Education for Science in Engineering and Business

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Abstract

The author is interested in information systems (IS) and knowledge management systems (KMS) for engineering and business uses in research and education. The author's experience in teaching how information and communication technology is summarized in education rules for business-oriented students comes from approaches verified over the long term in teaching science for future engineers and business people. During the education process, the students' knowledge must be permanently deepened by merging theory and practice using repetitive curriculum in exercises and practical tasks. Students must be the subject of the ongoing validation of acquired knowledge. The student's motivation must be constantly maintained by the teacher. An example is the course "Information Management", its lessons include the topic of information management geared to the creation of IS and other topics related to IS issues. The core of the course is IS development as its own theme, which is the best motivational aspect. Students' work must be independent and minimally influenced by the teacher. The teacher supports the development of students' creative abilities by setting fuzzy tasks (with no detailed explanation) so students have to look for original approaches and innovative solutions. In addition to educational themes, the teacher should contribute to students' soft skills: teamwork, managerial approaches, and project management. An example is the course "Information Analysis", its lessons included the topic of information processing using professional software (SW) for text mining. Students' independent work included the selection of their own theme for information analysis, the collection of information sources, the design of the strategy, information processing, and information analysis. The work of students was organized in teams. The transfer of research results in the teaching of students. To do this, the appropriate research topics must first be chosen, and if possible, students must be engaged in research projects. The validated results of research convert immediately into teaching. The departmental research activity in KMS resulted in systems that are in practical use. An example is the CEFME (Central European Forum for Military Education) portal for cooperation in the military university community.

1. Introduction

The paper includes two main parts. The first part is connected with information and communication technologies (ICT) skill for business oriented students and the second part is oriented to the development of creative abilities of ICT students.

The key capabilities in the form of knowledge, skills and attitudes appropriate to the context of the knowledge society are essential for every human being. They represent an added value for the labor market, social cohesion and active citizenship because they offer flexibility and adaptability, satisfaction and motivation. Modern ICT is rightfully considered the key factor of the economic and social development. However, to exploit its potential fully and effectively, certain knowledge together with the availability of qualified experts who will use it effectively, are essential [2].

2. The literature recherché

The literature recherché shows some examples of papers that are interesting in science and education.

In the Oswaldo Cruz Institute is a concern with the relationship between two of its missions: research and education. What are the educational bases required for science and technology activities for the future years? The contemporary explosion of knowledge imposes a need of continuous education to face the growing illiteracy. In order to face this challenge, there is an idea that the dialectic profile of tradition and transformation, always creating new perspectives to disseminate scientific culture in innovated forms [3].

With the continuous development of the urbanization process, there are more and more college students of science and engineering. As the main body of the future engineering activities, the engineering ethics awareness and attitude towards engineering ethic college students will directly

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determine whether the future projects can benefit the mankind. Therefore, it is necessary to carry out engineering ethic education for the students of science and engineering, to make them have a strong engineering ethic consciousness, engineering ethics responsibility and engineering ethics decision-making ability [4].

3. Information systems in education

Information Management (IM) is a course at the Tomas Bata University in Zlín. The lessons included the topic of information management, geared to the creation of IS and other topics related to the IS issues. The course begins with the analysis of the IS issues. The following topics are covered: the concept of IS, its meaning, data - information – knowledge, and the database system.

3.1 The Course Overview

Teaching of the IS development includes the topics of the IS model, principles of modelling, life cycle. Then a structured approach to the IS development and a conceptual level of modelling are introduced. This part is a core of understanding the field and the proper basis for analytical thinking of an IS creator. The structured methodology is explained. The constructs and rules of the entity-relationship diagram, functional scheme and data dictionary are explained.

3.2 Example of Student's Work

The example [1] presents an outcome of student's work in the theme 'Geocaching'. In the student's work is presented:
1. Assignment for the IS development.
2. Entity Relational Diagram (ERD).
3. Data Dictionary (DD).
4. Functional Scheme (FS).
5. Relational Data Model (RDM), see Fig. 1.
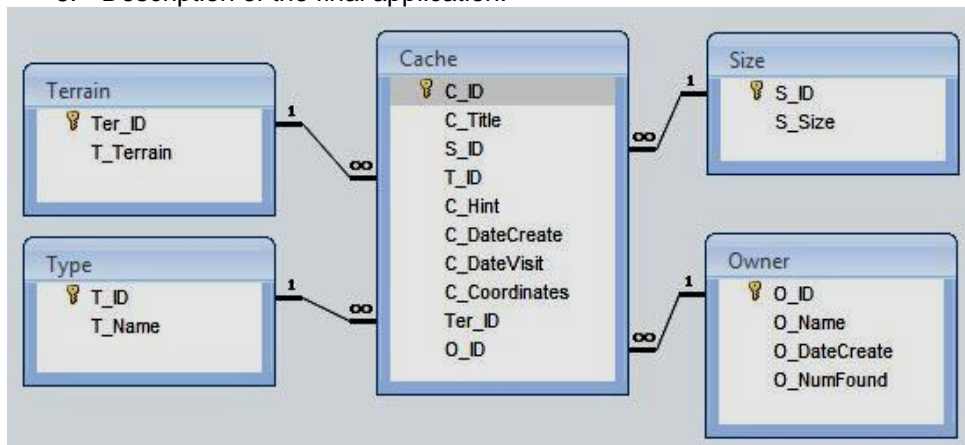6. Description of the final application.

Fig. 1. Relational Data Model

Assignment: Create an IS about cashes and their owners. The cache entity is characterized by the name of the cache, hint, the date of creation and the last visit, coordinates. The cache entity is further specified by the type and size of the cache and the difficulty of the terrain where the cache is located. The person is characterized by the attributes: owner's name, the date of creation the account, the number of caches found. The DD includes information about the data structure (metadata), and is the supplement of ERD. The FS is a hierarchy structure that specifies the functions of the future IS. The IS about caches was created in MS Access. The main menu offers seven functions (Fig. 2).
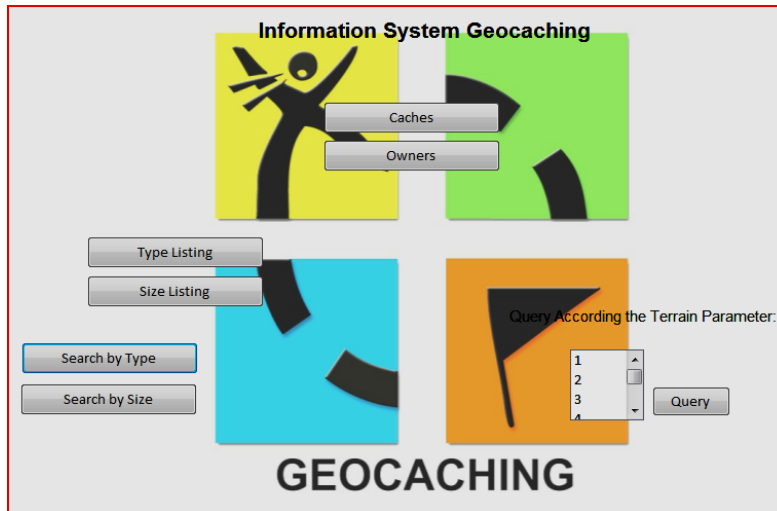
Fig. 2. User interface of the IS

3.3 Motivational aspects of the course

Knowledge of the student must be during the education process permanently deepened by merging theory and practice, using the constant repetition of curriculum in exercises and practical occupations. Student must be a subject of ongoing validation of acquired knowledge. Cannot forget the motivation of students and focus their interest on the teaching themes. The students' work should be (if possible) independent and influenced by the teacher only to the extent necessary. The teacher tries to contribute to SOFT-skill of students, such as teamwork, managerial approaches, and project management, results presentation, and defence of the project. The basic motivational tool is the continuous repetition of the teaching content and checking the students' skills and knowledge by testing them. Their test results are part of their final evaluation.

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. The structure of instruction and preparation tasks leads the students to independence. Brief orientation and the basic demands of the course credit work 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 phases of work are discussed with the teacher.

4. Information analysis and development of creative abilities

The experiences are from the course Information Analysis (IA) for ICT students of study program in Magister's degree at the Faculty of Military Technology, University of Defence in Brno, Czech Republic. The initial lecture focuses on the IS issues with explanation term's data, information, knowledge, metadata, 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 phases of text processing and with SW Tovek Tools (TT) module for searching and analyzing information. The teaching takes the form of training.

Searching in the document base is performed at first with individual key words, then with a pair of words linked with different operators; the search result is explained and students must always understand it. Interesting for students' is creating more complex query in the form of hierarchy structure of key words. The last teaching block includes individual work with all modules.

The search at the extensive base of documents and the analysis of the demanded text in particular is focused on developing independence and creative abilities. The students receive a brief specification of the task and are only roughly methodically guided. They pick a topic from a list of documents subject to analysis. The topics include issues which appear in the news with greater frequency, for example, terrorism, the war in Afghanistan, NATO's missions abroad, corruption, economic crisis, etc.

The document base changes; students will first develop the strategy of the work procedure and consult it with the lecturer. It is an individual process. They mostly start with approximate analysis, which determines the documents dealing with the respective topic. For the creative implementation of correct procedures, the approaches and processes of Competitive Intelligence can be applied. It is necessary to ask appropriate questions, which will direct the students to the desired result. The question WHY will be responded by stating the goal of the analyzed activity. The question HOW will be answered by explaining the way to achieve goals. The question WHAT leads to a task list. During the analytical process, the persons, organizations, things, events, resources, places are determined and adequately categorized.

5. Transfer the research results to education

The portal CEFME (http://beta.cefme.eu/) is the result of the research. The main feature is a user-friendly access to the information about universities. Data for the portal was accessed from the open sources. The structure of the portal respects a knowledge principle. It means that information is in context and builds the network; it is possible to browse in one query of information to another without interruption. The work was based on the methodology which includes:

1. Collecting information sources and their processing utilizing analytical software.
2. Clarification of the terms in the area in interest and verify them against the document base.
3. Ontology design, implementation and its verification.
4. Creating a knowledge base.

The procedure and method of teaching the knowledge approaches and creation of knowledge-based systems to students were directly transferred from the research project into the education. The course KMS is tightly connected with the course IA. The most important part is ontology preparation and after implementation it can be created the knowledge base of the KMS.

6. Conclusion

The article presents the experience of teaching for science. The positive responses from students to the IM and IA course are based on individual work. In addition to the education themes, should teacher contribute to SOFT-skill of students, such as teamwork, managerial approaches, project management. Transfer of research results into teaching of students is the last experience of the education practice of the author and it is demonstrated in the CEFME project. The departmental research activity in KMS resulted in systems that are in practical use.

References

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