

Chapter 37

A Web-Based Collaborative Learning System Using Concept Maps: Architecture and Evaluation

Anal Acharya

St. Xavier's College, India

Devadatta Sinha

University of Calcutta, India

ABSTRACT

The growth of communication technologies in the last two decades has led to development of web based learning systems for a variety of applications. The efficiency of such learning systems has often been enhanced by the use of collaboration tools and techniques. This study proposes a method of collaboration for construction of Concept Map of learning among a set of 'n' learners divided into 'k' groups using Short Message Services (SMS). This concept map is used as a sequence for construction of learning system. The functional modules of the architecture of this system are derived from the 'Extended' theory of Meaningful learning proposed by David Ausubel. Two approaches have been used for evaluating this collaborative learning system. Firstly, paired t-test was conducted on student marks before and after collaboration to find the degree of significance between these. Secondly, efficiency of the collaboration process is computed using a set of Collaborative Efficiency Indexes (CEI) derived from a set of proposed metrics.

INTRODUCTION

In recent times the most important innovation that has changed the face of educational technology is web-based education. This has been possible due to tremendous advancement in the field of computer networks and communication technology. As a result, researchers have used various tools and techniques to enhance learning process for various types of courses. A typical example of such a tool is Intelligent

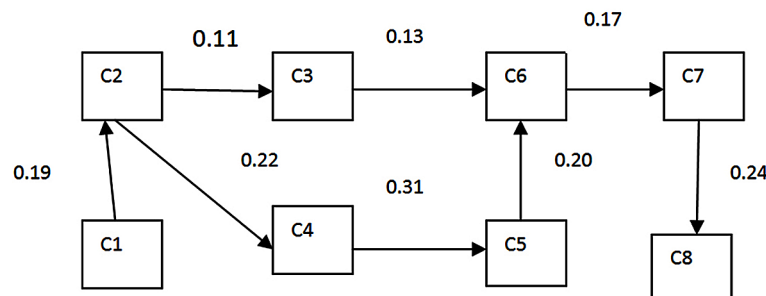
DOI: 10.4018/978-1-5225-0058-2.ch037

Tutoring Systems (ITS). An ITS is a computer system that aims to provide immediate and customized instruction and feedback to the learners without the intervention of human tutor (Postka, 1998, pp. 55-59). Johnson (1989) made the first significant contribution in this area which he proposed a authoring environment for building ITS for technical training for IBM-AT class of computers. Vasandani (1989) in his work built an ITS to organize system knowledge and operational information to enhance operator performance. There has been a lot of work in ITS in Mobile Learning (M-Learning) environment as well. In 2005, Virvou & Alepsis (2005) implemented a mobile authoring tool which he called Mobile Author. Once the tutoring system is created it can be used by the learners to access learning objects as well as the tests. Around the same time Kazi (2006) proposed Voca Test which is an ITS for vocabulary learning using M-Learning approach. However ITS suffer from two major drawbacks: Firstly, they do not use any tools for organizing and structuring knowledge and secondly, they lack face to face interaction between the learner and the tutor (Hwang, Wu & Ku,2011).

The first disadvantage has often been overcome by the use of different Mind tools (Hwang *et al.*, 2011) to organize knowledge. A Mind tool is a computer based knowledge construction tool that enables the learner to organize the subject they are studying A typical example of such a mind tool is concept map. The development of concept maps can be traced to the theory of Meaningful Learning proposed by David Ausubel (Pendican, 2005) in 1963. In meaningful learning the learner is able to relate the new knowledge to the relevant concepts already known to him. Two methods were proposed by Ausubel for this purpose: (i) signaling which indicates important information and (ii) advanced organizers which indicate the sequence between these. These psychological foundations led to the development of Concept Maps by Joseph D Novak (Novak & Canas, 2007) in Cornell University in 1972. Since then concept map has been used by a lot of researchers to structure and organize knowledge in web based learning systems for various applications. Figure 1 shows a typical concept map of learning. There are 8 concepts connected by 8 relationships. The edge $C1 \rightarrow C2$ indicates that learning concept C1 is a prerequisite to learning concept C2. In other words, if a student has failed to learn a concept C2 it is perhaps due to the lack of mastery over concept C1. Associated with the rule $C1 \rightarrow C2$, there is a confidence level(0.19), which states that if the student fails to understand C1, then the probability for him failing to understand C2 is 0.19 (Haan & Kamber,2011).

The second disadvantage has led to the development of web based learning systems. There are several ways in which web based learning may be implemented. The most primitive form of this is Electronic Learning (E-Learning). E-Learning is a general term that is used for learning from any electronic device such as radio, television, computer and all other devices that may be invented in the near future that

Figure 1. A Concept Map of learning



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