

THE MEANINGFUL LEARNING AND TEXT VISUALIZATION

Ondřej Svoboda^{a)}, Ondřej Procházka^{b)},

^{a)} Institute of Economy and Management, Faculty of Economics and Administration,
Univerzity of Pardubice

^{b)} Faculty of Informatics and Management, Univerzity of Hradec Králové

Abstract: *This deal with concept of meaningful learning, especially process of learning based on visualization of concepts and relations between concepts. Everybody who needs to study must read many texts. Understanding the meaning of text is the main criterion of studying success. For better understanding we can use text visualization to gain better organization of our knowledge. The aim of this article is to bring an idea about meaningful learning and it also to bring experiences with model for text visualization.*

Keywords: *Knowledge Representation, Concept Maps, Meaningful Learning, Text Visualization.*

1. Introduction

The concept of meaningful learning [1] was established in 1960 by David Asubel. The main principle of this concept is based on the incremental process of learning – before learning of new knowledge learner realizes what he or she knows and after that connects new knowledge to an existing knowledge structure.

Creating concept maps as one form of knowledge representation is useful approach of meaningful learning. Non-automatic making of concept map is relatively slow process and now there is no algorithm for automatic producing of concept map from non-structured data which could work succesfully without many limitations [6]. In this article we describe experiences with suggested model of text visualization, which can be useful as preprocessing of making concept maps. Our experiences are shown in examples of meaningful learning process.

2. Meaningful learning

2.1 Concept of meaningful learning

Learning as a process can be divided into two types [1]. First it is a discovery learning that is used every time when learner identifies concepts autonomously. Second type is a reception learnig when concepts are described to learner using a language, into they are transferred. In both types we speak about learning of new concepts. You can learn new concept by your own discovery or by reception from another people. The question is do we integrate this new concept with our existing knowledge?

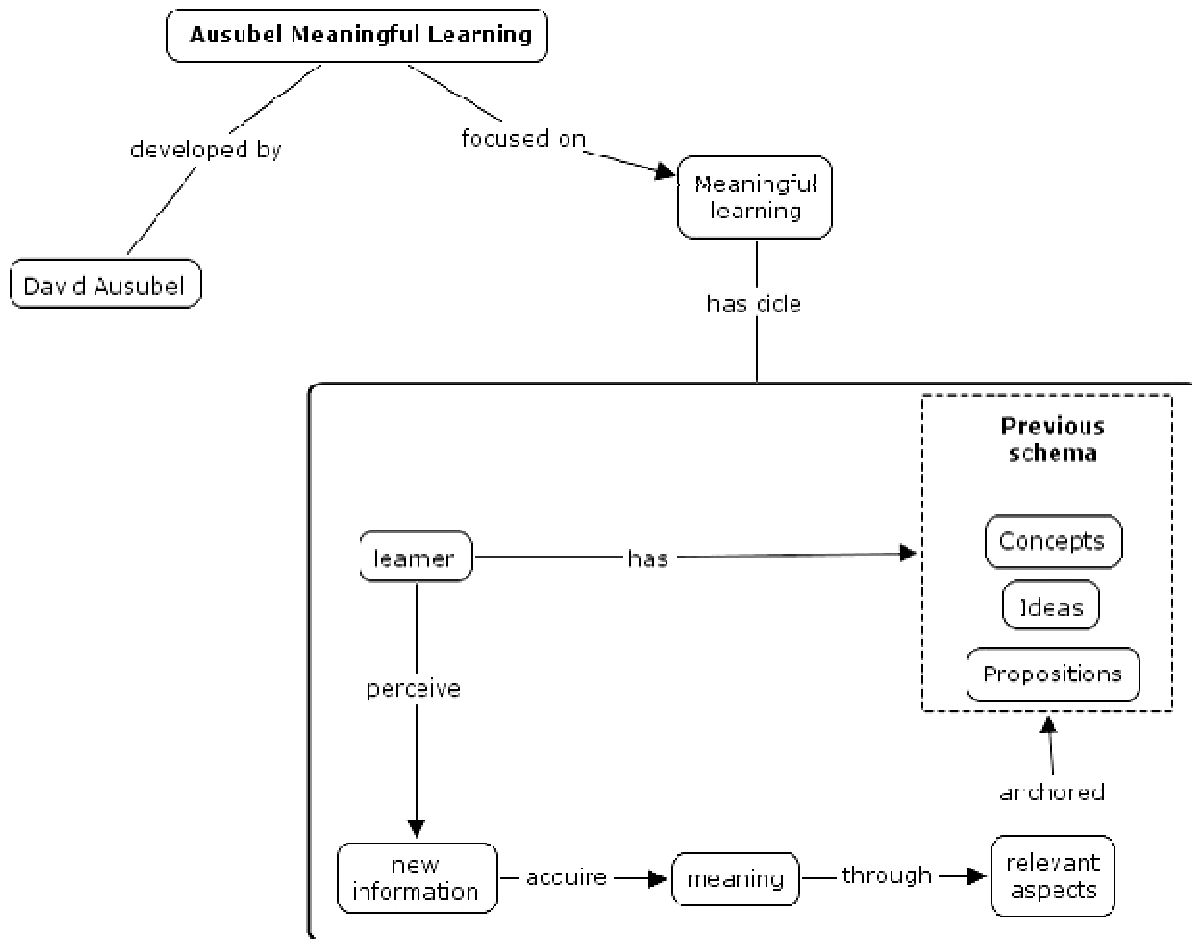
For this purpose we can distinct between rote learning and meaningful learning [1]. Rote learning is defined “*as arbitrary, non-substantive storage of knowledge in cognitive structure without the effort to integrate it with previously learned knowledge*” [2]. This can be seen in school assessment where students tend to learn by rote. On the opposite site meaningful learning requires integrating new knowledge with existing knowledge. To understand meaningful learning we have to realize that learner has to choose to learn meaningfully. It is the necessary condition. One of the effective ways of meaningful learning is the creativity.

Ausubel (1960) believed that meaningful learning involves personal recognition of the links between concepts [10]. The most important element of meaningful learning is not so much how it is presented but how new information is integrated into an existing knowledge base.

A major instructional mechanism proposed by Ausubel is the use of advance organizers. The advanced organizer approach to teaching became a cognitive instructional strategy used to promote the learning of new information. This approach encourages students to build upon prior knowledge and mentally organize their thoughts before being introduced to the details of new concepts. In another word, before learning something new, realize what you know. Understand your own concepts to be prepared to incorporate new one [10].

Ausubel emphasizes that advance organizers are different from overviews and summaries, which simply emphasize key ideas and are presented at the same level of abstraction and generality as the rest of the material. Organizers act we can imagine as a subsuming bridge between new learning material and existing related ideas. The most general ideas of a subject should be presented first and then progressively differentiated in terms of detail and specificity [10].

Picture No.1 shows Ausubel theory as summarized by students.

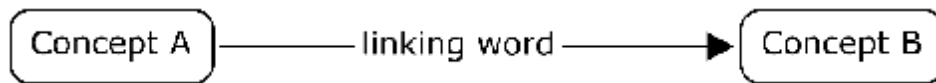


Picture No. 3: Ausubel theory (<http://cmc.ihmc.us/cmc2006Papers/cmc2006-p152.pdf>)

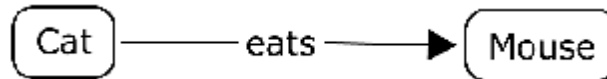
2.2 Concept map

Concept maps (cmaps) are graphical tools for organizing and representing knowledge. Basic element of cmaps is concept. Novak defined concept [9] as “a perceived regularity (or

pattern) in events or objects, or records of events or objects, designated by label". By joining concepts together with appropriate linking words we made a statements or propositions. The propositions are building blocks for knowledge.



Picture No. 2: Basic type of proposition (source: authors)



Picture No. 3: Example of proposition (source: authors)

Concept maps include concepts, usually enclosed in circles or boxes, and relationships between concepts indicated by a connecting line linking two or more concepts. Words on the line, referred to as linking words or linking phrases, specify the relationship between the concepts [9].

The label for most concepts is a word, although sometimes we use symbols such as + or %, and sometimes more than one word is used. Two or more concepts connected using linking phrases to form a meaningful statement are known as proposition. The definition of propositions [9] can be: “Propositions are statements about some object or event in the universe, either naturally occurring or constructed.” Propositions are also called semantic units, or units of meaning [3].

In this part we explain concept of meaningful and rote learning using the text visualization.

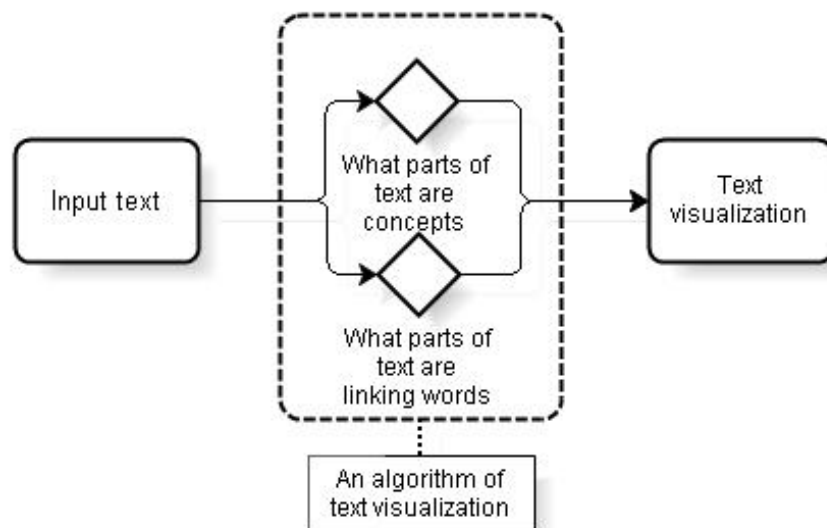
3. Text visualization

The human perceptual system is highly attuned to images, and visual representations can communicate some kinds of information more rapidly and effectively than text [7]. We suggested the model for text visualization, which produces “near-concept-map” visualization of text. This structure looks like concept map, but it is only “near-concept-map” visualization, because in real concept maps there are links among concepts which are constructed according to logical relationships contrary of suggested text visualization where the links are constructed according to sequence of the words in the text you visualize.

Automatic constructing of concept map from text is very difficult issue. Currently there is no algorithm, which can solve this problem without big limitations. Algorithms, which can approximately solve this problem, are often algorithms of artificial intelligence [6].

3.1 Text visualization with using the Czech National Corpus

Suggested model of text visualization is based on finding concepts and linking words in text. Output of this “near-concept-map” visualization can be used as preprocessing of creating a real concept map. The process of text visualization is described on picture No. 4.



Picture No. 4: Process of text visualization (source: authors)

The suggested model of text visualization (it is described in part 3.2) generates “near-concept-map” by using the Czech National Corpus [4]. The Czech National Corpus (CNC) is an academic project focusing on building a large electronic corpus of mainly written Czech. A Corpus is a collection of texts in electronic form, used for linguistic research. Today it contains about 300 million words. A special search engine facilitates work with this corpus. It also enables further processing of the found data (alphabetical classification, etc.). This search engine also enables finding words according to parts of speech [11].

3.1.1 *Classification of linking words by using the CNC*

Every scientist, who is registered to the CNC, can do many operations with outputs of corpus by using program Bonito (which is free for download). Between main operations, useful for classification of linking words, belongs finding words according to parts of speech.

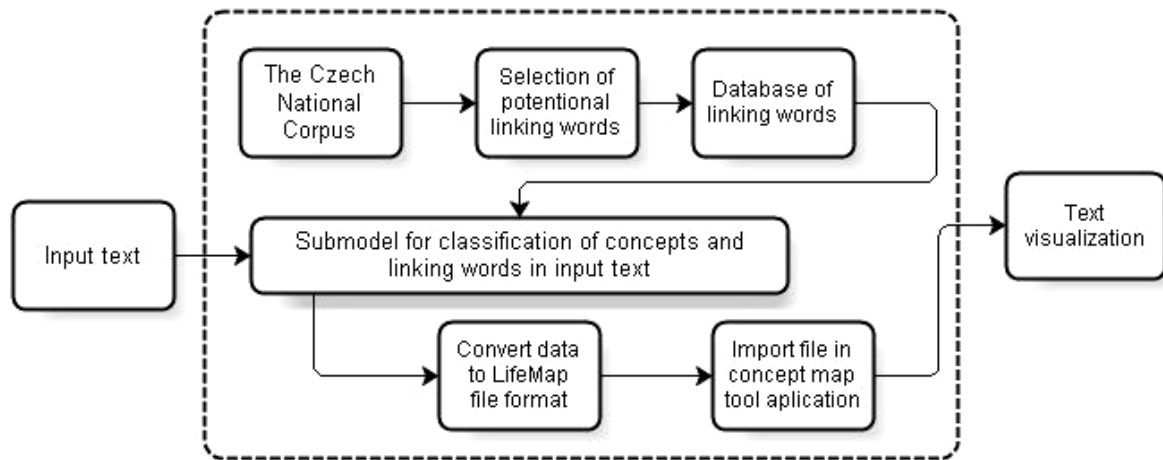
Traditional grammar classifies words based on eight parts of speech: the verb, the noun, the pronoun, the adjective, the adverb, the preposition, the conjunction and the interjection. The CNC uses special expressions (tags) for finding words according specification you need. For example: [tag="P.*"], where “P” is for finding all words in corpus which are the pronoun. Searching words according to the parts of speech is very simple and fast. Output of searching can be exported to the external file for another process [5].

3.2 *The model of text visualization*

The suggested model of text visualization use for classification of linking words four parts of speech (the conjunction, the preposition, the verb and the pronoun) and some selected words. So the other words in text (mainly the noun) are automatically classified as concepts. The model for text visualization generates “near-concept-map” by using classification submodel and concept map application (concretely was used freeware utility: CmapTools).

Submodel for classification of concepts and linking words was created as a number of linked spreadsheets in Microsoft Excel. The spreadsheets contain classification algorithm and database of linking words created by searching in the Czech National Corpus. The first spreadsheet contains cell for input text, which you want to convert to structured data importable to concept map application. As output format, which can be easy importable to

CmapTool application, was selected LifeMap file format. The last spreadsheet contains output structure of converted data, which can be copy and paste to blank **txt.** file and then imported to CmapTool application. Picture No. 5 describes process of text visualization.



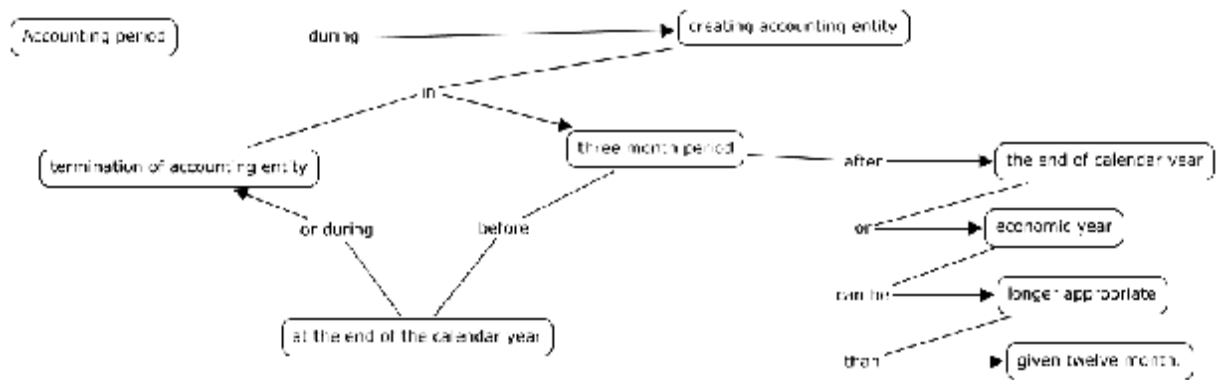
Picture No. 5: The model of text visualization (source: authors)

3.2.1 Experiences of automatic generating “near-concept-map”

The model of text visualization was tested on forty sentences, which was randomly selected from the text of Law of accounting. Our experiences show that the model has some limitations. The first limitation is that you can convert at once only one sentence. This is because of the design of algorithm. This limitation could be take out in a near future and isn’t so limitative because you can copy more outputs from Excel to one txt-file.

The other limitation results from the complexity of the language. The Czech National Corpus naturally contains only words, which are not rare in the Czech language. So there is a possibility of unsuccessful classification of rare linking words. When we generated “near-concept-map” from relatively long sentence, then we obtained structure which is not so understandable – see picture No. 6. On the other hand we obtained the good results when we use more simple sentences – see part 3.3. The input sentences in all examples were selected from the Law of accounting.

Input sentence: „Accounting period during creating accounting entity in three month period before at the end of the calendar year or during termination of accounting entity in three month period after the end of calendar year or economic year can be longer appropriate than given twelve month.“ (English translation from the Czech Law of accounting) [8] Visualization of input sentence is on picture No. 6.



Picture No. 6: Automatically generated text visualization of relative long sentence, English translation (source: authors)

3.3 Example of meaningful and rote learning by using text visualization

Rote learning

Disadvantages of rote learning is based on the fact, that knowledge learned by rote learning tends to be quickly forgotten and the cognitive structure of the learner is not enhanced or modified to clear up faulty ideas [9]. Advantage of rote learning is based on the fact, that it's very fast.

Points describe process of rote learning:

- 1) Learner reads sentence No.1 and 2.

Sentence No.1:

„Accounting period either matches with calendar year or is an economic year.“ [8]

(English translation from the Czech Law of accounting)

Sentence No.2:

„Economic year is an accounting period which can start only first day of another month than January.“[8] (English translation from the Czech Law of accounting)

- 2) Learner has not-organized knowledge (there is uncertainty whether the learner understands the meaning of text)

Meaningful learning

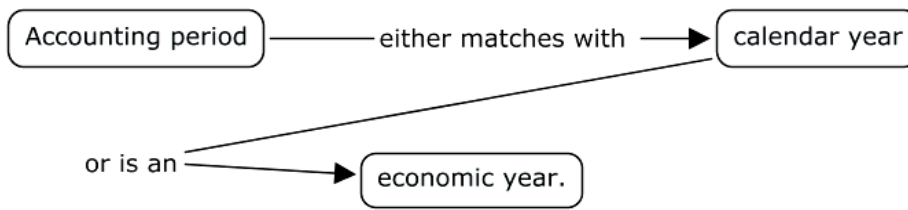
Meaningful learning costs more time than rote learning, but it produces well organized and relevant knowledge structures. It consists in organizers act, which we can imagine as a subsuming bridge between new learning material and existing related ideas [9]. Next points describe process of meaningful learning:

- 1) Learner reads sentence No.1 and he or she visualizes the “near-concept-map” of this sentence (see picture No.7). This “near-concept-map” he or she manually modifies to concept map according to logical structure of relationships between concepts (see picture No.8). This operation helps to realize what the learner knows about relations between concepts.

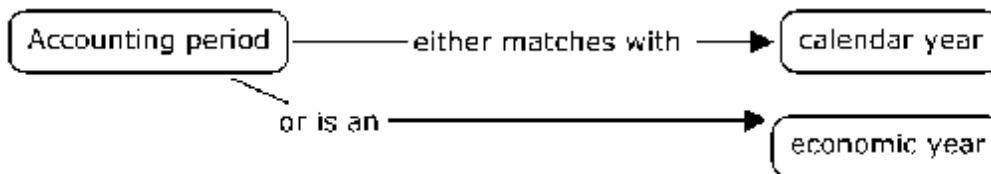
Sentence No.1:

„Accounting period either matches with calendar year or is an economic year.“ [8]

(English translation from the Czech Law of accounting)



Picture No. 7: Automatically generated text visualization of sentence No. 1, English translation (source: authors)

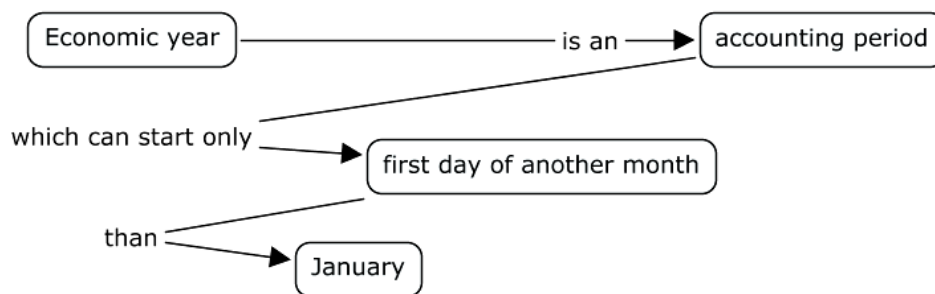


Picture No. 8: Manual modification of text visualization of sentence No. 1, English translation (source: authors)

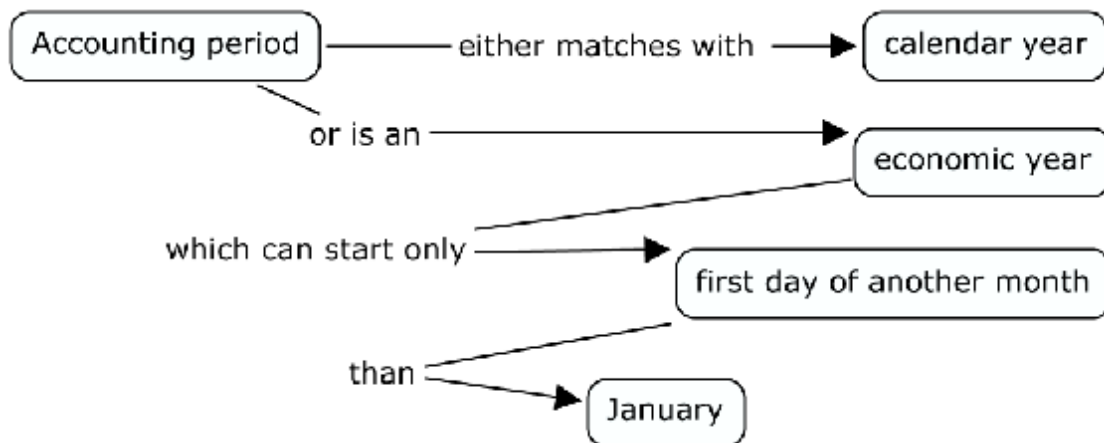
- 2) Learner reads sentence No.2 and he or she visualizes the “near-concept-map” of this sentence (see picture No.9). This “near-concept-map” he or she manually modifies to concept map according to logical structure. Next step is to incorporate this new “near-concept-map” of sentence No.2 into an existing knowledge structure of sentence No.1 (see picture No.10).

Sentence No.2:

„Economic year is an accounting period which can start only first day of another month than January.“[8] (English translation from Czech Law of accounting)



Picture No. 9: Automatically generated text visualization of sentence No. 2, English translation (source: authors)



Picture No. 10: Manual modification of text visualization of sentence No. 1 and No. 2, English translation (source: authors)

4. Conclusion

We discuss the concept of meaningful learning in contrary of rote learning. It shows examples of both types of learnings using suggested model of text visualization.

Concept of meaningful learning produce well organized knowledges than rote learning. It is based on an incremental principle of learning – before learning of new knowledge learner realize what he or she knows and then connects new knowledge to an existing cognitive structure.

The suggested method of text visualization brings a new approach to the text visualization by combining possibilities of database of electronic texts (the Czech National Corpus) and concept map tool applications. The model of text visualization was successfully tested on forty randomly selected sentences from Law of accounting. Both the suggested model of text visualization and CmapTool application appears as a useful aid for meaningful learning.

Acknowledgement

This work was supported by the scientific research project of Ministry of Environment, Czech Republic under Grant No: SP/4i2/60/07 with title Indicators for Valuation and Modeling of Interactions among Environment, Economics and Social Relations.

References:

- [1] BOETTCHER, Judith. *What is Meaningful Learning?* [online]. [2006] [cit. 2009-10-23]. Accessible at WWW: <http://www.designingforlearning.info/services/writing/bits.htm>.
- [2] CARDELLINI, Liberato. *Conceiving of Concept Maps to Foster Meaningful Learning: An Interview with Joseph D. Novak.* *Journal of Chemical Education* [online]. 2004 [cit. 2009-10-22]. Accessible at WWW: <http://www.jce.divched.org/Journal/Issues/2004/Sep/p1303.pdf>.
- [3] *Concept Maps* [online]. 2009 [cit. 2009-10-25]. Accessible at WWW: <http://tceisd.org/Portal/files/resources/ConceptMaps.pdf>.

- [4] *Czech National Corpus - SYN2005*. Institute of the Czech National Corpus, Praha 2005 [cit. 2009-10-25]. Accessible at WWW: <<http://www.korpus.cz>>.
- [5] ČERMÁK, František. *Jak využívat Český národní korpus*. Praha : Nakladatelství Lidové noviny , 2005. 181 s. ISBN 80-7106-736-9.
- [6] FRANCISCO, Lopes, VALENTE, Júlio, FAVERO, Eloi. *A new approach to meaningful learning assessment using concept maps: Ontologies and genetic algorithm*. Proc. of the First Int. Conference on Concept Mapping [online]. 2004 [cit. 2009-10-14]. Accessible at WWW: <<http://cmc.ihmc.us/papers/cmc2004-238.pdf>>.
- [7] HEARST, Marti. *Search User Interfaces*. [s.l.] : Cambridge University Press, c2009. 408 s. [cit. 2009-10-14], ISBN 9780521113793. Accessible at WWW: <<http://searchuserinterfaces.com/book/>>.
- [8] *Law No. 563/1991 Sb. of accounting*
- [9] NOVAK. *The Theory Underlying Concept Maps and How to Construct Them*, Technical Report IHMC CmapTools [online]. 2006, Florida Institute for Human and Machine Cognition [cit. 2009-10-14]. Accessible at WWW: <<http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf>>
- [10] TAROUCO, Liane M., GELLER, Marlise, MEDINA, Roseclea. *Cmap as a communication tool to promote maningful learning*. Proc. of the Second Int. Conference on Concept Mapping [online]. 2006 [cit. 2009-10-25]. Accessible at WWW: <<http://cmc.ihmc.us/cmc2006Papers/cmc2006-p152.pdf>>.
- [11] *The Czech Nationa Corpus* [online]. 2005 [cit. 2009-10-25]. Accessible at WWW: <<http://ucnk.ff.cuni.cz/index.php>>.

Contact Address:

Ing. Ondřej Svoboda
 Univerzity of Pardubice
 Faculty of Economics and Administration
 Studentská 84, 532 10, Pardubice
 Email: ondrej.svoboda.@upce.cz
 Pnohe: +420466036480

Ing. Ondřej Procházka
 Univerzity of Hradec Králové
 Faculty of Informatics and Management
 Rokitanského 62, 500 03 Hradec Králové
 Email: ondrej.prochazka@uhk.cz