Inquiry-Based Science Education (IBSE) (what, why & how)

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1.

"What”

What is IBSE?
What is Inquiry?

“Science has been taught too much as an accumulation of ready-made material with which students are to be made familiar, not enough as a method of thinking.” (Dewey, 1910, pp. 122, 124)

What is IBSE?

- Traditionally:
  - Memorizing and organization of facts.
  - Teachers relate facts to the students – students learn those facts.
  - transmission of a series of unchanging facts from teacher to students, with students being required to learn these facts by heart (Riga et al., 2017)

What is IBSE?

- IBSE
  - Student-centered approach.
  - Focus more on questions & problem-solving.
  - learn through reasoning and doing, through asking questions, carrying out experiments, weighing up evidence and considering alternative hypotheses.
  - Learn about the facts rather than received the fact from teacher.

“Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. (National Research Council, 1996, p. 23).” *(Dewey, 1910, pp. 122, 124)*

Levels of IBSE

- Confirmation
  - traditional ‘recipe style’ laboratory activities.
  - Students are given step-by-step guidance to confirm already-known principle.

- Structured inquiry
  - Teachers provide questions to be explored, equipment and instructions.
  - Students do not know the result/solution.

Levels of IBSE

- Guided inquiry
  - Teachers only provide problem/question.
  - Students design/choose the methods to collect & analyse data.

- Open inquiry
  - Teachers provide a general topic.
  - Students generate their own scientific question to investigate.
  - Students have complete autonomy in designing and conducting the investigation.

2.
"Why”

Why does IBSE matter?

Why does IBSE matter?

- 20th century
  - reading, writing & counting.
- 21st century
  - critical thinking, collaboration, creativity, communication (4C).
  - need to focus more on building reasoning skills early in life.
  - IBSE play important role

3.

”How”

How to implement IBSE?

Implementing IBSE

- ”implementing inquiry” has come to mean different things to different people.”
- using only inquiry approaches (open inquiry)
- students “should themselves find out by inquiring into the world, rather than simply being told what science has found out” (Taber, 2011, p. 258).
- incorporating inquiry approach – when possible and where appropriate.
- implementing inquiry at school does not automatically imply that students are practicing science as “real” scientists do.
- can involve highly structured to open-ended project.
- IBSE project is not an additional component to the basic science teaching project - covered in the curricula.

Implementing IBSE

- Teacher preparation
  - proficient in the basics of the various branches of science.
  - having the necessary knowledge to answer children's.
- Teaching materials
  - attractive, well- designed material for students; and supplies for experiments that are readily available to facilitators.
- Attitudes & school authorities
  - administrators have detail knowledge of IBSE, encourage teachers and students.
  - prepare the facilities.
- Resources centre

“Science classes should be given by teachers who understand the basic principles of science and are able to stimulate children’s curiosity and help them develop their experimentation skills so that they can clarify their doubts on their own”

Information provided by teachers while engage in ’structured’, ‘guided’ or ‘open’ inquiry activities.

Structured

- the question or issue to examine.
- the resources needed.
- instructions presented to students in a step-by-step format.

Guided

- the question or issue to examine.
- the resources needed.

Open

- None provided – learner makes all the decisions about:
- what to investigate
- how to conduct the investigation
- why to research this particular question

Questions learners might ask themselves when engage in ’structured’, ‘guided’ or ‘open’ inquiry activities.

Structured

- What observation do I need to make and record?
- How should I record my observations?
- Can I explain what the observations mean?

Guided

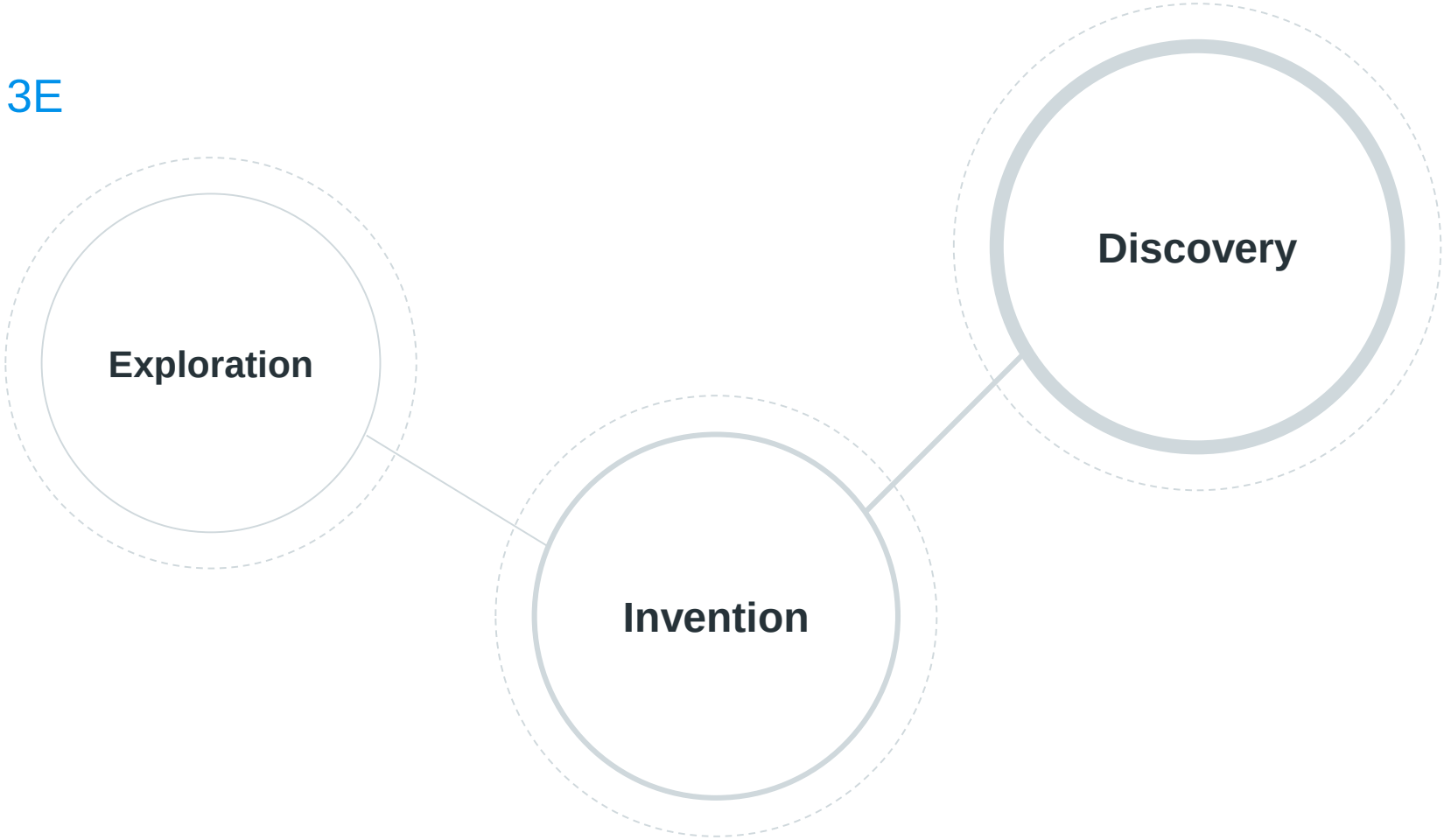
- How can I go about answering the questions?
- What procedure(s) or method(s) can I devise/think up that will enable me to answer the question?
- What observations do I need to make and record?
- How should I record my observations?
- Can I find out how other people have gone about answering the question?

Open

- What questions should I decide to investigate?
- How should I phrase the question?
- What background research will I need to conduct before proceeding?
- How should I go about investigating this question?
- What procedure(s) or method(s) can I devise/think up that will enable me to answer the question?
- How should I record my observations?
- How can I best present my findings?

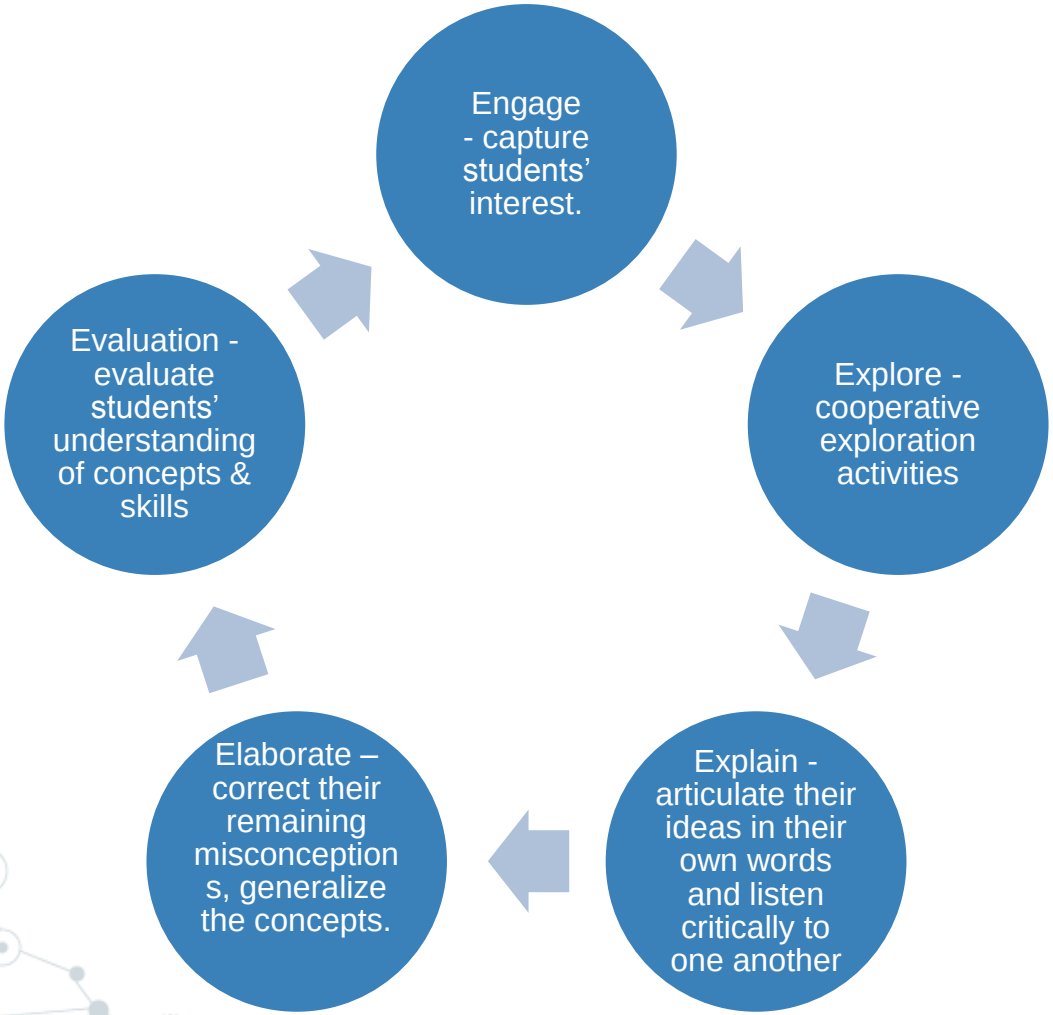
Instructional Model

3E



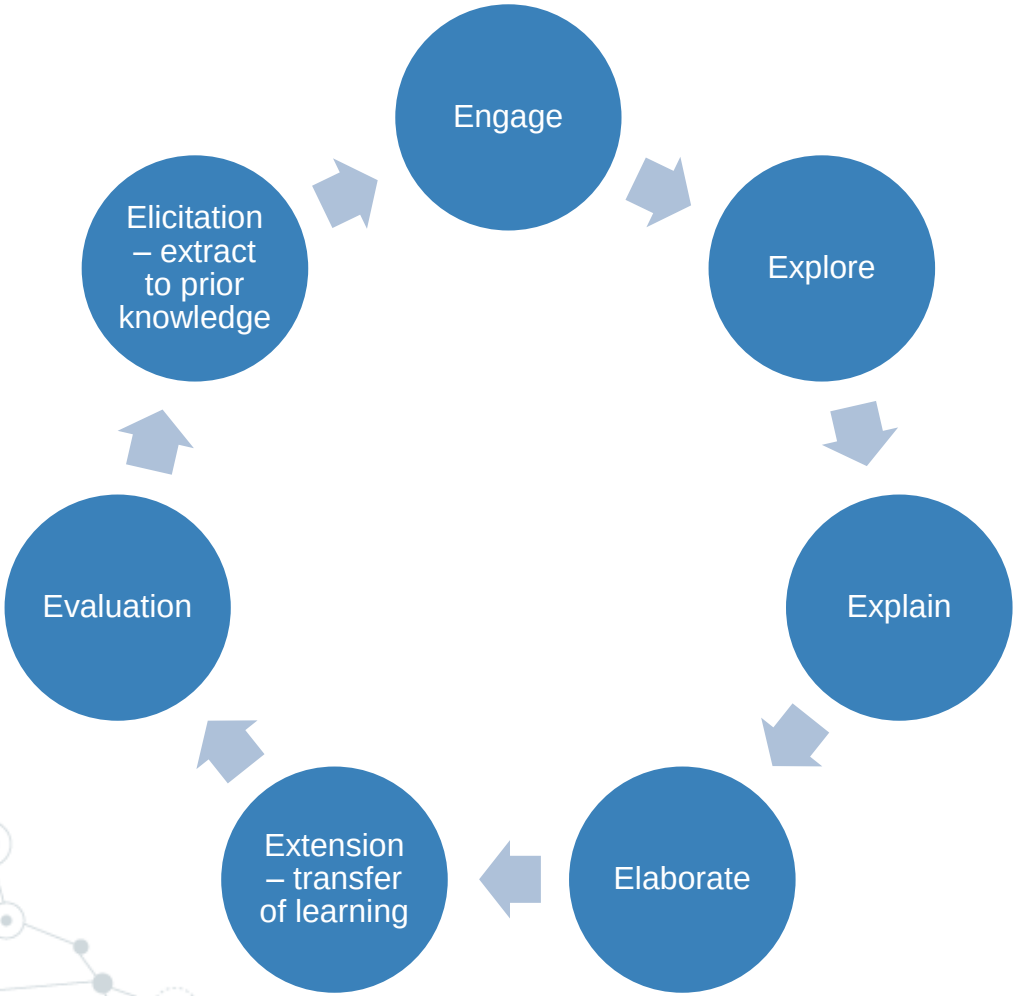
Instructional Model

- 5E Learning Cycle



Instructional Model

- 7E Learning Cycle



Teachers' Roles

- Motivator
- diagnostician
- guide
- innovator
- experimenter
- researcher
- mentor
- collaborator
- learner

Teachers' Roles

- active collaborator
- leader
- apprentice
- teacher
- planner

IBSE Classroom/Instructional Environment

- often overlooked.
- provide resources/materials to equip students in pursuing inquiry tasks.
- e.g. computers, internet access, book, journals, chart paper, magnifying glasses etc.
- conducive space to elicit thinking processes that inquiry requires.
- furniture/desks arrangement – static or change according to the tasks?
- inducements – posters, displaying students work, display reflecting students'/teachers' particular interests – change or update regularly?

Assessment of IBSE

- Formative assessment:
  - teachers' questions & allowing sufficient time for answering.
  - teachers giving feedback on students' work.
  - teachers listening to students' feedback on their teaching.
  - students' self-assessment & peer-assessment.
- Summative assessment:
  - tests incorporating knowledge application as well as simply recall.
  - questions & tasks that assess Sc inquiry skills.
  - verbal and/or written explanation to justify events
  - data and/or prediction.
  - portfolios of work generated over some time.

Challenges to Implementing IBSE

- Time consuming
  - content would have to be sacrificed.
- Confusion due to complexity of inquiry
  - presenting doubts & array of alternatives to choose would only bewilder them.
- Teachers training
  - teachers lack of training.
  - bound to textbooks & examination requirements
- Limited resources
- Job requirements
  - pressure from industry for particular skills (e.g. engineers) place restriction on the curriculum.
- Economics
  - too costly to implement in everyday classroom.

Your Task:

1. Identify learning goal.
2. Plan a lesson.
3. Choose level of inquiry.
4. Choose instructional model you want to use.
5. What type of assessment you want to assess students' learning.

References

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List of Recommendation Readings

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Thanks!

Any questions?

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