SPN1022
Learning Science and Mathematics

Cognitive Theory
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Three ways to understand

- Enactive: through action and manipulation

- Iconic: Through the formation of images and organization of learning, seeing and kinesthetic perceptions.

- Symbolic: through words and symbols.

Spiral Curriculum

- Whatever skill or knowledge can be taught to the pupil at each age level if that skill or knowledge is adapted to the pupil's development.

- It is necessary for the teacher and pupil to revise what has been learnt from time to time, acquiring deeper understanding each time.

Spiral curriculum in school

PRIMARY	LOWER SECONDARY	UPPER SECONDARY
Experience on objects that float and sink	Measurement of mass and volume; calculation of mass/volume	Calculation of specific gravity, Archimedes' Principle
Observation of change of color indicator by acid or base	Neutralization of acid and base by mixing measured volumes of acid and base	Titration: the use of concepts of volume mol and related formula

Inductive learning

- Pupils are not passive hearers, but can learn well if their minds act on what they study.

- Inductive learning can motivate active learning as well as the formation and understanding of concepts.

- It start s with the specific experience of the pupils which is then consolidated with more and more ideas until a general idea or concept is formed.

INDUCTIVE LEARNING

SPECIFIC

GENERAL
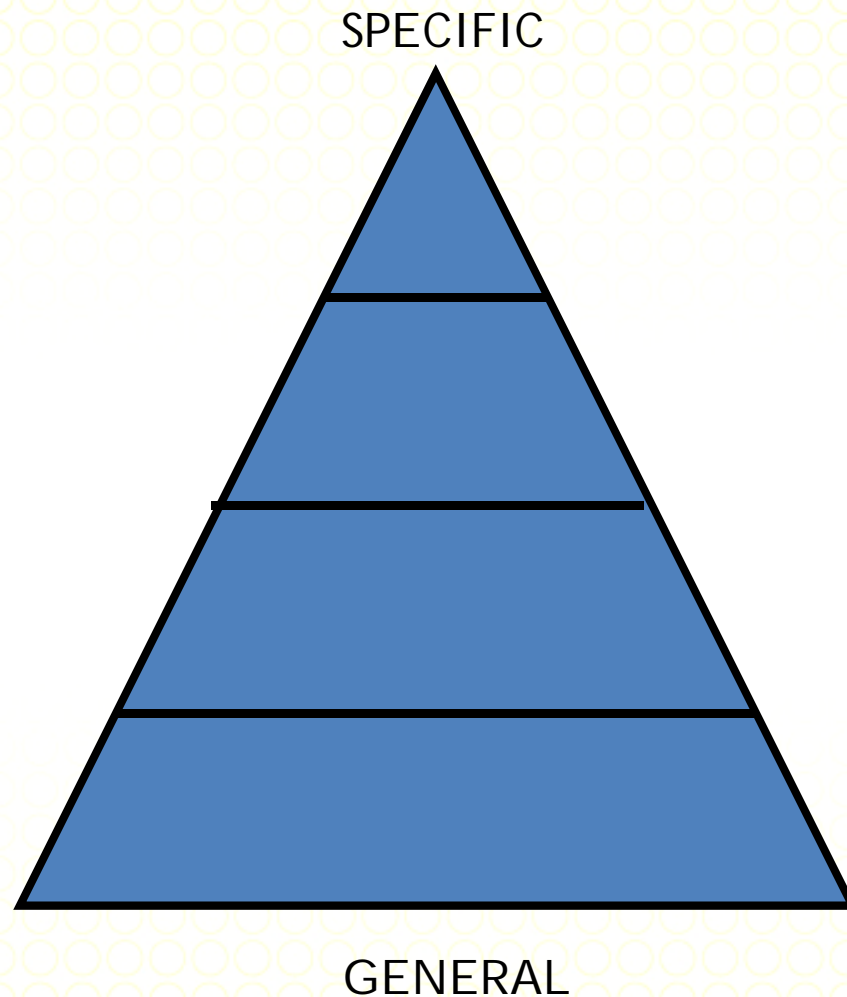
- 1: The pupil is introduced to an experience and learns specific examples for the concept to be discovered.

- 2: The teacher helps the pupil to examine these examples and identify the similarities and differences.

- 3: The teacher guides the pupil to form a concept and general idea.

- 4: The pupil develops an understanding of the concept examined and applies the concept in different situations.

Discovery Learning

Discovery learning in Science

- Children should be give the learning opportunity to discover a concept themselves.

- The teacher prepares the atmosphere and facilities and only helps if necessary.

Benefits of discovery learning

- Increase of intellectual potential.
  - Helping student learn how to learn.
  - Learn the skills of problem-solving and inquiry, enables them to arrange and use what they learn in new situations and learn further concepts.
- Shift from extrinsic reward to intrinsic reward.
  - Self-satisfaction

Benefits of discovery learning

- Opportunity to learn the heuristic of discovery (inkuiri terpimpin).

  – Heuristics is the method of training a person to discover things for himself.

- Helps the process of memorizing.

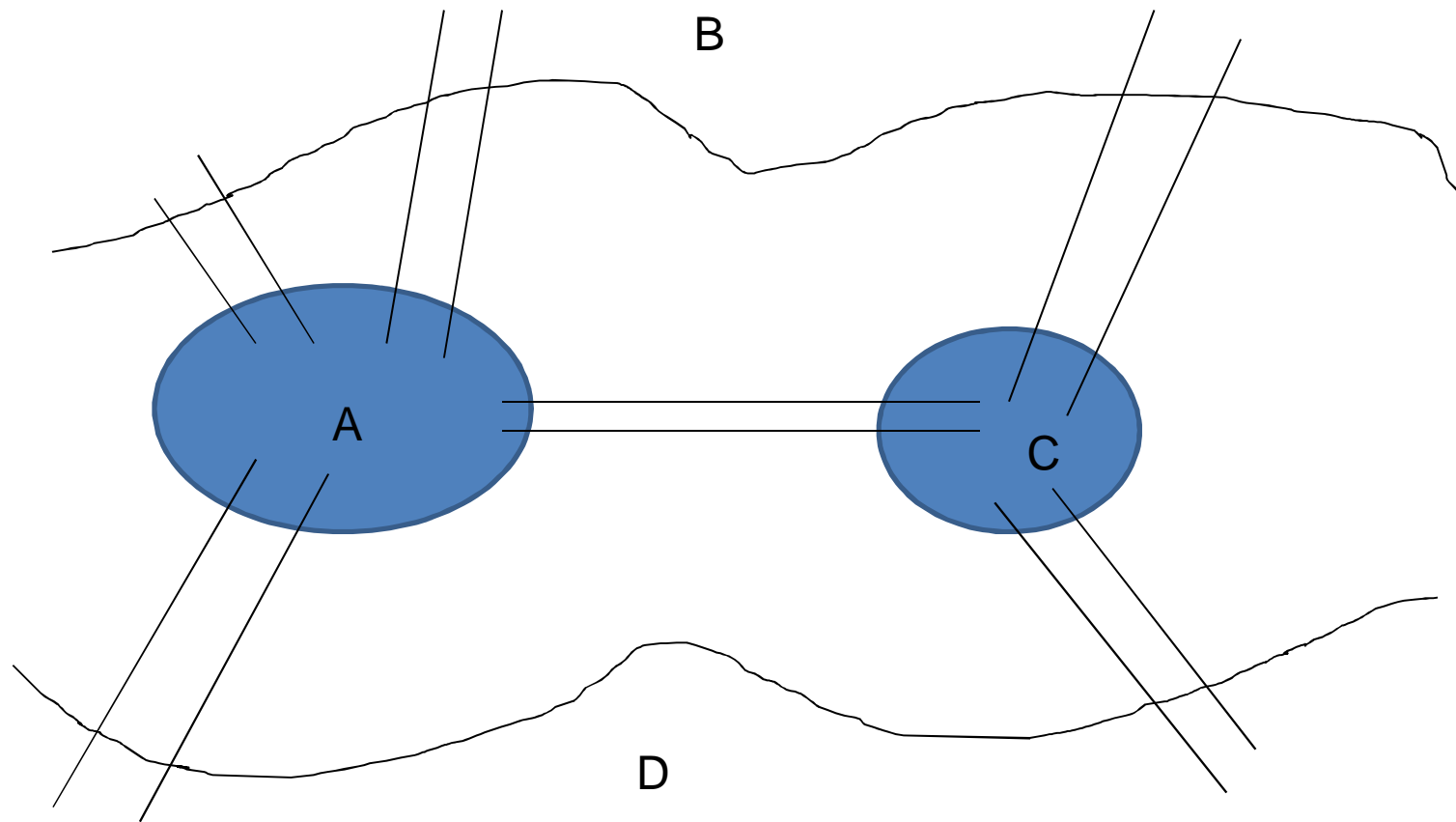- Knowledge that produced through discovery is easier to remember and more easy to recall.

Discovery learning in Mathematics

- Most mathematics knowledge of today have been discovered and not created
- Al khawarizmi: discovery of 0
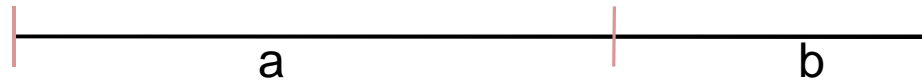- Pythagorean theorem
- Fibonacci sequence:

$$F_1 = F_2 = 1, F_n = F_{n-2} + F_{n-1}, n \geq 3$$

- Golden ratio
- Euler circuit

Euler's circuit

Golden ratio

$$\frac{a}{b} = \frac{a+b}{a} = 1.618 = \varphi$$

Discovery learning defined

- Learner makes a discovery through a variety of learning activities

- In mathematics, the learner **may make a conjecture, formulate a hypothesis or find a mathematical truth** through **inductive** or **deductive** process

Induction process

- Induction is a process of making a generalization from specific cases

- Example:

3+4=4+3

5+6=6+5

7+8=8+7

Therefore, a+b=b+a

Deduction process

- Deduction is a of making a specific conclusion based on a given general statement
- Example:
- Volume V of a right prism is Ah, A=base area, h=height.
- Given solid P is a right prism,
- Therefore volume of P, V=Ah

Why discovery learning in mathematics?

Purposes of discovery learning

- Students will learn some procedures that are necessary in figuring things out themselves
- Develop attitudes and practice strategies used in problem-solving, inquiry and research
- Increase students' ability to analyze, synthesize and evaluate information
- Intrinsic rewards such as satisfaction when making a discovery motivate students in math classroom

- Students are actively involved
- Learn to find patterns in abstract and concrete situations
- Develop effective ways in working in a team
- Skills and concepts learnt in discovery lessons are more meaningful to students

Discovery learning strategies

Discovery learning strategies

- The best is guided discovery where the teacher:

i. Encourage students to discuss with one another

ii. Direct discussions towards useful outcomes

iii. Monitor the flow of ideas and activities in the classroom

iv. Teachers should answer students' questions

v. Ask leading questions

vi. Provide some useful information when students need help

vii. After a discovery has been made, the teacher should help in formulating an understandable statement and to test its reliability and validity

Fears for discovery learning in class

- Take too much time
- Lead to frustration when students cannot discover
- Discover the wrong thing

Guide to create a guided discovery lesson class

- Have specific small objectives

- Ask leading questions

- Give useful resources to students

- Be prepared to guide students and give information

Class Activity

- Create a discovery lesson for your class
- Discuss in 2-3's
- Present to your classmates