USING CONCEPT MAPS IN TEACHING CHEMISTRY IN THE CLASSROOM

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Abstract

Chemistry teaching and learning are extremely demanding and regarding. To create exciting learning environment with adequate chemistry curriculum that would engage every student is challenging enough. Monitoring the progress and level of understanding of individual in chemistry can be overwhelming. Nevertheless how can the chemistry teacher ascertain if students have a coherent and scientific understanding of the important concepts? Is it possible to produce a snapshot of this understanding? The above raised questions were addressed in this paper by sharing some practical tips for using concept map as a way of monitoring students understanding. In view of this it was discovered that the use of concept maps enable students to understand more about the relationship between concepts. The researcher recommended among others that practical experience of how to use concept mapping could be provided for pre-service teacher.

A concept map is a graphical representation of the relationship among terms. This invariably would sound familiar if you have used graphic organizers or visual learning tools such as inspiration software. In an attempt to make chemistry more attractive and to boost achievement of students, it is necessary to address these questions. How can students acquire the much needed experience for understanding scientific phenomenon? The response is the call for and a look at the way chemistry is being taught in schools. This is necessary so as to identify improved strategies and alternative models of instruction that would help raise achievement in chemistry teaching and learning.

Many studies have been carried out on the teaching and learning strategies, among which are: advances organizers (Ausubel 1960,Egbupan 1983 ,Seweje 1982).Using of Analogous,(Clement 1993, Holyoak 1985),concept mapping (Novak 1990,and Okebukola 1990).

It may be of great important to streamline how some of these strategies may be used in classroom in exposing chemistry concepts to students. Concept mapping is a Meta Cognitive tool developed by Novak et al (1977). It is an act of constructing maps or diagrams indicating inter-relationship among concepts to represent meaning or idea on domain of knowledge (NOVAK 1999).

According to Lawal (1999) the theory of concept mapping emphasizes that the single most important factor that influence learning is what the learner already knows. He opined that it is with this that the learners relate new knowledge through the process of indicating interrelationship, with map construction. Organizing concepts into a form that shows these interrelationships help learners to make a mental correction.

Benefits of Concepts Maps

When students are engaged in new chemistry concepts, they embark on a cognitive process of constructing meaning and making sense by consciously or subconsciously integrating these new ideas with their existing knowledge. Concept maps provide a unique graphical view of how students organize, connect and synthesize information. As a result, concept mapping offers benefits to both students and teachers.

Concept Maps Give Students the Opportunity to

Think about the connections between the chemistry terms being learned,

1. Organize their thoughts and visualize the relationships between key concepts in a systematic way and
2. Reflect on their understanding. In summary, concept maps give students the room to think deeply about chemistry by helping them to better understand and organize what they learn and to store and retrieve information more effectively, students at the same time also articulate and challenge their thoughts about chemistry when they discuss their maps with each other.

Concept mapping naturally integrates literacy and science by providing a starting point for writing about science; this can be particularly helpful for English language learners.

Concept maps are valuable tools for teachers because they provide information about students' understanding. Teachers can examine how well a student understands chemistry (science) by observing the sophistication of their concept maps. When an expert creates a concept map, it is typically an elaborate, highly integrated framework of related concepts (Chi, 1988). Highly sophisticated maps show highly integrated knowledge structures, which are important because they facilitate cognitive activities such as problem solving.

A closer look at the preposition in a concept map also reveals students' level of understanding. For example, linkages drawn between two unrelated concepts expose students' alternative or naïve conceptions in chemistry. Likewise the absence of a link between two closesely related concepts can reveal that a student has not yet developed a strong understanding of the relationship between the concepts. When concept maps are used on repeated occasions, they can clearly show how students' understanding, improve over time. Providing students with the same concepts on more than one occasion can show how the quality of the students' propositions improves over the course of instruction. Accordingly teachers can quickly see gaps in learning and modify lesson plans based on the information from student's concept maps.

Planning and Designing a Concept Mapping Activity

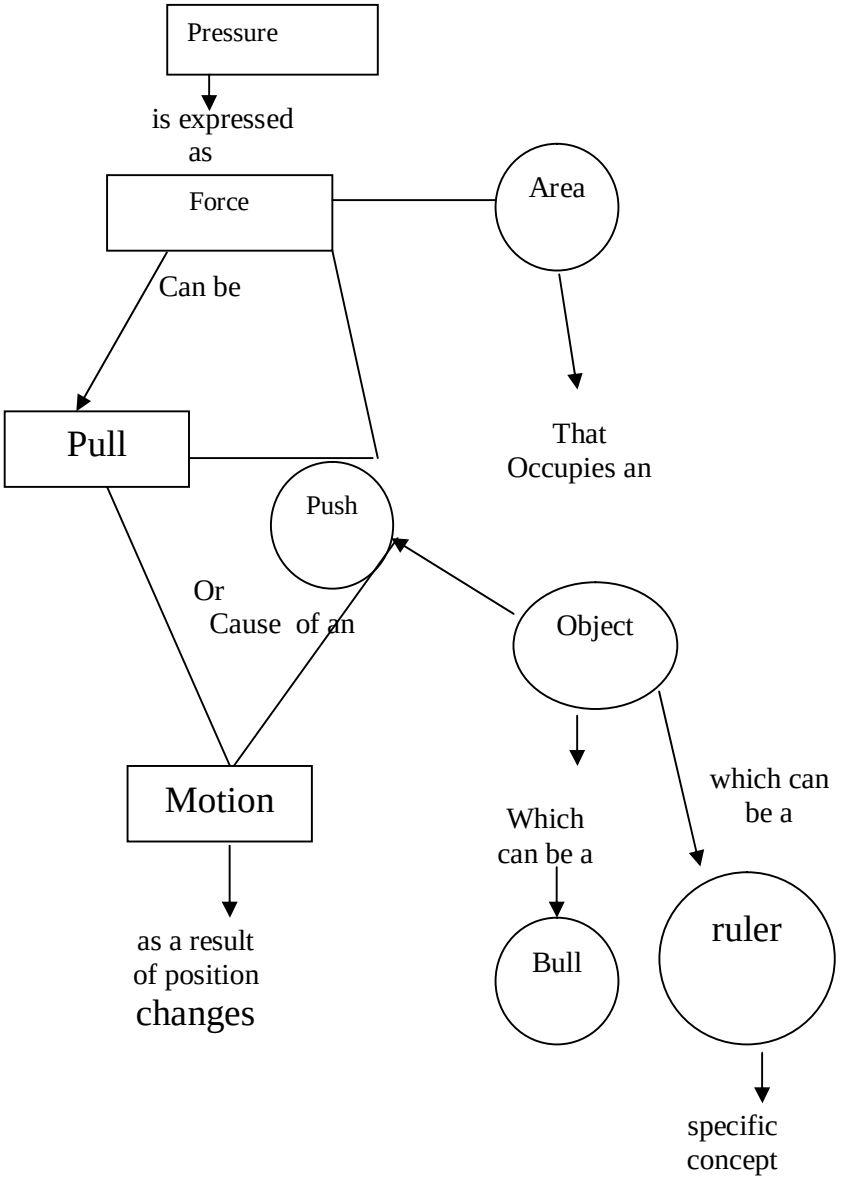
As both instructional and assessment tools in the classroom setting concept maps have great potential, but the design of the activity can invariablely change what is measured. For effective use of concept maps in teaching and learning chemistry in classroom the following steps could be adopted:

Step 1 – Selection of key terms. Scan your curriculum unit and select the most important and critical terms related to the key concepts being taught. With the selected terms see if you can instruct propositions that reflect what students should know and be able to express at the end of the unit. Keep the concept map manageable by selecting a short list of about 8 to 12 terms.

Example 1: Concept Map Created by Teachers for Pressure

As an example for a unit on pressure, we considered pressure, force, area pull, motion, push, Object ball and ruler; to be the most fundamental terms. These concepts are used for constructing the map below.

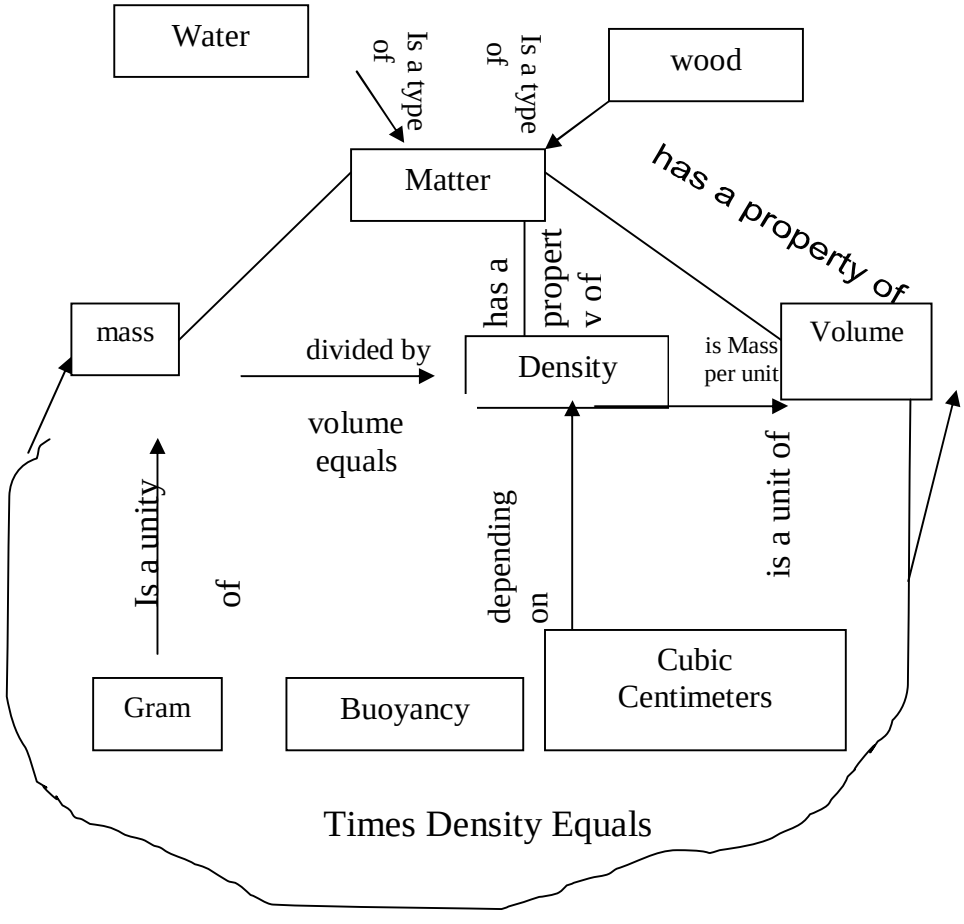
Most General Hierarchy



Example 11: Concept Map Created by Teachers

For density and buoyancy unit the fundamental terms are matter, density, mass, volume, and buoyancy; To determine if students understood related measurement terms

grand and cubic centimeter are included. To add real – life context and allow connections to matter water and wood are included.



Step 2:- Determine where in the unit of curriculum the maps will be embedded; concept maps fit best when alternated with the hands on chemistry activities in a unit. Mostly, concept maps are based on the terms that make up the content of a series of investigations. As such consider interesting a concept mapping activity a key junctures in the unit. Same criteria to keep in mind in identifying these natural joints are:-

(1) a sub-goal of the unit is achieved and there is a body of knowledge that can be assessed

(2) a critical point in instruction is reached which demands for students' understanding before proceeding, and

(3) a critical shift in understanding of student is expected after definite series of investigations and feedback to students is crucial to help them improve their understanding and to help inform your instruction.

Step 3:- Create the activity. To again insight into student understanding design the activity to follow the open ended construct only provided with the key terms (Yin et al, 2005). To make it convenience for students, you can have them write the chemistry terms on small slickly notes. This would enable students to move and organize their thoughts while creating their rough draft. Implementing a concept map activity in your classroom.

Step 1:- Train your students. Provide students with a practice topic they are familiar with, for example, chemistry concept that is so familiar to students' such as the water cycle.

Step 2:- Create individual Maps first. Firstly ask students to create there own individual maps. This independent reflection step is crucial; it elicits the personal understanding of each student.

Step 3- Review the maps in small groups. After finishing individual concept maps by students organize small group discussions. Have student share their concept maps with partners. Ask them to find similarities and differences in their maps and try to reconcile them. Group discussions provide opportunities for students to engage in their social aspect of science for articulation of their thoughts and learn from each other.

Step 4- Whole class discussion of certain parts of the small group concept maps. Ask each group to present their important propositions to the whole class and explain their choices many propositions may be discussed but focus on those that are more relevant to what you want to know about students' level of understanding. A whole – class map can also be created based on these discussions to document class progress and engage students conversations about chemistry.

Evaluating Concept Maps

Concept maps are informative even without formal grading or scoring. A quick scan of the maps will show you that what your students are thinking which in turn, will help you generate ideas for improving their understanding. In case you might want to formally score students maps. Select important chemistry terms from the curriculum and create consistent scoring process, a concept map activity can be a powerful assessment instrument. The following factors are to be followed:

1. The complexity of the maps. Since map complexity is easy to determine and is quite informative begin by evaluating this feature. This include observing whether the maps are complex networks, or if they are simple structures. Highly proficient students tend to create highly interconnected maps, whereas novices tend to create simple structures that are linear, circular a hub with spokes, or a tree with few branches.

2. The existence of the most important propositions (Paris of connected terms): The most important propositions describe relationships that reflect the main ideas contained in your chemistry unit. They are the important ideas that you expect students to ascertain and find out, after completing the curriculum unit. So the important propositions are what you hope to see on students' maps. For instance in a unit; on pressure and force, you would hope to see connections among force and pressure, area and object.

Force and Motion See Example 1

If a student misses these connections in his or her concept map the student may not understand the relationships among the key concepts in the unit.

Quality of the Propositions

The existence of the important propositions or links on map shows whether the students ascertain that there are relationships among those concepts. However, it is still unclear whether the relationships identified are reasonable, or scientifically meaningful. To examine the quality of propositions, a four – level rubric is to be used. For example, when connecting mass and matter actual student responses included;

O – Mass is an object equal to matter (wrong)
1 – Mass is related to matter (partially incorrect)
2 – Mass measures matter (correct but scientifically thin)
3 – Mass is amount of stuff in matter (Scientifically correct)

You may score individual propositions and sum them to obtain a total score. (Yin, Vanides, Ruiz – Primo, Ayala and Shavelson, 2005).
When students' maps are scored, identify common misconceptions for further discussion with the class or with individual students. These may serve as the basis for a follow – up or clarification lesson.

Conclusion

Using concept maps in the classroom teaching when adopted would in no doubt encourages creative thinking among students for instance the use of open-ended activities where students create there own phrase and map structure would revealed the following among students:

1. Reflect more accurately differences across students' knowledge structures,
2. Provision of greater latitude for demonstrating students' partial understanding and misconceptions
3. Provision of more opportunities for students to determine their conceptual understanding, and,
4. Every high – order cognitive processes such as explaining and planning. In general, concept map provide a different perspective on student understanding that complements selected response and performance based in instruments. For insights into your students' thinking about chemistry a carefully designed concept map activity can be a tremendous asset.

Recommendations

Based on the benefits and findings of this study the researcher, made the following recommendations:

1. The concept mapping method of teaching should be adopted by the teacher in the teaching of chemistry.
2. In the use of the concept mapping method of teaching teacher should play the role of a facilitator since the approach is students oriented.
3. Practical experience of how to use concept mapping could be provided for pre-service teacher.
4. Curriculum developers and authors could include concept mapping strategies in the recommended method used by teachers in teaching chemistry concepts.
5. The teachers of chemistry should always encourage their students in individual and group concept maps construction for the development of creative thinking.

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