A Proposal for Developing a Primer for Constructing and Analyzing Conceptual Structures

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Abstract. A rationale and proposal for developing a primer for teaching-learning of conceptual structures is presented. The skills required and developed by an engagement of constructing and analyzing conceptual structures are richer and easier to be dealt with in school education. The teaching-learning context of CS is fundamental and important enough to introduce the topics from logic, philosophy, computer science and linguistics. A proposal is made for the formation of a special interest group for the primer.

Keywords: primer, conceptual structures, education, knowledge representation, propositions, logic, philosophy, teaching-learning.

1 Introduction

This is a proposal for developing a primer on conceptual structures addressing: (a) reasons to learn or teach conceptual structures (CS), (b) background knowledge required for representing and analyzing CS, (c) activities and exercises that will help develop the skills required and (d) to provide a glimpse of the various applications of conceptual structures. After going through the primer the learner can take an undergraduate level (101) beginner course on CS. This paper provides a justification for why such a primer is required, why CS-LTA community should spend time in developing this primer, and suggests an outline of the primer for discussion at the workshop.

2 Rationale

Knowledge representation skills are almost mandatory for those who decided to work in Artificial Intelligence, Logic, Databases, Semantic Web, Linguistics and Philosophy. The community of experts who work in these areas are primarily responsible for developing as well as popularizing this discipline. A repertoire of skills required during the development of these disciplines however have a wider use. One such use is school education. As researchers working in science

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education, we think teaching the basics of learning conceptual structures will play an important role in developing rigor, critical reasoning, clarity of thought and expression[1]. Since these skills are essential for mastering any discipline, and if our diagnosis that CS will help the students develop these skills is correct, we can argue that the teaching and learning of CS is essential for higher education of any discipline. Therefore, we would like to make a strong case by suggesting that just as basic arithmetic, algebra and geometry are considered essential for all those who graduate from school, a basic course on conceptual structures (which includes logic) is essential. We need modules that impart skills in constructing and analyzing conceptual structures through basic exercises. Availability of a primer in the form of independent units/modules would facilitate easy integration in the school curricula.

3 Networking with Other Initiatives

Concept maps are already being widely used in school education. These are considered to be imparting meaningful understanding, eliciting knowledge, evaluating students' understanding, for pedagogical designing, lesson planning, etc.[2]. For the purpose of general education, concept maps bear significance, however, when it comes to its use in representing scientific knowledge, these are considered to be informal[3]. The freedom to choose the linking words makes it vulnerable to creating ambiguous representations, hence are not considered to generate the precision and rigor that is required in scientific knowledge[4].

Not surprisingly, there exist groups who do believe that logic, philosophy etc. should be taught as a subject matter even at the school level. Some studies have presented course material of logical reasoning in the high school. It is also very important to introduce logical reasoning along with mathematics to school students as young as 10-12 years old[5]. To help cope up with the information explosion, courses were designed to impart skills to organize, critically read, analyze and evaluate the content[6]. Moreover, these courses were offered for the students enrolled in both the pure sciences as well as social sciences.

There have been tools designed to teach Aristotelian syllogism for elementary logic course using PrologPlusCG[7]. The objective of the idea is to improve argumentation skills and an in-depth understanding of logic, logical reasoning, and conceptual structures. Conceptual graphs were used in business computing wherein students were engaged in inquiry based learning enterprise[8]. In another study Prolog environment was introduced in a course in computer science for developing an understanding of the first order logic. The course trained them in problem solving and knowledge representation skills. Such students were reported to be successful in developing knowledge-based projects in pure and applied sciences such as, biology, medicine, chemistry, archeology, mathematics and geometry[9].

Teaching-learning of philosophy at the school level is already tried in the UK under the program of Philosophy in Children to develop critical thinking skills[10,11]. Another very active group, International History, Philosophy, and

Science Teaching Group [12] is promoting school and university science education as informed by the historical, philosophical and sociological issues of sciences. Apart from the high school students, recent developments in science such as bioinformatics demand knowledge of creating ontologies, semantic web, logic and semantics[13]. Since subject experts of these domains do not have a sound knowledge of logic or semantics, it is felt that an introductory course on conceptual structures would be useful.

Though the efforts of introducing logic, philosophy, computer science etc. are laudable in themselves, we think that the teaching-learning context of CS is richer and easier to introduce the topics from logic, philosophy, computer science and linguistics. When these subject are done independently, the subject matter becomes more abstract, highly formal and therefore difficult. Since CS is less formal than logic and computer science it can help bridge the gap while learning the more formal subjects. One possible way is to introduce the teaching learning of CS as modules within the existing courses[14]. The reasoning that learners apply during constructing CS gives ample opportunities to introduce logic, philosophy and linguistics. The proposed primer is an attempt to meet the objectives of developing rigor, critical reasoning, clarity of thought and expression, as well as an entry to the existing books on conceptual structures [15,16,17] which are targeted at the undergraduate level.

4 Special Interest Group

The development of proposed primer could be carried by a collaborative effort with groups of experts from the disciplines mentioned above. Conducting field trials may be necessary to check the effectiveness of the modules. Inorder to achieve these tasks, we suggest the formation of a Special Interest Group (SIG) preferably as an initiative of CS-LTA. This group may also invite people from the other groups such as [18,19] who attempted to bring in logic, philosophy and computer science into school education.

5 A Draft Framework of the Primer

As a framework for the primer, we have sketched a draft plan of the units which comprises of learning objectives. We propose the units be framed according to the level of difficulty and an appropriate teaching-learning sequence. The framework can be viewed from http://gnowledge.org/∼meena/primer-framework.pdf to get an idea of the units proposed. The items were mostly chosen from the teaching-learning sequence suggested by the dependency mapping for conceptual structures [20].

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