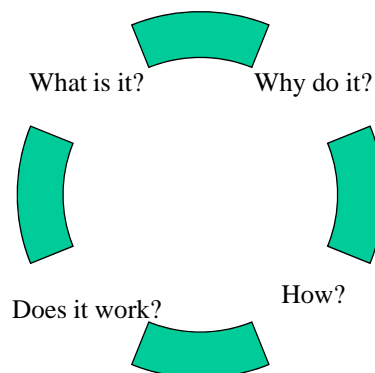


Why science education should be inquiry-based - and how to know if it is

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Questions about change in education



Changes in understanding what is Inquiry-Based Science Education (IBSE)

- Hands-on only ?
- 'Discovery'?
- Same for all learning?

Inquiry

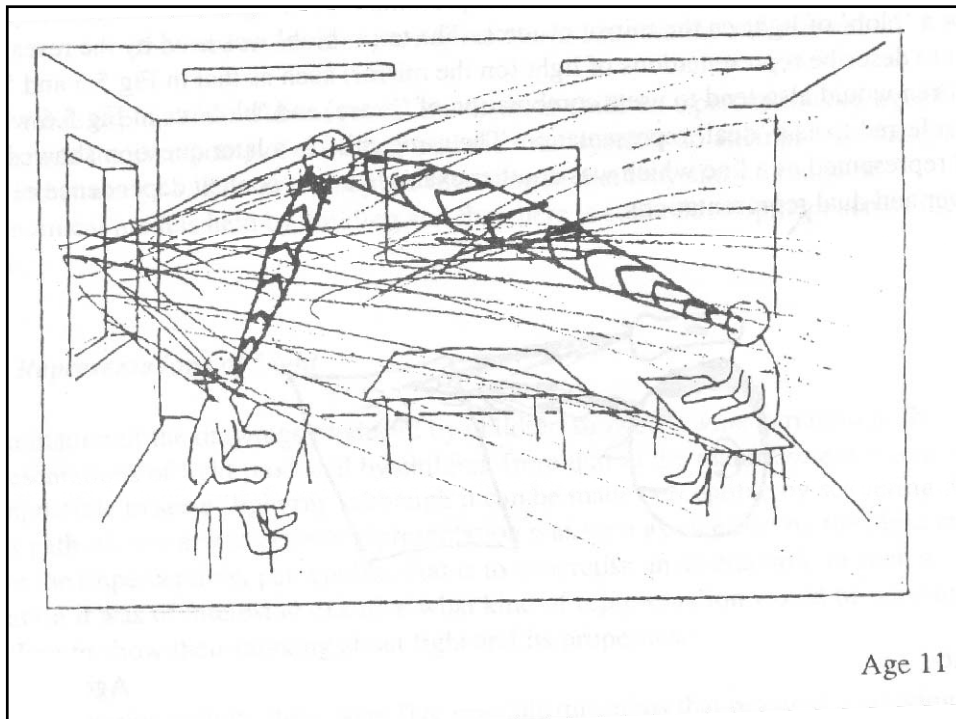
- A process in which learners build their understanding of fundamental scientific ideas through direct experience with materials, by consulting books, other resources, and experts, and through argument and debate among themselves. (NSF, 1997)

But:

- Not all learning in science involves inquiry
- Not all inquiry in science is scientific inquiry

Why IBSE? Reason 1

- IBSE is consistent with current views of how learning takes place, that is that:
 - children work things out for themselves from an early age (eg from repeated actions)
 - they often arrive at ideas that conflict with scientific ones because they are based on young children's necessarily limited experience and reasoning
 - seen from the children's point of view they are reasonable
 - these ideas cannot be easily replaced by giving the 'right' answer



Developing more scientific ideas

- Access to alternative ideas through discussion, hearing other explanations, defending own ideas.
- Develop and test models, using **inquiry skills**
 - observing, raising questions
 - using suggested explanations to make predictions
 - gathering, analysing, interpreting, communicating
- As a result they –
 - refine ideas
 - move from 'small' towards 'bigger' ideas
- If the skills are non-scientific, then we can expect non-scientific ideas to be formed

Why IBSE? Reason 2

- IBSE is consistent with current views of what students need to learn in preparation for the modern world:
 - A grasp of the 'big ideas' which enable active participation in science and technology-related decisions ('scientific literacy')
 - A basic understanding of what science is, how it works and its strengths and limitations
 - Ability to continue learning

Implications for IBSE programmes

- Build from the ideas that students bring to the classroom at each stage.
- Set out a progression in 'small ideas' towards a small number of 'big' ideas which students gradually grasp.
- Provide activities in which students collect and use evidence from first hand investigation and other sources.
- Promote collaborative learning through dialogue, discussion and argumentation among students and between students and teacher.

Does IBSE work?

- Prior question is: how do we know that IBSE it is happening?
 - Study the programme
 - Study the students
 - Study the teacher
 - Etc

But we need some criteria or standards against which to judge what we find.

Learning activities of students

- Acumulando evidencias por la observación de eventos reales o de otras fuentes. (Gathering evidence by observing real events or using other sources)
- Siguiendo asuntos que han identificado como propios, aún habiendo sido inducidos por el profesor. (Pursuing questions which they have identified as their own even if introduced by the teacher)
- Haciendo preguntas adicionales que pueden llevar a otra investigación. (Raising further questions which can lead to investigations)
- Haciendo predicciones basadas en lo que ellos piensan o descubren (Making predictions based on what they think or find out)
- Conversando entre sí o con el profesor sobre lo que están observando o investigando. (Talking to each other and the teacher about what they are observing or investigating)

Activities of teachers where IBSE is being implemented

- Proporcionando oportunidades a los estudiantes para encontrarse con materiales y fenómenos que puedan investigar directamente. (providing opportunity for st to encounter materials and phenomena to explore or investigate at first hand)
- Haciendo arreglos para discusiones en pequeños grupos (Arranging for discussion in small groups)
- Fomentando la tolerancia, el respeto mutuo y la objetividad en discusiones en clase. (Encouraging tolerance, mutual respect and objectivity)
- Proporcionando acceso a procedimientos e ideas alternativas por medio de la discusión, referencia a libros, recursos tales como Internet y otros recursos de ayuda. (providing access to alternative procedures and ideas through discussion, etc)

Some suggestions for standards

Teachers should :

- Use a range of methods suited to the achievement of various goals of learning science
- Provide simple materials and equipment for students' first-hand exploration and inquiry
- Provide activities that are interesting, enjoyable and relevant to students
- Provide opportunities for inquiry relating to the *scientific phenomena* in their environment
- Regularly ask questions which invite students to express their ideas
- Know where students are in the development of ideas and inquiry skills

contd

Continued...

- Ensure that students have evidence to back up their claims and ideas
- Include in lesson plans what students are intended to *learn* as well as what they will *do*
- Provide comments that help progress in oral or written feedback on students' work
- Ensure that students regularly have chance to raise questions and that these are addressed
- Ensure that students always know the purpose of their investigations and other science activities

Continued...

- Provide opportunities for students to discuss observations, plans, findings and conclusions in small groups and as a whole class
- Provide opportunities for students to obtain information from books, the Internet, visits out of school and visiting experts
- Discuss with students the qualities of good work so that they can assess and improve their work
- Provide time and encouraging students to reflect on how and what they have learned
- Keep records of students' progress based on questioning, observation, discussion and study of products relevant to learning goals.

Using standards to improve practice of IBSE

- As standards of practice that should be the aim of each teachers and school
- As guidance for evaluation of practice
- For devising or revising classroom programmes and activities
- Most importantly, for reflection by teachers, trainers, school management and researchers to compare their practice with widely agreed standards.