CONCEPT MAP BASED LEARNING AND EVALUATION – A REVIEW

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ABSTRACT

Concept maps are graphical representation for establishing and demonstrating information. The objective of this paper is to review the seven models which are used to evaluate concept maps of students in classroom. These assessment models provides instructor with an instrument to evaluate concept maps and emphasizing the learning method as a replacement for modern teaching procedures present in some advanced learning organizations. To construct this paper, an unfathomable research in national and international journals is done so as to discover assessment models of concept maps. This paper does not intend to argue or converse which model is measured the most applicable for the assessment. Nevertheless it is possible to witness that the models have few "mutual" proportions of assessment. As a result, it is up to instructors' choice who has to choose the most appropriate one.

Key word: Concept Map, Assessment Models, Scoring.

1. INTRODUCTION

Joseph Donald Novak proposed the term called concept map, which has the most significant characteristics of monitoring and observing the modifications with respect to the students alertness resides within a class. Generally, the concept maps are proposed to realize how the learners fix the problem and link the concepts projected in the tutorial room [1]. As a result, a

problem arises: "how could an instructor evaluate a concept map designed by a student?" The answer is up to instructor to select the most appropriate model for their requirements in addition, bearing in mind few limitations such as: properties of the course undertaken, topic content, students' age and, also, the purpose of the learning institution. Hence, the impact of this paper is headed for teaching, as long as instructors to practice the graphical demonstration of concept map in guiding their students or valuation substitutes.

Concept map is one of the graphical representations of knowledge acquired by a person. In general the concepts are enclosed within the circles or boxes of some types, some lines are drawn between two concepts which specify the relationship between the concepts and so called – linking phrases or propositions [2]. Propositions are defined as the event occurred either logically or as fabricated. Most probably the propositions are represented in words, sometimes with the help of symbols. The process of linking two or more concepts in the name of propositions is defined as semantic units. This can be illustrated with the help of a structured diagram as shown Figure 1.

In other words, Concept map is defined as the graphical representation of the consolidated information acquired by any external source. For example, when a student is asked to create a concept map, their concept map represents their own idea of the subject they have learnt from the teaching of the instructor.

The demonstration is given below for the construction of concept map [5]:

1. Ascertain the main theme of the subject
2. Make sure to create a list of thoughts for each concept related to our theme
3. Consolidate the concept visually in whatever manner seems suitable
4. In last step the linking process of each thought must be carried out with the help of the connecting lines.
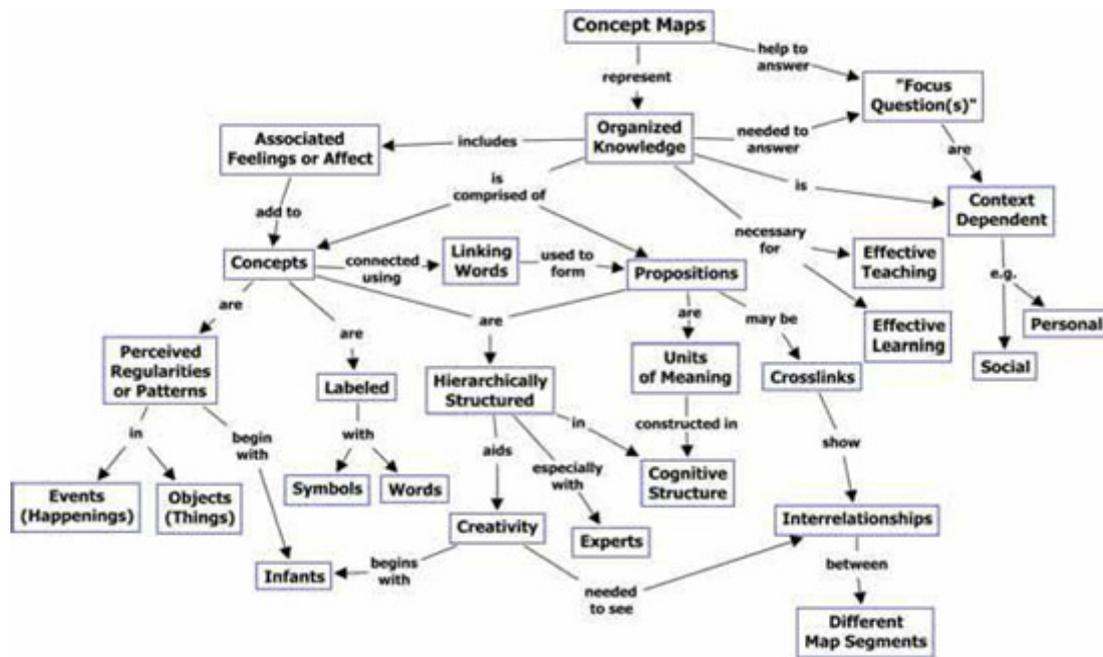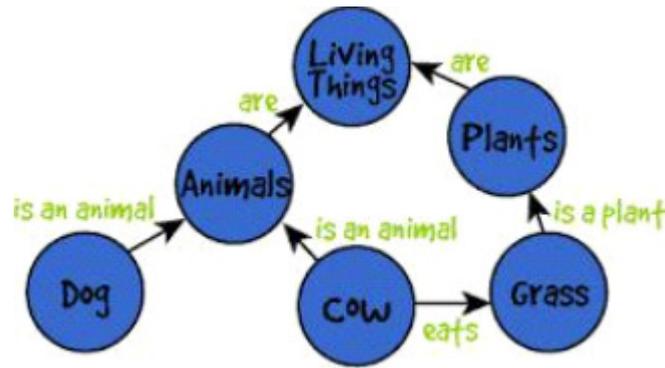

Figure 1 Representing the characteristics of the concept map [4]

The construction of a simple concept map can be illustrated in Figure 2:

Figure 2 An example for concept map construction

2. VARIOUS METHODS TO DEFINE A CONCEPT MAP

Concept maps can be segregated based on their structure [6]. Some of them were

1. loop structure,
2. hierarchical tree structure, and
3. hierarchical cross-link structure

Some concept maps have limitations with respect to assessment standards. Since some constraints takes only the concept nodes where the links plays a minor role. To overcome this concept of weighted concept map is introduced. Concept map can be evaluated with the help of scoring algorithm which gives a score value in percentage with respect to the randomly assigned values (weights) in each levels of the concept map.

2.1. Weighted concept map

Mislevy and Gitomer stated that each proposition has its own importance in the process of emphasizing the student learning evaluation techniques. As a result each design has a weight ranging from 0 to 1 which is called as "Weighted concept map" [7]. Concept with high significance has the highest weight and vice versa.

3. MODELS FOR ASSESSMENT OF CONCEPT MAP

One of the major challenges of the concept maps is the evaluation process, due to this circumstance that the map is designed by the perception of personalities learning [7]. In the other words, no map that exists is 100% inappropriate (or wrong). However, there are few models using assessment measures, for example 0-3; and there are others who measure using: good, satisfactory and unsatisfactory. To understand the knowledge of a student, we have to invite an instructor to design the concept map with respect to the knowledge subject, which tends to given a name called skilful concept map. Then the concept map designed by the student was compared with the skilful concept map.

From this comparison the plan of the subject knowledge can be one of the following learning states:

1. Learned
2. Partially learned
3. Unlearned
4. Or misconception about the planning.

From our assumption we could easily find out the students ability of attentiveness that resides inside the particular class. Hence this assumption helps the instructor to help the

students' in their area of week subject to be improved in future assessments. In order to offer a variety of choices of assessment, there are seven alternatives for assessing a concept map.

4. CONCEPT MAP EVALUATION MODELS

4.1. Bartels model

Bartels model is illustrated with three different categories [8]. First comes the concept and terminology, explaining the knowledge of the relationship among concepts and ability to communicate through concept maps. If the score obtained is 3 then it implies that the concept and principle of the concept map is clearly understood and it uses the appropriate notation and terminology, also have a good relationship and communication with the concepts. If the score value is 2 then it implies that some misunderstanding with the concept and terminology is drawn with few mistakes, incorrect connections and communication is also not good between the concepts. And if the score is 1 then there is more misunderstanding with the concept, terminology is also drawn with full of mistakes, many incorrect connections with more interruptions in between the concepts. If the score is 0 this implies that the concept is not in understandable manner and hence terminology cannot be drawn, the connections and communications are also not possible hence the final product is not at all a concept map.

4.2. Cronin, Dekker and Dunn model

According to Cronin, Dekker and Dunn, the process of linking the concepts with a term called "Grouping" comprised of events and the links are named with labels [9]. Grouping is of three types as follows:

1. Point grouping: concepts originating from one particular concept and for each concept a score 1 point is given in that group
2. Open grouping: more than one concept linked with a single chain for each concept a score 2 point is given in that group
3. Closed grouping: This deals with the process of forming a loop and for each concept a score 3 point is given in that group
4. If the concept map takes a hierarchical structure then the score value is assigned with respect to the levels designed by the instructor. Even if a single level is removed from the assigned level then the score value is reduced. If there exists a condition that there is no more levels to be removed from the assigned level or only two levels are left in the design then there is no score for that concept. Or else the concept map are represented in the form of branching, each branching point acquires score 1 point, which must have at least two statement lines. Last comes the proposition, which defines the relationship between concepts or phrases written on the line joining any two concepts, in which each word and propositions is assigned with score 1 point and score 2 point respectively. If the words are repeated extra one point is added to it.

4.3. NCSEC model

NCSEC stands for National Computation Science Education Consortium which deals with concept map with respect to four levels of standards [10], which are as follows:

1. Exemplary: Concept map have a disciplined, analytical format with association of main concepts and has a treelike structure which follows the standard map conventions. Every links are exactly categorized and the linking words exhibit superior intangible consideration.
2. Exceeds Standards: well-structured with association of main concepts. Linking words can be traced easily but not exactly categorized.
3. Adequately Meets Standards: Not fully organized and incoherent, and also consists of few main concepts. Linking words cannot be traced easily but not exactly categorized.

4. Below Standard: Irregular and puzzling which are even difficult to follow and have no links.

4.4. University Minnesota Model

University of Minnesota, proposed the fourth model which consists of four parameters: structure, relationship, exploratory and communication [11]. If the design of the concept map is said to be excellent then it has a non-linear arrangement that provides a thorough picture of the knowledge with a complex association of its comparative importance which were effectively drawn, and this clearly explains the complex thinking about the connection between designs. When it comes to communication, the information is clear and has a good understanding skill. If the design of the concept map is said to be good then it also has a non-linear arrangement that provides a thorough picture of the knowledge with a complex association of its comparative importance which were very effectively mapped, and this shows the operative thinking about the meaningful relationship between ideas. When it comes to communication, the information is clear and has a good understanding skill. If the design of the concept map is said to be unaccepted then it has an inappropriate arrangement which has no evidence of meaningful relationship between ideas hence thinking process is not clear. When it comes to communication, the information is clear and has a good understanding skill.

4.5. Novak and Gowin Model

Novak and Gowin model deals with scoring criteria for concept maps [12]. This model comprised with four parameters: propositions; hierarchy; cross links; and examples. If the concept map has a valid proposition then its score is 1 point otherwise 0 point, with respect to hierarchy and cross links the score point is 5 and 10 respectively for each valid level in the design. Unique or creative cross links might be given special appreciation or extra points. Score points 1 is assigned when there is a relevant example in the design.

4.6. McMurray Model

This model is also similar to Novak and Gowin Model, but consists of six parameters to illustrate a concept map [1]. The six parameters were breadth, interconnectivity, and usage of descriptive links, efficiency of links, layout and development over time. The concept map is said to be excellent if it defines the domain in multiple levels and interlinked with all concept which accurately describes all relationship in a distinct manner and exposed in multiple hierarchical level comprised of relevant examples with links. As a result of these the final map shows considerable cognitive progression which has greater depth of understanding the domain. The concept map is said to be good if it defines the domain in limited number of levels and interlinked with each other concept which accurately describes valid relationship in a distinct manner and exposed in multiple hierarchical level comprised of fairly relevant examples with links. As a result of these the final map shows considerable cognitive progression which has average depth of understanding the domain. The concept map is said to be unacceptable if it defines the domain with many levels missing and interlinked with few other concept which does not describe any relationship, hence no hierarchical level of concept is found. As a result of these the final map does not shows considerable cognitive progression, therefore the understanding of the domain is lacking.

4.7. Muller Model

Mueller, who developed this model, has established the concept map with four different assessment parameters as follows [12]:

1. Legible- the proposition is easy to read and encounter an error then the score point varies between 0 and 1, otherwise 2 points
2. Accurate- if the concept map is more accurate score point is 5, less accurate varies between 3 to 4 and if no accuracy exists then score point is drawn between 0 to 2
3. Complete- if the map is complete that is comprised of all relevant relationships and concepts the score value is 5 points otherwise reduces from 0 to 4 based on the completeness of the map measured.
4. Sophisticated- finding meaningful connections between the concepts gives 8 points as score value and reduces till 0 points with respect to the meaningful connections encountered.

5. SCORING ALGORITHM

Scoring algorithm, otherwise known as Fisher's scoring, is a form of Newton's method used in measurements to solve extreme likelihood equations mathematically, named after Ronald Fisher [3], which is used to evaluate the score value for each and every model. Based on the depth of the hierarchy of concepts, a random scoring system that provides a discrimination of random scores for each concept at a particular level represented by the student. A particular concept may be related to another concept with a relation; this relation is pivotal in identifying the level of hierarchy involved in the concept map. The more concepts a student represents in the concept maps with its relation the more we believe he or she understands the idea about the topic in study. Thus, the number of concepts identified in a concept map plays a significant role in identifying the depth of knowledge for that particular topic conceived by the student.

The scoring analysis is carried out in three steps:

1. All the concepts at Level 1 are given equal increments of a random score to each of the concepts.
2. A concept at Level 0, which happens to be the root node, is given a random score after the scores are assigned to Level 1 concepts.
3. All the concepts in the Level 2 are given an equal increment of random scores after assigning the score to Level 0 concepts

For example this can be illustrated with the below algorithm.

Score[count(Concept $_{level}$)]

Score[0] = 5

for i:1 to count(Concept$_{level1}$) - 1 do score[i] = score[i-1] +5

score[count(Concept$_{level0}$)] =5+ score[count (Concept$_{level1}$) - 1]

for i: count(Concept$_{level1}$) + 1 to count(Concept$_{level1}$) + 1 + count(Concept$_{level2}$) do

score[i] = score[i-1] + 5

6. EVALUATION OF STUDENTS' CONCEPT MAPS

Concept map deigned by the instructor serves as a standard against the concept map designed by the students. An algorithm has been implemented in order to differentiate the patterns used by the students' with respect to the predesigned concept map constructed by the instructor. This algorithm is a complex structured in organization and consistency in nature in accordance with the construction of concept maps.

Concept maps can be represented in two types of relationships:

- Most significant relationships between the corresponding concept maps are expected to be the most significant understanding in the learning course and they were awarded with 5 points, and

- Least significant relationships that describe only the necessary information will be awarded with 2 points.

The relationship within the student's concept map can be evaluation in accordance with their propositions comprised of absolute involvement of its parts used for designing that concept map. For example – the existence of significant relationship in the students' concept map is 40%, a correct representation of directions is 15%, and correct linking propositions is 30%, an exact variety is 10% and correct relationships in the exact places they were needed is 5%.

According to Alla Anohina, Janis Grundspenkis [13, 14], the scoring schemes (they are used to evaluate the student's concept maps accurately and consistently) are classified using the following five criteria.

- Type of scoring: Quantitative, Qualitative, or Combination.

- Scoring Method: Structural, Relational, or Combination.

- Scoring on the basis of an expert map or without its usage.

- Scheme offered or used for automatic or human-based scoring.

- Presence or Lack of restrictions concerning application of a scheme.

7. CONCLUSION

It is clear that the concept maps are: operative in recognizing effective and ineffective thoughts; agreed as facts in creation, because they are suitable for fitting into a mutual constructivist-integrationist outlook; tools for chronologically establish content using philosophies from broad-minded assortment and integrative resolution; concepts and threads must be explained by those who create them; flexible tools that can be used in several circumstances and commitments; operative for concentrating the content projected to be learned, since it imitates the understanding from who prepares it and when those process taken place. As a result the concept map works with a number of enlightened philosophies to reach a concept. Every concept map has its own nature of philosophies which is stated as the outcome of the instructors' belief in the form of design created by the student.

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