

Human Resources Preparation for Digital Information Processing

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ABSTRACT

The article describes the content and teaching methodology of information systems development and processing of information sources. The authors present the structure of courses, motivational aspects applied and the approaches leading to the development of creative abilities of students. The illustrative example of student's work is shown. As a theoretical approach, the structured methodology for information systems development is applied.

The term of creative ability is analyzed. SW Tovek Tools have been applied as a process tool for information retrieval and analysis. A discussion is held on whether to provide the students with detailed care, or rather let them struggle on their own to find a creative solution to tasks.

KEYWORDS

Teaching, information system, information retrieval, analysis, structured methodology, creative ability, Microsoft Access, Tovek Tools.

1 TEACHING OF IS DEVELOPMENT

The development of information systems (IS) for commercial use is being executed through agile methodologies and object approaches. Predominantly, web applications are being created, and working with IS by using mobile devices is being solved.

Yet we should not condemn some historical methodology approaches, such as structured methodology; we should use them appropriately with respect to the new conditions, bearing in mind what is important and how they can be useful in teaching. Although the structured methodology is rather historical, its application is still required, e.g. [4].

The first part of article presents the experience gained in teaching the course named 'Development and administration of IS', which is based on a structured approach. It is specified in

studies for bachelor's degree as follows:

1. The introductory course in the 'Information Systems' programme for future specialists in information technology (IT).
2. The course providing basic information about IS for future specialists in business (economics, management, etc.).

Authors describe the structure and content of the course, pay attention to its motivating factors, show an example of student's work and evaluate the benefits of the course.

1.1 Structure and content of the course

The course begins with the analysis of IS issues. It includes the following topics: the concept of IS, its meaning and classification, data - information - knowledge, database system (DBS), data structures of database systems, the function of database management system (DBMS) and database (DB) properties.

Then follows the teaching of the IS modelling. It includes the topics of the IS model, general principles of modelling, IS life cycle, explanation of terms methodology - method - technique - tool. After that a structured approach to IS development and a conceptual level of modelling are introduced.

This part can be described as the core for understanding the field and the proper basis for analytical thinking of an IS creator. The structured methodology (levels and dimensions of modelling, application of general approaches to modelling, a conceptual level model) are explained. The constructs and rules of the entity-relationship diagram (ERD), functional scheme (FS) and data dictionary (DD) are presented.

The course also includes the creation of IS by students themselves. The necessary information is conveyed through an example, starting with the specifications and finding requirements for the IS, proceeding to various levels of modelling, creating the custom application and documenting

the process and outcome. The theme for the creation of an IS is chosen by the students themselves. The procedure for the IS development and the outcome are given by detailed guidelines. In the last part of the course, the logical and physical levels of IS modelling are introduced. They include the relational data model (RDM), the transformation of the ERD to RDM, RDM normalization, and relational operations. The development environment of the DBMS MS Access and the description of the basic elements of the application (table, query, form and report) are presented.

The above mentioned structure of the course is suitable for teaching the IT specialists. In the case of the 'business' oriented students, some of the passages can be omitted or modified, and thus the learning objectives can be adapted to the students' needs. It is not necessary to present the details of DBS, it is possible to replace the definition of the RDM by the 'table view of data', to omit normalization and relational operations. In addition, this group of students could become more familiar with the work in MS Access. The course requirements include a course credit and an examination. The credit is earned for documenting an IS. Students use a textbook [3].

1.2 Motivational aspects of the course

The basic motivational tool is continuous repetition of the teaching content and checking the students' skills and knowledge by testing them. Their test results are part of the final evaluation. In addition, the process of the IS creation is checked individually, the ERD design and its transformation into the RDM are discussed.

A well-proven motivational tool is the choice of the IS theme according to student's interest. It is easier to design and create an IS when the student is familiar with its environment and has a positive relationship with it. After several years of assigning this task, it can be summarized that the most popular topics for IS creations are:

- ICT (computers, graphic cards, mobile phones, software, data media, satellite communication, errors of security codes, overview on signals).
- Trade and services (car or motorcycle sales, car service, mobile phones, music, food).
- Machinery (automobiles, motorcycles, weapons).

- Music (music bands and singers, recorded music, DVD, musical instruments).
- Sports competition (soccer, fire sports, athletics, shooting, body building).
- Teaching (student records, future practice for students, eLearning exercises).

The structure of instruction and the way the tasks are assigned and evaluated lead the students to independence. This is especially evident when they work on their course credit task. Brief orientation and basic demands for their credit task are given to students in the form of written instructions. After the approval of the theme for their IS development and specification of the IS requirements, they proceed, if possible, on their own. The important progressive phases of work (conceptual and logical model) are discussed with the teacher, and the students continue only after submitting the outcomes and obtaining the teacher's approval.

The actual development tool for the implementation of IS is not presented in detail at lectures. It is up to the students to master work with MS Access; they themselves have to acquire the necessary aids. The submission of the course credit assignment is interactive; the students respond to the teacher's comments via electronic means of communication.

1.3 Example

The example presents an outcome of student's work. Its theme is 'Guitars' [9]. The following parts are presented:

- Assignment for the IS development.
- Entity-relationship diagram (ERD), Figure 1.
- Functional scheme (FS), Figure 2.
- Data dictionary (DD), Table 1.
- Relational data model (RDM), Figure 3.
- Description of the final application.

Assignment specification: Create an information system (IS) about internet shop with guitars. Register vendors and producers, their name, website, contacts (phone, email).

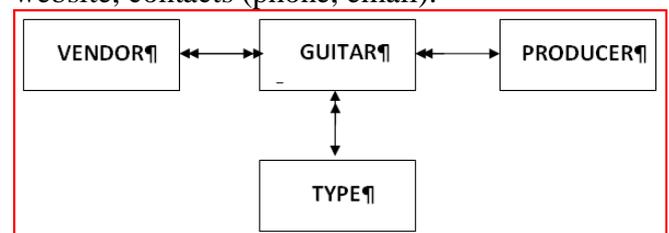


Figure 1. Entity-relationship diagram

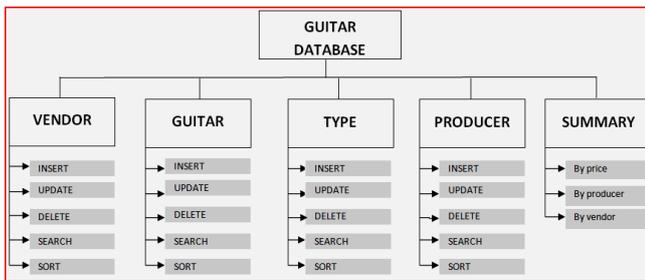


Figure 2. Functional scheme

Table 1. Data dictionary

Entity	Attribute	Data type	Length	Obligat.	Key
GUITAR	ID_KYT	aut. num.	6	YES	PK
	NAME	text	30	YES	
	COLOR	text	50	YES	
	SENSOR	text	30	YES	
	WOOD	text	70	YES	
	SCALE	number	3	YES	
	TREMOLO	text	3	YES	
	FRETS	number	2	YES	
	ID_VYR_FK	number	6	YES	FK
	ID_TYP_FK	number	6	YES	FK
VENDOR	ID_PRO	aut. num.	6	YES	PK
	NAME	text	30	YES	
	ADDRESS	text	30	YES	
	CONTACT	text	30	YES	
	WWW	text	40	YES	
PRODUCER	ID_VYR	aut. num.	6	YES	PK
	NAME	text	30	YES	
	ADDRESS	text	45		
	EMAIL	text	30	YES	
	WWW	text	45	YES	
TYPE	ID_TYP	aut. num.	6	YES	PK
	NAME	text	30	YES	
	GUIT_VEND				
	ID_PRO_FK	number	6	YES	FK
	ID_KYT_FK	number	6	YES	FK
GUITAR	PRICE	number	15	YES	
	STOCK ITEM	number	10	YES	

Additionally to record data on the guitar, its name, type, price, colour, sensors, wood, scale, frets, tremolo, and the number of pieces on a stock. These items is possible to insert into IS, update, sort, and search. For users of IS must be available a list of developers, of stores, report of guitars by price, producer and vendor.

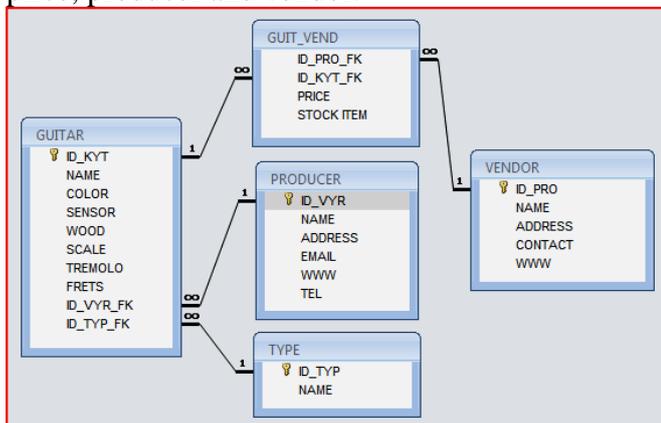


Figure 3. Database structure on the RDM

Description of the final application: The IS about guitars was created in MS Access DBMS. The IS provides to users convenient and clear working with data, browsing through database and produce information (reports according to selected criteria). The main menu (see Figure 4) offers six groups of function buttons.

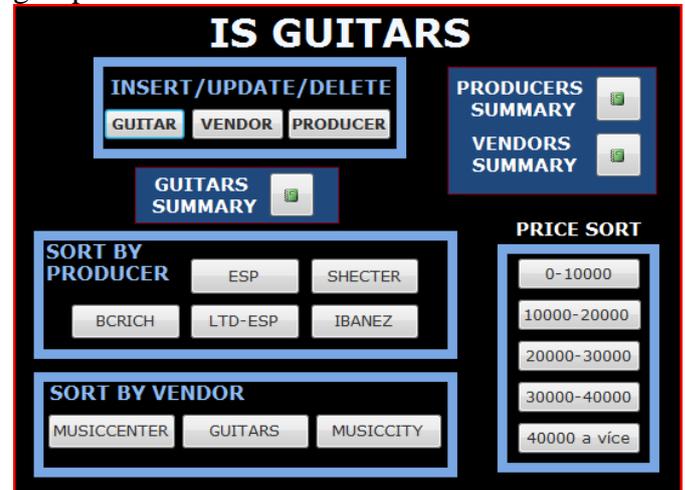


Figure 4. User interface of the application

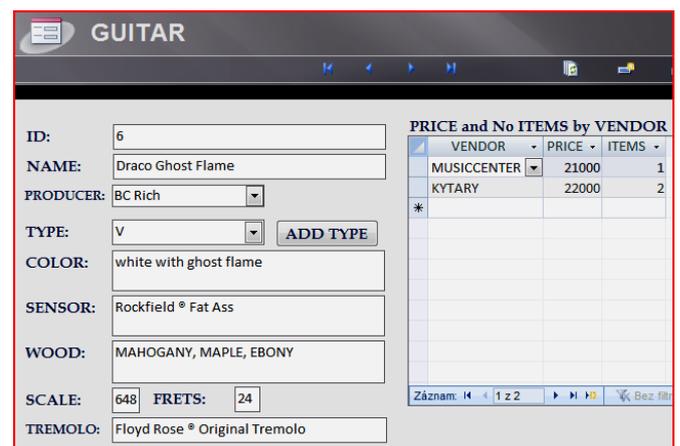


Figure 5. Insert data about guitar

In group “INSERT / UPDATE / DELETE” is the database administrated. The functions for inserting, updating, and deleting data are available. Example of inserting data about guitars is at the Figure 5. Group “PRODUCERS SUMMARY and VENDORS SUMMARY” enable to users view data about producers and vendors, etc.

1.4 Importance, benefits, and discussion

The importance of the course for ‘business’ oriented students lies in obtaining comprehensive theoretical information and practical experience in IS and their development. Certainly, the subject

contributes to the students' ability to document the results of their work and to work independently on an assignment.

The future IT specialists should benefit from the course by acquiring strong knowledge of basic concepts of IS, which can be developed in their further study and practice. The students do not need expansion of the knowledge concerning the relational data model in the future, which, despite all the advances in IT, is nearly 100% presented in current DBMS.

An important benefit of the course is the development of students' ability to work independently and to document the results of their work. In both groups of students, the evaluation of the documentation of their IS is aimed at encouraging students to work professionally with a text editor. It is truly surprising that most of our secondary schools graduates are not ready to create quality documents and are very poorly trained in the use of the office automation software.

The preparation of undergraduate students includes the described course as an introduction to the study. They have obtained substantial foundations for further education in IS and gained deep interest in the study program.

2 INFORMATION RETRIEVAL

The article reports on the experience from the courses called 'Analysis of information sources' and 'Designing communication and information systems (CIS) - Information management' at the University of Defence in Brno. The courses are a part of the Master's Study Programme. Their goal is to master work with Tovek Tools (TT) created by TOVEK [2] and established within the Ministry of Defence of the Czech Republic. Students gain knowledge from using the TT. They undergo orientation training and then they can manage the information resources workflow. The course has been designed to contribute to the development of creative abilities of individual students. There is also a course book [3] available for them. The courses are suitable for both face-to-face instruction and distance learning.

After the introduction, this part of the article analyzes the concept of creative ability, introduces the tools used for teaching, and discusses the courses and teaching methods, which should contribute to the students' creative abilities.

2.1 Creative ability

A number of information sources dedicated to creativity and creative thinking (for example [6], [8]) agree that there are many definitions of this term. A widely accepted definition of creative thinking describes it as "*A process leading to the production of a result, or a concept, that is unique and usable*" [1]. This particular definition incorporates the common themes found within a number of pre-existing theories of creativity; 'effective novelty' and the requirement for the end-product to be 'original and useful' appear to be of most importance. Two essential processes, which occur during the act of creative thinking, include the cognitive process (what we know) and the non-cognitive one (what we feel). Hence, the thinker's emotional state is intrinsically linked to the effectiveness of creative thinking.

Some information sources, such as dissertations [7], refer to the source [6], in which the concept of creativity is divided into four parts. It defines creativity as "*Imaginative activity fashioned so as to produce outcomes that are both original and of value.*" Creative processes necessarily involve behaving and thinking imaginatively, positing alternative solutions to problems, thinking around situations, and engaging in mental play. They are a form of purposeful activity, an active, engaged application of imagination to meet a particular goal. They involve the generation of something original, which may be original in relation to the creator's own experience, that of her peer group, or just uniquely and historically original. Finally they must be of some value, as defined in relation to the original objective of the process. For a creative activity to be valuable it doesn't have to produce something good, or beautiful, or useful, or possess any other subjective quality; instead value is assessed on an individual basis, and requires 'judgment and criticism [and] critical thinking'.

2.2 Tovek Tools applied

The TT software is applied for professional work with information resources in class sessions; it is the set of modules for advanced analyses of information in various textual data (documents, messages, records, etc.). It includes [2]:

- Index Manager (IM) to index data.
- Tovek Agent (TA) to search in data sources.

- Query Editor (QE) to create the queries.
- Harvester (HA) to content analysis.
- InfoRating (IR) to context analysis.

Working with the data source starts with indexing using the IM. Data sources are marked; it is necessary to distinguish the language in them and to set it in the IM because of the correct lemmatization and then the sources are indexed. All other activities in the analysis of information are already underway over the indexed collection. Of course, there is an access to the source document, if it is needed in any of the TT modules. The query takes place in the TA.

A query can be prepared in the form of a Boolean expression, in free text, and as TOPIK – the result of work in the QE. The search interface of the TA component is shown in Figure 6.

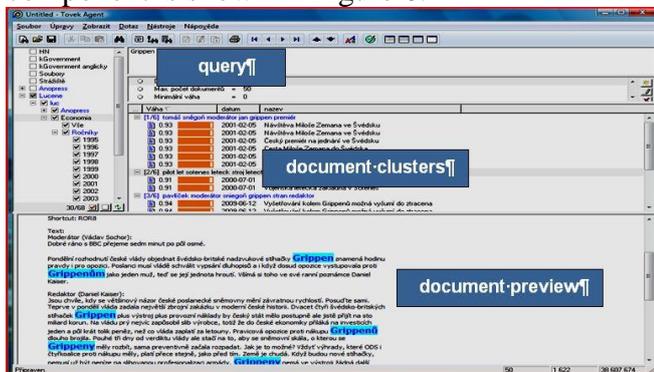


Figure 6. Search interface of the Tovek Agent

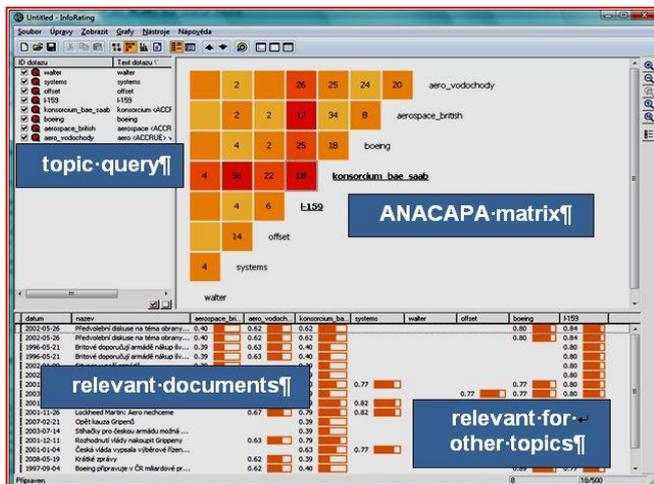


Figure 7. InfoRating for a context analysis

For the actual document analysis the IR and the HA modules are further applied. Into their environment, a set of selected documents from the TA is exported. The IR is a module for context analysis; the user interface is shown in Figure 7. It analyses the context of the selected documents, their

neighbour words and displays the context in the table or graph.

The HA is a module for content analysis. The interface to the analyzed documents offers individual words and their successors and predecessors, and the graph of the terms occurrence in the documents; see Figure 8.

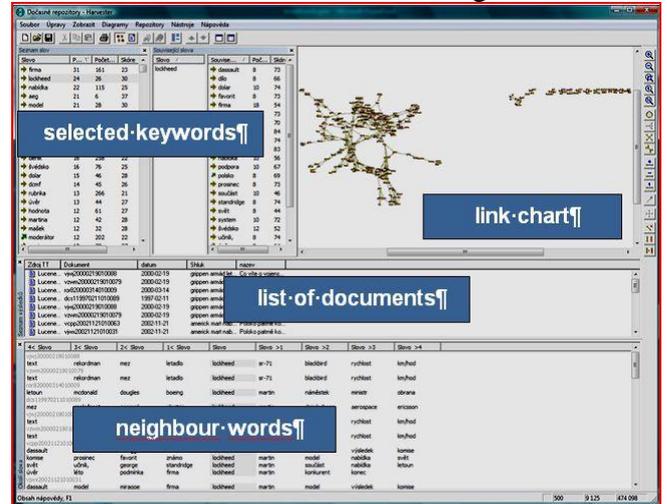


Figure 8. Harvester for a content analysis

The analysis of the documents is based on specified goals and is not predetermined. It will be affected by the current results of the analysis, when the exploration may be conducted in different directions to obtain:

- Lucid and detailed information.
- Contexts in documents, the relationships between analyzed events and their actors.
- Trends of the reality being analyzed.

The analysis of the documents is a creative issue, and thus its teaching allows students to develop creative abilities. It is 'only' necessary to prepare an appropriate assignment. An ideal form is blended learning, in which the theoretical part is explained in face-to-face instruction and individual work continues through distance learning.

2.3 Methodology of teaching

The class instruction includes well-proven teaching methods: lectures, exercises and practical, as well as training for mastering the SW. The initial session is focused on the information system (IS) issues. The following topics are covered: concept of the IS, its meaning and structure; data – information – knowledge; metadata; unstructured and structured data; databases and data structures of database systems.

Also, the historical horizon of data search is mentioned: from library index systems through Boolean to the concept search.

The further teaching block deals with Document IS: individual phases of text processing and the respective approach to it are explained. Then the teaching block of the key topics follows; it explains working with TT modules when searching and analyzing information. The teaching takes the form of training. Working with TT modules is at first tried on a small Czech document base which includes about two hundred documents. The indexing of documents proceeds within a few seconds after the document base is identified, which does not pose a slightest problem for the students.

Searching in the document base is performed at first with individual key words, then with a pair of words linked with different operators (OR, AND, NOT, ACCRUE).

The search result is explained and students must always understand it. ACCRUE becomes the favourite operator for students' future work (it searches using the operator OR and arranges the search results by the operator AND).

Then they search in the documents as required by the task. After that the creation of more complex queries in the form of TOPIK follows; it is arranged in a hierarchical query structure, see Figure 9.

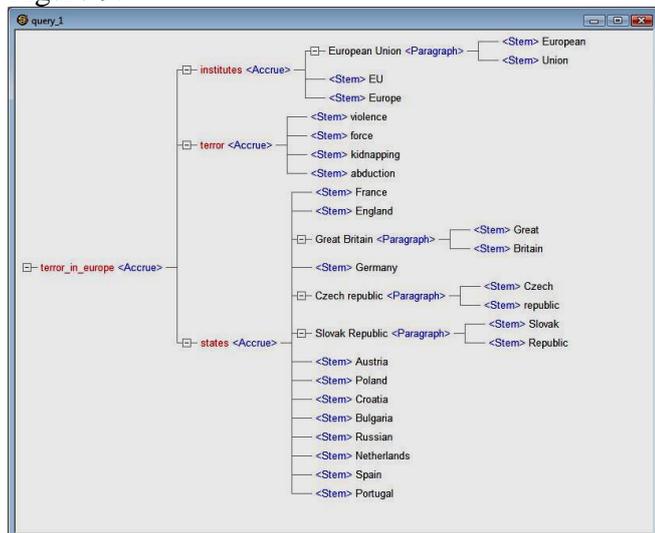


Figure 9. TOPIK for a complex query

The last part of the lecture is the use of the IR and the HA modules. The application of both modules in analytical work is illustrated by examples.

Another teaching block includes controlled individual work with all modules with a small

English document base subsequently followed by independent work of the students who analyze a large English document base, comprising several thousands of documents.

3 CONCLUSIONS

The first part of article summarizes the experience in teaching the foundations of IS. By stepwise refinement of the content and process of teaching, the course has reached the stage which guarantees its stability with the useful pieces of knowledge gained from methodological procedures applied, including the activation of students and their independent work development.

It is shown an illustrative example of student's work, which is presented without any corrections. The students' feedback on the course is positive; they appreciate the opportunity to become familiar with one of the approaches to IS development, and are grateful for the strong knowledge concerning the theory of IS modelling.

The IS modelling and development is an interest of many organizations and conferences, for example The International Association for Computer Information Systems (IACIS) [5] that is a non-profit association founded in 1960 and dedicated to the improvement of IS and the education of information systems and computer professionals. The article meets the ideas of the IACIS, because offers experiences in IS education.

The second part of article presents the content and experience of teaching the subject analysis of information sources. It explains the possibilities of the TT modules and approaches which develop independence and creative abilities of students. Many teachers believe that they must 'serve' the students with the task together with accurate and detail instructions on how to solve it.

This approach, however, does not force the students to think and find their own way to fulfil the task. Thus, when the first problem and uncertainty occurs, the students receive detailed support, they ask for clarification of the instructions and want to be literally 'spoon-fed'.

The method of developing a creative approach is, on the contrary, based on the precondition that the students get rather vague assignment with the desired result. It is their task to determine the process and the teacher does not intervene in this activity.

The teacher ignores students' requirements to explain the details of tasks; they have to cope on their own. In their lives, there will not be a tutor available all the time to provide them with explicit instructions.

The results evaluation of the approach describing in the paper are still not very optimistic. The students are not yet prepared to innovative think and work, because in other subjects is that culture not applied.

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5 REFERENCES

1. ALDOUS, C. R. Creativity in Problem Solving: Uncovering the Origin of New Ideas. *International Education Journal*, 5(5) (2005)
2. Analytical SW Tovek Tools, TOVEK company. [Cit. 2013-01-03]. Available at: www.tovek.cz. (2013)
3. BURITA, L., ONDRYHAL, V., TRUNDA, M. Information systems. Coursebook U-3099. Brno, Czech Republic: The University of Defence Press (2005)
4. GIANNOCARRO, R. at al. A Structured Methodology for Developing Performance Measures in any Environment. Available at http://maja.uni-mb.si/files/apem/APEM2-2_91-99.pdf (2012)
5. IACIS. Available at <http://www.iacis.org/> (2012)
6. NACCCE report. 2. The National Advisory Committee on Creative and Cultural Education. All Our Futures: Creativity, Culture and Education. [Cit. 2013-01-03]. Available at: <http://sirkenrobinson.com/skr/pdf/allourfutures.pdf> (2013)
7. RALLEY, James D. ICT and Creativity in Education: Examining the Effect That New Labour Policy Had on Creative ICT Practice, and Why This Practice is Important. [Cit. 2013-01-03]. Available at: <http://www.scribd.com/doc/77932877/ICT-and-Creativity-in-Education> (2013)
8. RILEY, Nigel R., AHLBERG, Mauri. Investigating the use of ICT-based concept mapping techniques on creativity in literacy tasks.. [Cit. 2013-01-02]. Available at: http://scholar.google.cz/scholar_url?hl=cs&q=http://education.korea.ac.kr/innwoo/edu603/computers_in_education/investigating. (2013)
9. VLAŠIC, Zbyněk. IS Guitars. Course credit assignment: IS Development and Administration Course. Brno: University of Defence (2010)