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Concept Mapping in Education and Semantic Knowledge Representation: an Illustrative Survey

Raghavendra Katagall^{*}, Rakesh Dadde^{*}, R H Goudar^{*}, Sreenivasa Rao^{}**

^{*}Dept. of Computer Network Engg. (CNE), Visvesvaraya Technological University, Belagavi-590018

^{**}SIT, JNTUH and MSIT, IIITH, Hyderabad

rkk4691@gmail.com, rakeshdadde@gmail.com, rhgoudar@gmail.com.

Abstract

Concept Maps are graphic representations of topics, ideas, and their relationships. They allow users to group information in related modules so that the connections between the modules become more readily apparent. Among the potential uses of concept mapping for the improvement of learning and teaching in classrooms, the powerful technique of concept mapping could improve education in four different categories: (1) as a planned learning strategy, (2) as an instructional strategy, (3) as a strategy for planning curriculum, and (4) as a means of assessing students understanding of science concepts. Concept Maps are essential to increase meaningful learning in students and for representing the knowledge, experience of individuals and teams in education, science, medical and management course. In this paper we have made exhaustive survey to bind up various research works carried on concept maps in the above mentioned disciplines and have simplified the things for beginners to carry out research on concept mapping.

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1 Introduction

Concept maps are graphical tools created by Joseph D. Novak and his team at Cornell University in the

1970's. These concept maps are based on Ausubel's learning theory². This technique has been used by many disciplines to organize and represent knowledge and enhance meaningful learning. Concept maps stimulate the generation of ideas, and help improving one's own creativity. They include concepts usually enclosed in circles or boxes of some type, and relationship between these concepts denoted by a connecting line linking to concepts. Words on the line represent the linking phrases. The roots of concept mapping arise from Ausubel's theory of meaningful learning. This theory was produced after Ausubel's work on how learners learn large amount of useful information from textual and verbal inputs.

Number of advantages of the use of concept maps for educational purpose are supplied by some prominent authors:

- Differentiation among essential and nice-to-know outcomes by users.
- Themes will be easy to discover.
- Sets way for thinking.
- Key concepts belonging to more than one discipline can be identified.
- Concept map provides a basis for discussion.
- Conceptual relationship used for intended program and course outcomes can easily be explained.

Concept maps are represented in hierarchical fashion with the most inclusive, most common concepts at the top of the map and less common concepts hierarchically below. Concept maps have a distinct advantage over many other types of instructional strategies when it comes to supporting higher order thinking skills. Creating of concept map requires a clear understanding of how ideas are related to one another and cognitive skills that cannot be accomplished simply through memorization or even the use of heuristics.

2 Literature Review

A number of studies are conducted using concept mapping as a pedagogical tool in all the discipline including Medical, Science, Education, and Management course etc. 17 researches are used in this section spanning from 2008 to 2014. The following subsections summarizes those researches in various disciplines,

2.1 Concept mapping in science subjects

In Jorge Villalon et.al³, proposes that concept maps acts as scaffolding by making conceptual understanding visible at different stages of the learning process for both undergraduate and postgraduate students. Paper throws light on Concept Map Miner (CMM) which is used to generate automatically concept maps from student's composition. The challenge for using Concept Map (CM) is time consuming and expensive. CMM is an automated tool for constructing concept maps and identifies concepts and their relationships. CMM can be integrated to e-learning environment. Concept Map Miner tool supports writing activities by scaffolding author's reflection during the process of writing. At last authors concluded that using CMM, students can easily generate concept maps from composition, and they can discuss its design and implementation.

In A.M.M et.al⁴, Authors stated that manufacturing is knowledge intensive activity. As we all know that the Internet can help us to create Internet Aided Manufacture (IAM) using concept mapping. This paper tells the interplay between IAM and Cmap. Cmap is an effective means for representing existing knowledge as well as representing new knowledge gained from existing knowledge. Knowledge in IAM is categorized as General Knowledge (GK) [Description], Exploratory (ExK) [analysis, laboratory work, documentation], Emergent (Emk) [critical thinking] [GK Union ExK]. Using Cmap tool we integrate GK, ExK, EmK and represented in IAM. Knowledge is not the reality as it is but logical or perceived interpretation of it. The explanation namely evidential ordering and eliminatory explanation on that are useful for formulating emergent knowledge from Exploratory and General Knowledge. Cmap is used in representing knowledge underlying complex engineering problems.

In Yingying Jiang et.al⁵, proposes a kind of context aware hand drawn concept map with RFID tags, which is especially useful for pan based mobile devices. In the proposed method first the structure of the hand drawn concept map is extracted and then users can assign RFID tag to concept nodes. Authors finally suggests that their proposed method of concept maps improve the traditional concept maps in the following aspect.

- It adopts hand-drawn concept map which is natural.
- The representation ability can be enhanced by RFID tags.
- RFID tags could be used for retrieval of concept nodes as well as hand drawn CMs.

In Susan M. Zvacek et.al⁶, an experiment is carried on engineering students, who do well in memorizing large

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