Concept Mapping; An Effective Tool of Teaching-Learning Mathematics

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What does it mean when you say, *I understand*...?

How can you demonstrate your understanding?

Constructing a ‘Concept Map’ provides a way to expose, reflect on, deepen and share your understanding.
A concept map presents the relationships among a set of connected concepts and ideas.

It is a tangible way to display how your mind "sees" a particular topic.

For Example;
Mathematics

- Algebra
- Trigonometry
- Geometry
- Topology
- Arithmetic
- Statistics
- Analysis
- Calculus
What is a Concept Map?

A concept map is a way of representing relations between ideas, images or words in the same way that;
a roadmap represents the locations of roads and houses in the colonies,

a blue print represents an achievement test or

a chemical equation represents the chemical process
A concept map is a type of **graphic organizer** used to help students organize and represent knowledge of a subject.

Concept maps begin with a **main idea** (or concept) and then **branch out** to show how that main idea can be broken down into **specific** topics.

Examples;
Grass

- Grows
- Dries up and becomes

- Green
- Brown
In a concept map, each word or phrase is connected to another and linked back to the original idea, word or phrase.

Concept map is a way to develop logical thinking and study skills, by revealing connections and helping students see how individual ideas form a larger whole.
They are graphical tools for organizing and representing knowledge.

Concepts, usually represented as boxes or circles, are connected with labeled arrows in a downward-branching hierarchical structure.
The relationship between concepts can be articulated in linking phrases such as known as, used as, that relates to develop, is determined by gives, gives rise to through, results in, is required by represented by or contributes to etc.
SUN

Gives

LIGHT

Gives

HEAT
The technique for visualizing the hierarchical arrangement and the relationships among different concepts is called "Concept Mapping."

It is developed by Professor Joseph D. Novak of Cornell University (1983).
Concept Mapping is a convenient and concise representation of conceptual framework about any type of knowledge and can hence be defined as an interlocking network of existing and fresh knowledge of the learners.
Concept mapping is a learning strategy which was first developed as a research tool to represent learner’s prior, relevant knowledge and later as a tool to enhance meaningful learning.
Thus, we may use it as an effective tool of enhancing learning in general and mathematics learning in particular.
Characteristics of Concept Mapping

Novak define certain characteristics of concept mapping such as;
Characteristics No. 1;

- The concepts are represented in a hierarchical fashion with the most inclusive, most general concepts at the top of the map and the more specific, less general concepts arranged hierarchically below.
The hierarchical structure for a particular domain of knowledge also depends on the context in which that knowledge is being applied or considered.

Therefore, it is best to construct concept maps with reference to some particular question we seek to answer, which we have called a ‘focus question’
Characteristics No. 2;

- Another important characteristic of concept maps is the inclusion of cross-links.

- Cross-links are relationships or links between concepts in different segments or domains of the concept map.
How to make a Concept Map?

- Identify the **main topic or core concept**
- Brainstorm for everything **known** about the topic
Organize the information according to major points

Place information on a map; working from the core concept, to major points, to significant details

Linking related concepts with lines and labeling each line in propositional or prepositional form
Example

- Concept: Quadrilateral

- Focus Question: What is the area of a quadrilateral?
Mathematical Vocabulary

Introduced

- Quadrilateral
- Sides, Angles
- Opposite sides, Adjacent sides
- Opposite angles, Adjacent angles
- Diagonal, Base, Height
- Right angle, Supplementary angles
- Rectangle
- Square
- Parallelogram
- Rhombus
- Trapezium
- Area
- Enclosed region etc.
Concept Map

The following Figure shows the concept map of the ‘Area of a Quadrilateral’
Every Quadrilateral

- Have
  - 4 sides
  - 2 diagonals
  - 4 angles
  - Enclosed region is called Area

- If only one pair of opposite sides are parallel
  - Parallelogram
    - If each angle is right
      - Rectangle
        - If adjacent sides are equal
          - Square
            - Rhombus
              - Trapezium

- If both pair of opposite sides are parallel & equal
  - Bisect each other
    - Opposite angles are equal
      - Parallellogram
        - Base * height
          - Lenght * breadth
            - Side * side
              - Side * side
                - 2(product of length of diagonals)
                  - 1/2(sum of length of parallel sides) * distance between them
Who can use Concept Maps?

- Concept mapping is an effective learning tool across disciplines and can be used by anyone i.e., teachers, students, curriculum planners, researchers etc.
Uses of Concept Mapping

Concept mapping is an effective tool for teaching as well as for learning, since it serves several purposes for learners to improve their learning and for teachers for the improvement of their teaching.

Let us see how?
By Teachers:

Teachers can use concept maps;

(a) For Teaching
(b) For Assessing
(a) For Teaching:
Concept mapping may be used by teachers as a tool for effective teaching;

- Concept maps help in planning a lesson by identifying key concepts, their pre-requisites and the relevant examples
- It helps to see logic of relationships and choose proper activities and teaching aids
In constructing concept maps, difficult concept can be clarified and they can arrange in a systematic order.

By encouraging students to discover new concepts and the propositions that connect them.

By allowing students to more clearly communicate ideas, thoughts and information.
It also helps to decide the specific objectives that teacher must plan for students.

- Concept maps provide an explicit, encapsulated representation of important ideas on one page which is great for review.

- It helps teacher to see gaps in knowledge and areas of oversimplification, contradiction or misinterpretation.
(6) For Assessing:

- A concept map is not just a learning tool, but also an ideal evaluation tool for assessing the attainment of certain objectives, objectively and reliably.
- Teachers are able to see what students do not understand.
- They identify mistakes and areas of confusion.
Students may be provided with a set of unlinked concepts with which they have to construct a map or

They may be asked to construct a concept map after the teacher has taught a topic in order to assess their conceptual comprehension

For example;
After teaching **Quadrilateral**, the concepts such as Quadrilateral, Sides, Angles, Diagonal, Base, Height etc. have been given to students and ask students to **construct** a concept map.

Or students may ask to **complete** the following concept maps:
Quadrilateral

Have

- [ ]
- [ ]
- [ ]
- [ ]
By assessing the concept maps developed by the students, the teacher can:

- Gain **insight** into the way students view a concept or a topic, her/his **conceptualizing** processes, systems and relationships.
➢ Examine the valid understanding and identifying mistakes and areas of confusion

➢ Assess the structural complexity of the relationship students depict

➢ Assessing prior knowledge
By Students:

- It requires that students **break down** component /parts to see **how** things are **put together**
- When **created** correctly and thoroughly, concept mapping is a **powerful** way for students to reach **high levels of cognitive performance**
As students create concept maps, they reiterate ideas using their own words and help identify incorrect ideas and concepts;

The following figure illustrates a concept map which highlights the basic nature of concept mapping
THANK YOU