

# AN ALTERNATIVE PROPOSAL FOR ELICITING AND ASSESSING STUDENTS' KNOWLEDGE STRUCTURE

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*In this paper, we propose an objective assessment technique for evaluating students' knowledge structure. The assessment task is to create propositions based on providing with constraints i.e. concepts and linking words (relation types). The propositions are validated based on a comparison with an expert's knowledge base. An illustration of the technique is presented from the domain of senior secondary school level biology.*

## INTRODUCTION

One of the ways of understanding/assessing students' knowledge structure is through knowledge elicitation, which can be accomplished by interviews, open-ended questions, multiple-choice tests, etc. It is very important that assessment helps in eliciting students' conceptual frameworks, and conceptual change. In this abstract, we propose an alternative method of eliciting and assessing students' knowledge structure by means of an objective method of assessment. The method is introduced by providing constraints which in turn helps in recall and reflecting on prior knowledge which itself is the factor influencing learning and is stated as *what the learner already knows* (Ausubel, et. al., 1978) in educational psychology. A case study from a biology domain is illustrated.

The educative episodes involves *learner, teacher, domain of knowledge, social milieu* and *assessment* all of them interacting with each other (Novak, Mintzes & Wandersee 2000). Assessment in education is equally of significance as learning is. Assessment helps to provide with an index related to how well a student has understood the learning material, or how well the teacher has taught. In the curriculum the assessment comprises of an objective and/or traditional examination. The traditional assessment are the usual question-answers or essay/short questions. Objective assessment are used to assess learning outcomes at the recall and comprehension levels, for example multiple choice, fill in the blanks, match the column, true-false which are normally found at the end of each chapter in a conventional textbook. The objective assessment tests deeper levels of knowledge and understanding, while the traditional assessment is more of a memory-type (Harper, 1972, p. 289). The virtue of objective assessment is in the reliability, validity, and adequacy with which they cover the subject matter (ibid, p. 300).

An objective method of assessment mostly comprises of a selection based test wherein the options or choices are provided and one has to select correct answer. With the help of clues provided a student is able to recall, choose and provide a correct answer to a question. If we want to assess student's understanding of a domain it can be done by eliciting the knowledge of the student about the domain. Students' knowledge structure of a domain can be elicited in different ways such as --- word associations to concepts, concept similarity, concept maps (Ruiz-Primo & Shavelson, 1996, p. 570). It is assumed that the subject domain of science is conceived as a rich set of relations among

concepts and therefore eliciting this set of relations from students will help to assess students' knowledge structure.

## **ELICITING STUDENTS' KNOWLEDGE**

In this paper, we propose a model for objective assessment for knowledge elicitation at the level of simple propositions that are represented in science. The domain chosen is a chapter on *Cell Structure and Function* from Class VIII conventional biology textbook, NCERT curriculum, in India (Pant, et. al., 2004, pp. 118--126). Students' understanding can be elicited once the chapter is taught, and assessment can be carried out in two different ways---(i) providing with a few concepts, (ii) providing with a few linking words (i.e. relation types) along with a few concepts. In the first method, the list of concepts are provided as shown in Figure 1. Students will be asked to create a set of simple relations in whichever way they can represent based on their recall and comprehension.

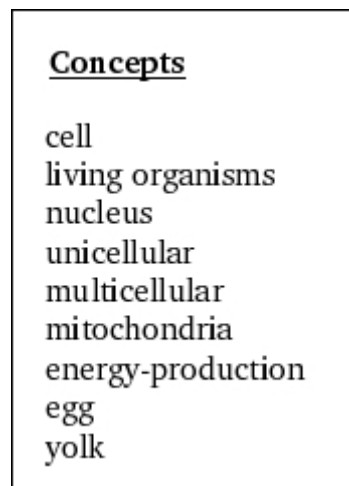


Figure 1: List of concepts.

In the second method, we provide the students with extra clues i.e. with a set of linking words (relation types) along with the list of concepts as shown in Figure 2. In this method, students have to apply the given constraints only. They will be asked to create set of relations using the concepts and relating them with any of the three given linking words. The linking words provide meaning to the relations. It is known that knowledge resides in the meaning of relations and choosing the appropriate unambiguous linking word will help the students to create meaningful relations. In this way students can represent the knowledge as an expert does i.e. using unambiguous, precise, parsimonious relations (Brewer, 1991). The added advantage of this strategy is to help the students to organize their knowledge, a strategy which is seen in experts (ibid), and as the students map the domain it helps in recall while creating simple propositions. This method helps the students to think like an expert during the knowledge representation. Studies have shown the importance of knowledge representation (KR) methods, also practiced in artificial intelligence (AI), on students' learning. KR helps the learners in understanding the meanings of concepts and relations between them. It helps to not only draw a picture of knowledge structure in their mind but also in

developing cognitive and meta cognitive skills. Most importantly, the knowledge initially possessed by the novices which is in implicit or tacit form is transformed into an explicit body of knowledge. The act of creating an organized structure of ideas on paper or in a computer helps in creating a knowledge structure in the mind. In this way KR helps the students to learn by creating a structured knowledge to make it more expert-like and which is also essential for assimilation, recall and comprehension (Fisher 2000).

| <u>Concepts</u>   | <u>linking words</u><br><u>(relation types)</u> |
|-------------------|---|
| cell              |   |
| living organisms  | consists-of                                     |
| nucleus           | includes  |
| unicellular       | function  |
| multicellular     |   |
| mitochondria      |   |
| energy-production |   |
| egg               |   |
| yolk              |   |

Figure 2: List of concepts and linking words (relation types).

## **ASSESSING STUDENT'S KNOWLEDGE**

The assessment task can be a paper-pencil task and the relations can be validated by an expert who is a human and/or using a criterion or expert's set of relations. The above method of assessment of students' knowledge structure can be easily validated if it can be automated or is computable. We illustrate a case of objective assessment of the same domain with the help of using an interface for comparison of student-expert knowledge structure implemented using a tool GNOWSYS (2006). GNOWSYS is a knowledge networking and organizing system (2004). In the interface, students are provided with a set of concepts and a set of linking words (i.e. relation types) and are assigned a task of creating simple relations as shown in Figure 3. After creating a set of relations from the given list of concepts and linking words, this set of relations is validated by comparing with an expert's or criterion map which is already existing in the tool's database. The tool will compare and provide with a result of correct and incorrect relations, a result of students' understanding of the domain, as shown in Figure 4.

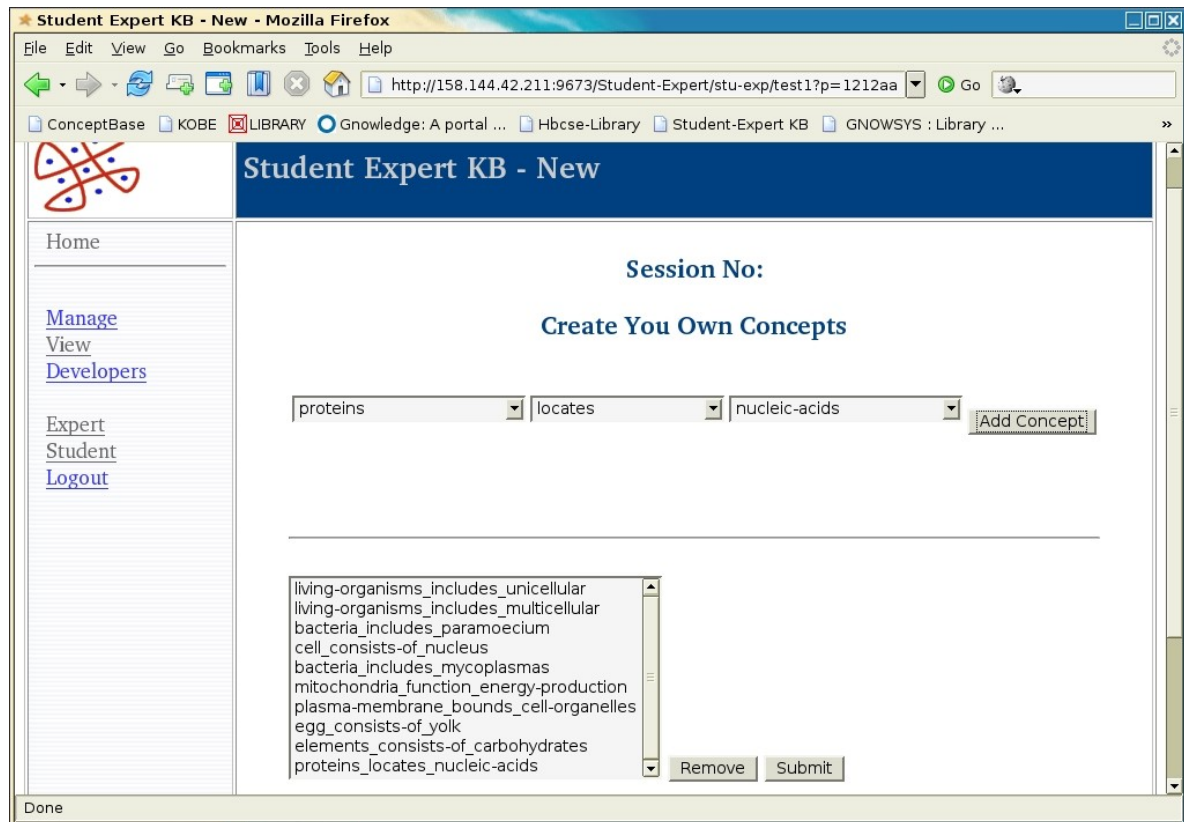


Figure 3 : Screenshot showing a session created using concepts and linking words (relation types).

## DISCUSSION

The earliest attempts in diagnosing students' knowledge frameworks were done by Jean Piaget using clinical interviews. In the current science education literature, several kinds of assessment techniques are recorded for investigating students' knowledge structure. Some of these are --- structured interviews, knowledge Vee (Gowin), concept circle diagram, image based test (Wandersee), concept maps (Novak), semnet (Fisher). Our proposed method of assessment, by providing constraints, falls very close to the scale of high-directed on the degree of directedness continuum as proposed by Ruiz-Primo (2004).

In this abstract, we have proposed an alternative method of eliciting and assessing students' knowledge structure. Further to support our proposal, we shall be conducting an empirical study in nearby schools. Using the above constrained method, we shall be probing the students to elicit their knowledge which will be based on set of relations. In another attempt, we shall elaborate the findings of the study with data and analysis.



Figure 4: Screenshot showing a session being validated based on expert's knowledge base.

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