Children spontaneous ideas on nature: a determining element in teaching science

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Keynote overview

• Why learning science?
• Things we know about learning science
• Taking children's ideas about science, examples
  • Day and Night Phenomenon
  • Light and Shadows
• Learning science through inquiry
• What about teachers’ training?
• Inquiry-Based Science Education: a topic for research
Why learning science?

From a social point of view…

From a technological point of view…

From a cognitive point of view…

• Children give sense to the world they live in

• They develop operative, coherent patterns of thinking (mindsets, mental constructs)

• These constructs have their own rationality but are often inappropriate when confronted to science rationality

Science enhances language, formal, kinesthesia abilities…
Things we know about learning science
Things we know about learning science

« When it [scientific spirit] encounters scientific culture, it is never young. It is even very old because it is as old as its prejudices »


Physics student’s answer provided to the following question: “Suppose I cover the lower half part of this lens. What would happen to the image?”
Things we know about learning science

« When it [scientific spirit] encounters scientific culture, it is never young. It is even very old because it is as old as its prejudices »

Things we know about learning science

**Scientific reasoning**

- Causality > functional relationships
- Conservation
- Abstraction
  - Thinking the invisible
  - Using several points of view
  - Formalizing

**Common sense reasoning**

- Chronological/temporal causality
- Nonconservative schemata
- Empirical statements
  - Finalism
  - Animism
  - Anthropomorphism
  - Egocentrism
  - Substantialism
EXAMPLES
Taking children's ideas into account

Day and night phenomenon...

- Anthropomorphism
- Finalism

« At night, the Sun lies down and goes in the bed of the Moon »

Emilie, 4-year-old
Taking children's ideas into account

Is that an appropriate model?
Taking children's ideas into account

Guided observation…

… to the movement of the Sun

- Why is there stickers on this window?
- *It is the Sun!*
- But there are thus some “suns”.
- *No, it is the Sun, it turned!*
Taking children's ideas into account

« At noon, the Sun is above our head and after it continues to turn and we can not see it anymore »
Taking children's ideas into account

Me and my shadow

• Before observing...

Me and my shadow

• After playing with shadows

Causal link?

Nawel, 6 year-old
Taking children's ideas into account
Taking children's ideas into account

Explanation of vision egocentrism

“I can see because my eyes send ray of “seeing” towards the flower”
Antoine, 5 year-old

Explanation of vision egocentrism

“The light goes into my eyes that allows to send a thing, electricity maybe, towards things and after that takes the shape, the color, so that we know what that is”
Stanislas, 5 year-old
— Demain nous nous occuperons de Saturne... et je vous engage d'autant plus à apporter la plus grande attention à cette planète que très probablement vous n'aurez jamais de votre vie l'occasion de l'apercevoir !...
IBSE a solution?
Learning science through inquiry

• Open learning approaches
• Collective learning
• Active students
• Teachers as mediators
• Research
Learning science through inquiry

IBSE

Experimental sciences
Cognitive psychology
Active pedagogies
Philosophy
Learning science through inquiry

Confucius

Plato

Comenius

Rousseau
Learning through inquiry : Dewey

« If there is no problem, there is only fumbling »
J. Dewey, The Theory of inquiry (1938)

« Inquiry » et problem according to Dewey

- Indeterminated Situation
- Problematical Situation
- Controled Situation
Learning through inquiry: teachers training

You are a scientist who wish to study the bouncing ball phenomenon – What do you wish to study? (Martinez & al. 2014)

« Inquiry » et problem according to Dewey

- Indeterminated Situation
- Problematical Situation
- Controled Situation

Focus on the ball / Focus on the movement of the ball...
C1 : Les variables à considérer sont trop nombreuses
C2 : Les connaissances (disponibles des enseignants) sont insuffisantes et
C3 : Les résultats expérimentaux contredisent ce qui était attendu

Martinez & al. (2014)
Learning through inquiry : teachers training

532 : Il n’y aucun lien entre le poids… |-voilà la réponse !|-… et le nombre de rebonds
561 : j’ai conclu… mais il n’y a rien de clair dans ma tête ! [O6A]
567 : on change de question ?
581 : il doit y avoir une différence, c’est le support … non ?
592 : sur la moquette ce n’est pas bien, parce que  [O6B]… ah non, alors tu sais quoi ? On prend ces balles et deux plans différents
608 : est-ce que la matière du support a une influence sur le nombre de rebond ? [Q7]
666 : regarde (..) celle-là… je lance de pas haut : hop (expérience) et je lance de haut : hop (expérience) ah oui, oui !
668 : il doit y avoir un rapport entre le rebond et la hauteur [du lâché]. Ça c’est presque sûr !
780 : y a-t-il un rapport de proportion entre la hauteur du rebond du départ et la hauteur du premier rebond ? [Q8]
IBSE: a topic to investigate

- Philosophical references?
- Type of knowledge concerned?
- Type of learning reached?
- Teachers’ training?
- Evaluation?
- Long term consequences?
- …

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Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching
Paul A. Kirschner, John Sweller & Richard E. Clark
Available online: 08 Jun 2010

The terminology evolved through the years and the concepts refined, and today the Inductive Approach is most often referred to as Inquiry-Based Science Education (IBSE), mostly applied to science of nature and technology.

Rapport “Rocard”, p.13

Inquiry-based methods proved their efficacy in science learning at primary level with increasing both children’s interest and teachers’ willingness to teach sciences.

Rapport “Rocard”, p.16
Concerning positive emotions, one of most powerful triggers that motivates people to learn is the illumination that comes with the grasp of new concepts – the brain responds very well to this. A primary goal of early education should be to ensure that children have this experience of “enlightenment” as early as possible and become aware of just how pleasurable learning can be.

Bruno Della Chiesa, *Understanding the brain*, 2007
THANK YOU

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