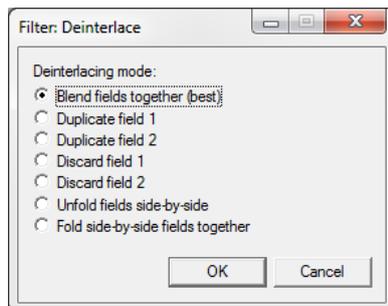
Fig. 7: Basic choice of deinterlacing method in Virtual Dub

The result of the Weave method is shown in Figure 8. There are odd and even fields in one frame, and the time lag of 20 ms between the fields is significantly noticeable. Comb artefacts completely degrade the quality of video playback on the computer.

Fig. 8: Weave Method

Figure 9 shows the output from the Blend method. Comb artefacts were removed by averaging the two fields, but the so called „ghosts" have formed.

Fig. 9: Blend Method

Duplicate method is shown in Figure 10. Odd frame is duplicated, even frame is dropped. Comb artefacts are noticeable, edges are jagged.

Fig. 10: Duplicate Method

In our case, the best deinterlace method is Smart deinterlace. The result of this method is shown in Figure 11. Although this method is demanding on computer performance, it brings the best results.

Fig. 11: Smart Deinterlace Method

Compression

Final video compression has a significant impact on the size of the final video file but also on the image duality of the video. Modern codecs are able to compress video into size that is 4× smaller than a DVD video, while retaining the same quality.

As a testing input video we used a 10 second video clip that was deinterlaced with Smart Deinterlace filter and the original resolution of 720×576 was converted to correct 768×432, which has the aspect ratio of 16:9. The video intentionally has both static and dynamic scenes. It comprises of static background and a passing cyclist and bus. No sound is present and therefore no compressed audio track. Figure 12 shows image from the clip.

Fig. 12: Frame from the compressed video

Several different compressions were used for the 10 s video:

- MPEG2 – original codec used for saving the video in the camera. Bitrate is 5000 kbps. The video file size is 5.9 MB. The quality is fair, the sunny weather provided enough lighting, there is no visible noise in the video.

- Uncompressed format – video was exported without compression. Bitrate is 200 000 kbps. The video file size is 237.27 MB. Picture quality is the same as the original. Twitches occurred during playback due to the enormous data rate.

- Xvid codec – video was exported with a 2000 kbps bitrate. Default setting of the codec. Resulting file size is 2.4 MB. Picture quality is identical with the original recording.

- Xvid codec – video was exported with a 1500 kbps bitrate. Default setting of the codec. Resulting file size is 1.6 MB. Picture quality is almost identical with the original recording.

- Xvid codec – video was exported with a 1000 kbps bitrate. Default setting of the codec. Resulting file size is 1.1 MB. Picture quality is sufficient in comparison with the original recording.

- Xvid codec – video was exported with a 700 kbps bitrate. Default setting of the codec. Resulting file size is 0.9 MB. Picture quality deteriorated a little in comparison with the original recording. Colour maps are visible with pixelisation of the static background. Dynamic scenes are blurry.

- Xvid codec – video was exported with a 500 kbps bitrate. Default setting of the codec. Resulting file size is 0.6 MB. Picture quality deteriorated significantly in comparison with the original recording. Large colour maps are noticeable with visible colour transitions and significant pixelisation of the static background. Dynamic scenes are blurry.

- Xvid codec – video was exported with a 2300 kbps bitrate. Motion setting has been turned off. Codec does not use prediction and motion detection change. B- and P-frames are not used, only I frames. Resulting file size is 3 MB. Picture quality is poor, the results are worse than those of the 500 kbps default setting Xvid encoding.

Optimization Assessment

The results of the video optimization show that it is necessary to use filters for conversion. It is also important to make sure the correct filter is chosen because the results of different methods are different. The computing power of modern computers is sufficient enough that we do not have to take into account the load on the computer and the time needed for video conversion.

Bicubic interpolation is the best choice for resolution changes in relation to aspect ratio. Bilinear interpolation achieves good results in less time and is fully sufficient for some videos. The „Nearest Neighbour" interpolation method is indeed the fastest but produces visible aliasing and it is therefore not suitable. Since the bilinear and bicubic transformation create subtle blur of the image, the video can be sharpened using a filter.

Weave method is the least desirable for deinterlacing dynamic scenes. This method only combines even and odd fields but does not deal with comb artefacts. Blend method creates the „ghosts" effects. Duplicate method brings better results than Weave but significant comb artefacts are visible in the edges. Smart deinterlace method is the best. It respects the scene dynamics and it is possible to set one's own interpolation method to calculate the pixels.

The main role for video optimization is played by the final compression in the chosen codec. MPEG2 is not suitable for web-used videos; MPEG4 is a better alternative. For a standard definition (SD) video, the Xvid codec, belonging to the MPEG4 ASP family, is a good choice. It offers good quality and small video file size. Default setting of the codec with the choice of a 1000 kbps bit rate is sufficient for the compression. The codec uses Motion Detection function and also I-frames (intra coded), P-frames (forward predicted) and B-frames (forward and backward predicted). If the Motion Detection is turned off, the video quality is unusable. For different types of movies we can utilise additional functions to improve the picture quality, such as *GMC* for handheld camera movies, *Cartoon Mode* for cartoon movies, or *Greyscale* for better encoding of black and white movies.

Conclusion

Students at the Department of Information and Communication Technologies learn about the processing of digital videos and apply this knowledge in the creation of teaching materials.

It is necessary to optimize videos from digital cameras in standard definition (SD) that are to be used for educational materials on web sites and in the LMS as a part of e-learning courses or as a part of multimedia objects. Of particular importance is the conversion of video resolution with regard to aspect ratio and video deinterlace. There are many interpolation methods that are used for conversion of video resolution, and deinterlacing filters that are used to deinterlace video. When choosing the appropriate method, it is not efficient to only take the speed of the conversion into consideration, as the fastest method results in the worst quality. It is best to use adaptive methods that take the dynamics of changes in individual video frames into consideration.

Choice of the codec and compression methods plays a key role. Suitable setting of the codec will ensure the smallest possible size of the video file with optimum picture quality.

A good alternative is to use a camera with progressive video storage which in addition uses square pixels. Some digital cameras currently have high-quality video recording and that is usually a progressive video with correct resolution to the aspect ratio.

References

MEŇHART, Pavel. *Odstranění prokladu v nekomprimovaných digitálních videosekvencích: Deinterlacing in uncompressed digital video sequences*. Brno: Vysoké učení technické, Fakulta elektrotechniky a komunikačních technologií, 2009. 1 elektronický optický disk [CD-ROM / DVD]. Diploma thesis.

SLAVÍČEK, T. Všudypřítomná interpolace. *DIGIfoto: největší časopis o digitální fotografii*. Brno: Computer Press Media, 2005, č. 7, s. 14-17. ISSN 1801-0873.

OUJEZDSKÝ, Aleš a David GROBELNÝ. Digital Video Processing. In: *Information and Communication Technology in Education: Proceedings of the 2008 ICTE Annual Conference.* Ostrava: University of Ostrava, 2008, s. 128-131. ISBN 978-80-7368-577-5.

BIJNENS, Marie, Mathy VANBUEL, Soetkin VERSTEGEN a Clive YOUNG. Handbook on Digital Video and Audio in Education. *VideoAktiv* [online]. 2006 [cit. 2012-11-13]. Dostupné z: http://www.videoaktiv.org/

SYSTEM FOR CREATION OF A DICTIONARY ICELANDIC-CZECH STUDENTS' DICTIONARY

Aleš Chejn
Department of Information and Communication Technologies, Pedagogical Faculty,
University of Ostrava, Fráni Šrámka 3, Ostrava-Mariánské Hory, Czech Republic
achejn@gmail.com

Abstract

This article concerns the creation of a lexicographic tool for compiling one-way bilingual dictionaries and encyclopaedias; the tool has served to create the Icelandic-Czech Students' Dictionary. The Introduction explains the aims of the project. The article briefly mentions the history of developing the application Dictionary System as well as the creation of the Icelandic-Czech Students' Dictionary. It also describes the programming methods, explains how the application works and presents its functions. Finally, the article introduces the practical use of the application and the Icelandic-Czech Students' Dictionary.

Keywords

Dictionary Writing System (DWS), Icelandic-Czech Students' Dictionary, web application

Introduction

In terms of education, the information technologies provide new possibilities of teaching and learning foreign languages. One of areas in which the information technologies are successfully applied, is lexicography.

The creation of a lexicographic tool for compiling dictionaries is closely associated with the Icelandic-Czech Students' Dictionary. At the time when the project of creating the dictionary was getting its shape (in 2001), there wasn't any suitable software allowing such a creation. At that time, there were several lexicographic tools that were expensive, e.g. TLex[1]. As the project of creating the Icelandic-Czech Students' Dictionary has been non-profit since the very beginning, such a tool couldn't be used. Other tools, e.g. Matapuna[2], were for free, nevertheless, they didn't meet requirements of complexity and data presentation or they didn't provide the possibility of publishing.

The lexicographic tool was required to:

1) fully support the creation of dictionaries with Icelandic as a first language;

2) guarantee a quality work environment for lexicographers;

---

[1] TLex. *TLex Lexicography and Terminology Software.*
[2] Matapuna. *Dictionary Writing System.*

3) provide a simple interface for editing dictionaries in any operating system;

4) have a secured system allowing none but a registered and logged-in user to edit the dictionary;

5) provide a possibility of publishing data either in a printed form, or through an offline dictionary program or online on the Internet;

6) be universal and support the creation of one-way bilingual dictionaries in any language combination;

7) be published under the free license with the source code.

The creation of the application Dictionary System (DS) and the creation of the Icelandic-Czech Students' Dictionary (ICSD) are interconnected. Therefore, the following part describes the history of creating both the application DS and the ICSD.

History of creating the application Dictionary System and the Icelandic-Czech Students' Dictionary

The project for the Icelandic-Czech Students' Dictionary began in 2001 upon an indirect suggestion of Doc. PhDr. *Helena Kadečková*, CSc. from the Charles University (CU). Having passed the optional subject „Icelandic language" at the CU, we created the first small dictionary, or more precisely, a list of words. That list contained Icelandic words and their Czech translations, information on morphology was added later as well as declension and conjugation endings, following the *Concise Icelandic-English Dictionary*[3]. At that time, the list contained about 1 200 words. It was published on static web pages and later, it was placed on the website of the CU. In 2006, the dictionary was extended by 1 500 new headwords and existing headwords were given another meanings, especially those of phrasal verbs. After passing a summer course of Icelandic language in Iceland in 2006, we converted the dictionary from the Excel program to the MySQL database and we started to create the application DS for supporting the creation of the ICSD. The content of the dictionary has been published under the free license on the website www.hvalur.org.

In 2007, during a scholarship at the University of Copenhagen, the first version of the application DS was created. The following year, a scholarship to study „Icelandic as a second language" at the University of Iceland was obtained. At that time, the project was joined by M.A. Renata Pešková Emilsson. She improved the dictionary by adding an extensive list of words related to everyday life in Iceland. Moreover, the dictionary was extended by new headwords following the *Icelandic-English Dictionary*[4]. Over the next three years, about 15 000 words were added to the dictionary. At the time, we set up new dictionary items: synonyms, examples, frequency.

In summer 2009, we created a script for generating headword declensions and conjugations. That function turned out to be very important as Icelandic language has retained a complex inflectional system with a huge amount of exceptions.

In 2009, we started to cooperate with *Biolib.cz*[5]. We were given a database containing pictures of zoological and botanical species. In the winter term, together with Amir Mulahumic and

---

[3] HÓLMARSSON, Sverrir; SANDERS, Christopher and TUCKER, John. *Íslensk-ensk orðabók / Concise Icelandic-English Dictionary.*

[4] HÓLMARSSON, Sverrir; SANDERS, Christopher and TUCKER, John. *Íslensk-ensk orðabók / Concise Icelandic-English Dictionary.*

[5] BioLib - Taxonomic tree of plants and animals with photos. *Biolib.cz.*

Dorota Nierychlewská-Chejn, we started to create a sound database of Icelandic words. Jón Gíslason recorded 22 000 words on a digital recorder. We created web pages called *Icelandic word sound database6*; those web pages were translated into 6 languages: English (Aleš Chejn), Icelandic (Jón Gíslason), Polish (Dorota Nierychlewská-Chejn), Serbo-Croatian (Amir Mulahumic), Slovak and French (Ján Zaťko). It is possible to search for an Icelandic word and listen to its pronunciation. Nowadays, the web pages provide also the IPA (International Phonetic Alphabet)[7] phonetic transcription of words. A compressed file containing all sound files is freely available to download and it is published under The General Public License GNU v.3.

In 2010, we added to the database the rules of Icelandic pronunciation included in *Handbók um íslenskan framburð[8]*. We created a script for generating a phonetic transcription of any Icelandic word. Together with Jón Gíslason, we keep improving the script, especially for compounds in which the rules of pronunciation are slightly different.

At the end of 2011, we merged the web pages of the dictionary with those of the application, we also unified and improved the design and added a drop-down menu function. The project was joined by Ján Zaťko, a student of Translation and Interpreting at Matej Bel University in Banská Bystrica. He translated the web pages and the Guide to the Dictionary into Slovak, French and English and the application DS into English.

In January 2012, we created web pages providing information on the application DS and we placed the complete application in three versions on the SourceForge.net portal[9]. The application is published under The General Public License GNU v.3.

Programming

The application Dictionary System is a web application. It is written in PHP using CSS and JavaScript. The application uses the relational database MySQL. Information included in database tables can be divided into tables containing system data, dictionary data, lists of abbreviations, information on the dictionary and information on photographs from Biolib.cz. Application uses the charset UTF-8[10], that guarantees correct data visualization and manipulation in all languages. The configuration file *connection.php* contains values for comparing two languages of the dictionary; by modifying these values, it is possible to achieve a correct comparison of any language combination.

Application Dictionary System

The application Dictionary System is a lexicographic tool designed for creating one-way bilingual dictionaries or encyclopaedias. It is so-called DWS (Dictionary Writing System[11]) or DPS (Dictionary Production / Publishing System) application. In the application, it is possible to add, edit and delete headwords and their meanings, to add photographs and sound files, to add, edit and delete declensions and conjugations, to control the process of creating a dictionary and to publish a dictionary in several versions. A new project – dictionary – can be either

---

[6] http://hljod.hvalur.org/index.php
[7] IPA. *Wikipedia: the free encyclopedia.*
[8] GÍSLASON, Indriði and ÞRÁINSSON, Höskuldur. *Handbók um íslenskan framburð.*
[9] The Dictionary System. *SourceForge - Download, Develop and Publish Free Open Source Software*
[10] UTF-8. *Wikipedia: the free encyclopedia.*
[11] http://en.wikipedia.org/wiki/Dictionary_writing_system

imported from a CSV file[12] or added word-by-word. The final result of the application is a multimedia online version of a dictionary, a printed version of a dictionary typeset in a quality form for a book format in LaTex (and then exported to PDF) and an offline version of a dictionary in DSL format (Abbyy Lingvo) for offline programs like GoldenDict. The application supports team work of lexicographers – it monitors activities, helps to coordinate objectives, records headword editing, etc. It provides an easy-to-use user environment for lexicographers, WYSIWYG[13] headword previewing and the access to the application through any browser.

Publishing the dictionary

The dictionary has three final versions. The first one is a printed version, the second one is an online version and the third one is an offline version designed for offline browsing in dictionary programs like GoldenDict. The printed version is designed either for book or normal printing. This version is limited by place (it is not possible to include complete declension and conjugation tables) and by medium (it is not possible to use sound files). Unlike the printed version, the online one allows to get complex information as it is not limited by place. Therefore, the online version contains more information (e.g. sound files with headword pronunciation, complete declension and conjugation tables, etc.) and it is possible to search for headwords by entering any word form. The offline version allows to browse the dictionary without Internet connection. Its advantage is high-speed headword searching (depending on the computer's speed), but it has some limitations in comparison to the online version. For example, it doesn't contain declension and conjugation tables and it is not possible to search for headwords by entering various word forms. However, unlike the printed version, it contains sound files and, through hyperlinks, it allows to move quickly among headwords.

Printed version

Fig. 1: Printed version sample

---

[12] http://en.wikipedia.org/wiki/Comma-separated_values
[13] WYSIWYG. *Wikipedia*: *the free encyclopedia.*

Online version

The headword part is arranged in Icelandic alphabetical order and headwords can be found through the search field. The screen consists of three columns: left, central and right. The following picture shows the arrangement of information in the online version:

Fig. 2: Online version sample

Legend to the picture above:

1)	Application language selection
2)	Search field with options
3)	Application menu
4)	Headword list
5)	Headword
6)	Photograph
7)	Synonyms and antonyms
8)	Thematically related words
9)	Compounds
10)	Pronunciation – IPA phonetic transcription and sound record
11)	Declension and conjugation tables

Fig. 3: Entry arrangement in the online version

Offline version

The offline version has a structure similar to that of the printed one; in addition, it contains sound files. The structure of the dictionary is simple and contains only information on the dictionary, the authors and the license as well as the headword part arranged in Icelandic alphabetical order.

Monitoring

Nowadays, the application DS is used for creating the ICSD. It registers when and from which IP address a user visited the web page, for which headword and in which dictionary field he searched. The table of geographical location of the IP addresses allows to get automatically information from which country a user visited the dictionary. Recording all these data has two purposes: statistics of words and monitoring the dictionary visit rate. Statistical data like word frequency help to find out for which words users search most frequently; if such a word isn't in the dictionary, it can be added. Monitoring the visit rate also helps to secure the application against attacks of spambots.

Using the application and the dictionary

The ICSD can be used not only for searching for Icelandic words and their Czech equivalents. Users can also search for declensions and conjugations because each headword contains declension or conjugation tables. In addition, the dictionary allows listening to Icelandic headword pronunciation and it also provides information on how to pronounce a phonetic transcription of a headword. The dictionary contains simplified rules of Icelandic phonetics and it is possible to generate a phonetic transcription of any Icelandic word. The rules of Icelandic phonetics are illustrated by examples with sound files. All these options are universal and do not relate directly to Czech language; they can be used by people from around the world. This is one of the reasons why the application and the web pages are translated into six languages (Czech, Icelandic, Polish, English, Slovak and French). We also put on the domain www.hvalur.org educational games for practising Icelandic language, e.g. Scrabble with Czech and Icelandic words, Memory game with cards that can be printed after winning the game and other morphological and phonetic games. Users from various countries can use the dictionary as an educational aid for learning Icelandic.

The creation of the ICSD mainly involves Aleš Chejn, Jón Gíslason and Ján Zaťko. At the present time, Jón Gíslason is a lecturer of Icelandic language at the University of Iceland in Reykjavík. Jón recorded all sound files of headwords. In the application, he mostly revises the phonetic transcription of words. He finds dictionary editing intuitive and quick. He appreciates that he can listen to the pronunciation and see the phonetic transcription of words at the same time. The alphabetical list of headwords allows him to browse the dictionary easily. Ján Zaťko translated the web pages of the ICSD into Slovak, French and English. He also translated the Manual for the application DS into English. Ján uses the alphabetical list of headwords on the left side to navigate the dictionary. He greatly appreciates that the dictionary allows him to find a headword even if it is misspelt in the search field. He also uses the option „Headwords in example" to find other headwords. Ján points out that a new user may find searching for Czech words difficult.

Conclusion

Nowadays, the application Dictionary System supports the creation of the Icelandic-Czech Students' Dictionary and, since 2006, it has run on the domain www.hvalur.org. The dictionary contains the introductory, the headword and the final part. The introductory part includes information on the dictionary and information on the phonetic transcription of headwords, tables of Icelandic pronunciation and a list of abbreviations. The headword part contains more than 24 000 headwords, the IPA phonetic transcription and sound files with pronunciation recorded by a native speaker, grammatical information on the parts of speech and the word endings, syntactic information, word phrases, proverbs, examples and example translations, synonyms, antonyms, Latin names, field and language categories. The dictionary uses multimedia options of the application and provides photographs and sound files for headwords. The final part of the dictionary includes the bibliography. The Icelandic-Czech Students' Dictionary and the application Dictionary System are published under The General Public License GNU v.3 and they are freely available to download.

At the present time, together with Jón Gíslason and Ján Zaťko, we revise the dictionary in detail. We intend to check all headwords in the dictionary, to add missing meanings and examples, to choose photographs and to publish the dictionary at our own expense in 2014. We expect that the printed version of the dictionary will have about 600 pages. This version in PDF format will be freely available to download on the web pages www.hvalur.org. The long-term objective is to add new headwords to the dictionary and to create a handbook of Icelandic phonetics and morphology.

References

BioLib: Taxonomic tree of plants and animals with photos [online]. 2012-10-26 [cit. 2012-10-26]. Dostupné z: http://www.biolib.cz/cz/main/

INDRIÐI GÍSLASON, Höskuldur Þráinsson. *Handbók um íslenskan framburð*. 2. útg. Reykjavík: Rannsóknarstofnun, 2000. ISBN 99-798-4736-0.

SVERRIR HÓLMARSSON, Christopher Sanders a Svavar Sigmundsson RÁÐGJÖF. *Íslensk-ensk orðabók*. 1. útgáfa, 4. prentun. Reykjavík: Iðunn, 1989. ISBN 99-791-0049-4.

Matapuna: Dictionary Writing System [online]. 2012-10-26 [cit. 2012-10-26]. Dostupné z: http://www.matapuna.org/

Obecná veřejná licence GNU v.3. [online]. 2012-10-26 [cit. 2012-10-26]. Dostupné z: http://www.gnugpl.cz/v3/

The Dictionary System. *SourceForge: Download, Develop and Publish Free Open Source Software* [online]. 2012-10-26 [cit. 2012-10-26]. Dostupné z: http://sourceforge.net/projects/dict-system/

TLex: TLex Lexicography and Terminology Software [online]. 2012-10-26 [cit. 2012-10-26]. Dostupné z: http://tshwanedje.com/tshwanelex/

Wikipedia: the free encyclopedia [online]. 2012-10-26 [cit. 2012-10-26]. Dostupné z: http://cs.wikipedia.org

INFORMATION AND COMMUNICATION TECHNOLOGY IN EDUCATION – PH.D. STUDY

Jana Kapounová
Department of Information and Communication Technologies, Pedagogical Faculty,
University of Ostrava, Fráni Šrámka 3, Ostrava-Mariánské Hory, Czech Republic
jana.kapounova@osu.cz

The doctoral degree program Specialisation in Pedagogy, in the field of study Information and Communication Technologies in Education (ICTE), is provided jointly by four pedagogical faculties in the Czech Republic: The Faculty of Education of the University of West Bohemia, Faculty of Education of the University of South Bohemia in České Budějovice, Pedagogical Faculty of the University of Ostrava and Faculty of Education of the University of Hradec Králové. We were inspired by the doctoral degree programme Theory of Education in Physics, taught by three of the aforementioned universities, and we also originally considered offering the doctoral degree programme Theory of Education in Informatics.

Preparations for the request for accreditation are accompanied by searching, ideas, refining views, numerous revisions and refining to precision once more. Searching for partners in resolving this issue was perhaps the easiest part. We know each other through European projects. Educators of departments providing training in informatics or at least information and computer literacy at pedagogical faculties in the Czech Republic have been meeting since 1992. Meetings have taken place at expert workshops, seminars and conferences. For example, in the European project dealing with information and communications technology in education, we first stayed four weeks in Glasgow, and spent the same amount of time in Barcelona. And over such a long stay there was enough time for us to discuss our approaches to ICTE. Therefore, since the beginning of discussions on the doctoral degree programme we know what we can expect from our team counterparts, that we can trust them and that they believe in attempting accreditation of such a degree programme.

Doctoral degree programme

After preparing accreditation, there exist certain rules that are formally given by regulations, documents, terms and processes. It is necessary to define the objective of study, the graduate profile, conditions for admissions, the academic programme – thus to define not only subjects and other obligations of the doctoral student, the topics for dissertations and ultimately to select a team of experts who can guarantee the third level of university education. It is also essential to comply with the Universities Act, as well as guidelines and regulations of participating universities or their pedagogical faculties. We will now discuss certain points.

Objective of the academic programme

The aim of the doctoral degree programme Information and Communications Technology in Education is systemic preparation of experts on independent creative work in science, research and development in the field with good expectations of further developing the field. We want to achieve the sophistication level of selected qualitative doctoral studies abroad.

In the Czech Republic there exists no doctoral degree programme with a similar focus or even in the framework of the degree programme Primary School Education or Secondary School Education, or in the Informatics programme.

Graduate profile

Graduates of this study augment their undergraduate studies with detailed knowledge of the content and methods of discipline from informatics and new directions in the area of pedagogy and psychology. They orient themselves in current opinions on education and information technologies here and abroad. They gain new knowledge and skills in designing modern information systems, in theoretical bases of informatics, and upon creation of educational materials for eLearning. They broaden their knowledge and skills in multimedia, visual and objectively oriented programming, and in the area of theory and practice of computers. They familiarize themselves with selected methods for resolving problems using the computer.

Doctoral studies graduates will work mainly as

- scientific workers dealing with information technologies in the context of teaching;
- teachers, didactics of informatics at faculties preparing informatics teachers;
- teachers, didactics of informatics at primary and secondary schools;
- authors of instruction supported by Information and Communication Technologies (ICT) for various forms of study, including eLearning;
- workers in state educational administration.

Characteristics of professions,

for whose performance the graduate will be prepared, other possibilities of his/her application and the characteristics of employers where the graduate will be able to apply his/her acquired education:

- scientific workers dealing with discovery of new forms of use of information technologies in education;
- employees applying themselves on the theoretical and application level during scientific research in institutions involved in education;
- employees taking part in preparation and gradual implementation of reform of education in informatics, which is realized at schools of all levels, including preparation of teachers at universities;
- employees capable of initiating and supporting introduction of ICT into education, to be responsible for their rational use, to propose a structure of a scholastic information system;
- employees capable of mapping the needs of ICT in education, of overseeing development of ICT in school in terms of methodology and education, of engaging in methodical management and preparing ICT coordinators;
- educators providing education in informatics at all types of primary and secondary schools and university faculties preparing informatics teacher and teachers of the 1st level of primary school;
- professional trainers handling complex applications in the field of informatics, including training for educators;
- creators of eLearning courses and other educational programmes and training materials;
- employees capable of cooperating in designing, implementing and evaluating on applications, including the capacity to communicate with resolvers and lecturers;
- employees capable of creating an evaluation of educational systems and judge the quality of degree programs from the field aspect.

The doctoral degree programme gives an opportunity to students who are currently completing their master's degree study, and previous graduates who are trying to work

scientifically in this field and develop it further. A condition for admission is due completion of a master's degree programme. During the admissions interview, the doctoral studies applicant presents his/her impression on content of a dissertation. The individual study plan then guarantees augmentation of knowledge in those areas in which the applicant does not have sufficient previous preparation – this concerns course of knowledge in informatics and pedagogical and psychological disciplines.

Conditions

which the student must fulfil during the course of study upon its completion are given:

- by an individual study plan;
- by content and scope of a state doctoral studies examination and requirements for proving the prescribed knowledge.

The basic differentiation of the study curriculum is comprised of the aim of the applicant's dissertation.

The degree programme includes

1. Subjects for a theoretical base (philosophical, pedagogical and psychological part, informatics and its theoretical bases).
2. Field subjects.
3. Other subjects – foreign languages.

During studies, the doctoral student must

- successfully complete at least three subjects for a theoretical basis, whereas in his/her individual study plan, both parts will be represented;
- successfully complete at least three subjects in the field;
- successfully complete a test in a foreign language;
- successfully complete at least one subject of his/her study plan at a different partner faculty;
- take part in three joint workshops of doctoral students, where the doctoral student will present results of his/her dissertation so far; these are published in an electronic proceedings;
- give a presentation in at least one domestic conference and one abroad;
- publish at least one paper in a certain professional journal, and in an international scientific journal or in the proceedings of an international scientific conference or its equivalent, e.g. a chapter of a reviewed book designed for an international public.

Further obligations

- participation in activities at a scientific research of faculty;
- activities relating to the actual creative activity of the doctoral student such as active participation in conferences, seminars, special courses, student's mobility at other centres, scholarship or research fellowship abroad;
- pedagogical activity for doctoral students in full-time form;
- research fellowship at a foreign university of the relevant type (as possibilities allow);
- participation in research projects and grants solved at the faculty with regard to professional dissertation focus.

State doctoral examination

The state doctoral examination tests

– the competence of the doctoral student to assess widely varying problems of the chosen field in the wider, both field-specific and interdisciplinary correlations;
– the capability of the doctoral student to judge whether the field of doctoral study can react adequately to the given problem in terms of practical consequences.

For the given topic, the doctoral student will answer questions

– of methodology and research correlations of the topic, i.e. he/she will critically analyze how the given problems are examined and will compare the developing approaches to understanding the topic;
– he/she states the newest theories relating to the given topic and compares it to previous concepts;
– critically assess conflicting aspects in the concept of the given topic;
– expounds in general terms upon the pedagogical aspects of the given topic, and discusses possible problems upon its implementation in educational practice.

The dissertation

must introduce an original solution to the given problem. At least part must be published in the reviewed scientific magazine or presented as a separate paper at a scientific conference.

Dissertation topics are in line of the specialization of the trainer workplaces that are gradually profiling themselves:

Faculty of Education of the University of West Bohemia – web technologies in education and new methods of teaching programming.

Faculty of Education of the University of South Bohemia in České Budějovice – researching changes caused by implementing ICT into education in relation to reformulation of education objectives, the impact of use of technology on a change of the educator's teaching style, the need for curricular changes of the given topic or subject being taught.

The Pedagogical Faculty of the University of Ostrava is focusing on certain areas of eLearning such as adaptive individualized teaching and personalization of teaching by means of eLearning or an evaluation of eLearning.

Faculty of Education of the University of Hradec Králové – management and control of technological processes, assessment and statistical elaboration of results of measuring, simulation of experiments and support of natural science fields by information technologies.

Topics already defended by dissertations

– Adaptive LMS systems.
– Analysis and design of learning graph theory optimization and combinatorial algorithms.
– Implementation of interactive animations in eLearning courses.
– Information and communication technologies in the pedagogical evaluation process.
– Projects in science education.
– Teaching of basic numerical methods in Matlab and its evaluation.
– Teaching of computer graphics at secondary vocational schools.

Departmental board of doctoral study

A common (national) departmental board provides the professional guarantee over the course and quality of doctoral study and a faculty departmental board does so at each contractual workplace. An *Agreement on the common form of a doctoral study program* has been concluded between the four workplaces.

Information and Communication Technologies in Education at the University of Ostrava

The Department of Information and Communications Technologies was established in 2000. It separated from the Department of Technical and Vocational Education which, *inter alias*, taught future educators how to use didactic aids such as overhead projectors and other projection devices, cassette players, and also taught them computer basics. Modern information technologies required modern computer classrooms furnished with multimedia equipment, slide projectors and interactive boards. The newly formed department searched for its own academic focus. Two areas crystallized:

- information technologies for all students of the University of Ostrava, especially the Pedagogical Faculty;
- ICTE as a separate field of study.

Study field ICTE

The department guarantees the study field ICTE within the framework of the programme specializing in bachelor's, master's and doctoral level in full-time and combined form. Graduates of master's degree programmes can perform the rigorous state examination, a part of which is defence of a rigorous dissertation. After successful performance of the rigorous state examination, the academic title of doctor of philosophy is awarded abbreviated as PhDr. listed before the name.

Scientific research trends of the department

The scientific research focus of the department cannot help but follow the direction of taught fields – integration of ICT in education. We also participate in one of the main directions of research activities of the University of Ostrava *Research of education with support of information and communications technologies*. All of this is too wide of a scope, and is regularly being specified and refined. In the long-term horizon, this concerns development of methods of modelling and optimization of educational processes. Research focuses on creating a laboratory of intelligent educational processes and their system integration into education.

Currently we focus on

- personalization of the learning process;
- evaluation of eLearning.

Conclusion

Everything – from the name through the enumeration of pedagogical and scientific research activities of the department – revolves around the ICTE concept. Without deviating from this topic in conclusion, we must mention the international conference entitled ICTE which has

taken place in Rožnov pod Radhoštěm for the past thirteen years under the patronage of the Rector of the University of Ostrava. An integral part of this conference is the doctoral section, which has undoubtedly enriched the conference programme. The Department of Information and Communications Technologies has become the main organizer and guarantor of the conference.

As of 2012, the department began publishing an electronic magazine entitled ICTE Journal. The papers in this journal correspond thematically to the topics of the ICTE conference. The aim is to conceive and edit the journal in order to apply to become a domestic, peer-reviewed magazine, and in the future, to have it included in the Thomson Reuters citation database.

Some publications of department members

KAPOUNOVÁ, J. *Používání informační a komunikační technologie ve výuce*. Ostrava: Ostravská univerzita, 1999. ISBN 80-7042-145-2.

KAPOUNOVÁ, J. (ed). *Od programovaného učení k eLearningu*. Ostrava: Ostravská univerzita, 2005. ISBN 80-7368-053-X.

KAPOUNOVÁ, J. et al. *Přístupy k evaluaci eLearningu*. Ostrava: Ostravská univerzita, 2012. ISBN 978-80-7464-121-3.

KAPOUNOVÁ, J. a J. PAVLÍČEK. *Počítače ve výuce a učení*. Ostrava: Ostravská univerzita, 2002. ISBN 80-7042-265-3.

KAPOUNOVÁ, J., K. KOSTOLÁNYOVÁ a J. PAVLÍČEK. Theoretical concepts, sources and technical background of e-learning. *The New Educational Review*. 2006, **8**(1), 97–106. ISSN 1732-6729.

KAPOUNOVÁ, J. a K. KOSTOLÁNYOVÁ. Studies and Research in the Department of ICT at the University of Ostrava. In: *ERIE – 7th International Conference Efficiency and Responsibility in Education 2010*. Praha: Česká zemědělská univerzita, 2010, p. 164–173. ISBN 978-80-213-2084-0.

KOSTOLÁNYOVÁ, K. Adaptive teaching via e-learning form. *Acta Didactica Napocensi*. 2009, **2**(4), 17–20. ISSN 2065-1430.

KOSTOLÁNYOVÁ, K. E-learning form of adaptive instruction: In: *DIVAI 2012 – 9th International Scientific Conference on Distance Learning*. Nitra: Univerzita Konštantína Filozofa, 2012. p. 194–201. ISBN 978-80-558-0092-9.

KOSTOLÁNYOVÁ, K. Experiences with new approach to use of information technologies in education. *Acta Didactica Napocensi*. 2008, **1**(1), 11–13. ISSN 2065-1430.

KOSTOLÁNYOVÁ, K. *Teorie adaptivního e-learningu*. Ostrava: Ostravská univerzita, 2012. ISBN 978-80-7464-014-8.

KOSTOLÁNYOVÁ, K., J. ŠARMANOVÁ and O.TAKÁCS, Structure of study supports for adaptable instruction. *The New Educational Review*. 2011, **13**(25), 235-247. ISSN 1732-6729.

NAGYOVÁ, I. Aspekty výuky programovacího jazyka Logo. In: *DidInfo 2012*. Banská Bystrica: Univerzita Mateja Bela, 2012. p. 156-161. ISBN 978-80-557-0342-8.

NAGYOVÁ, I. Modelování výukových procesů Petriho sítěmi. Nitra: Univerzita Konštantína Filozofa. *Prírodovedec*. 2011, 488, 48–63. ISBN 978-80-558-0034-9.

NAGYOVÁ, I. E-Learning Education of Educational Technologies in Full-Time and Combined Studies. *Acta Didactica Napocensia*. 2010, **3**(3), 25–33. ISSN 2065-1430.

NAGYOVÁ, I. Teaching of programming – creation of recursive algorithms. In: *Information and Communication Technology in Education.* Ostrava: Ostravská univerzita, 2011. p. 233–240. ISBN 978-80-7368-979-7.

OUJEZDSKÝ, A. Educational Web-Based Portals. In: *Information and Communication Technology in Education.* Ostrava: Ostravská univerzita, 2010. p. 135–138. ISBN 978-80-7368-775-5.

OUJEZDSKÝ, A. Optimizing Video Clips in Educational Materials. In: *Information and Communication Technology in Education.* Ostrava: Ostravská univerzita, 2011. p. 265–271. ISBN 978-80-7368-979-7.