Constructivism and its critique

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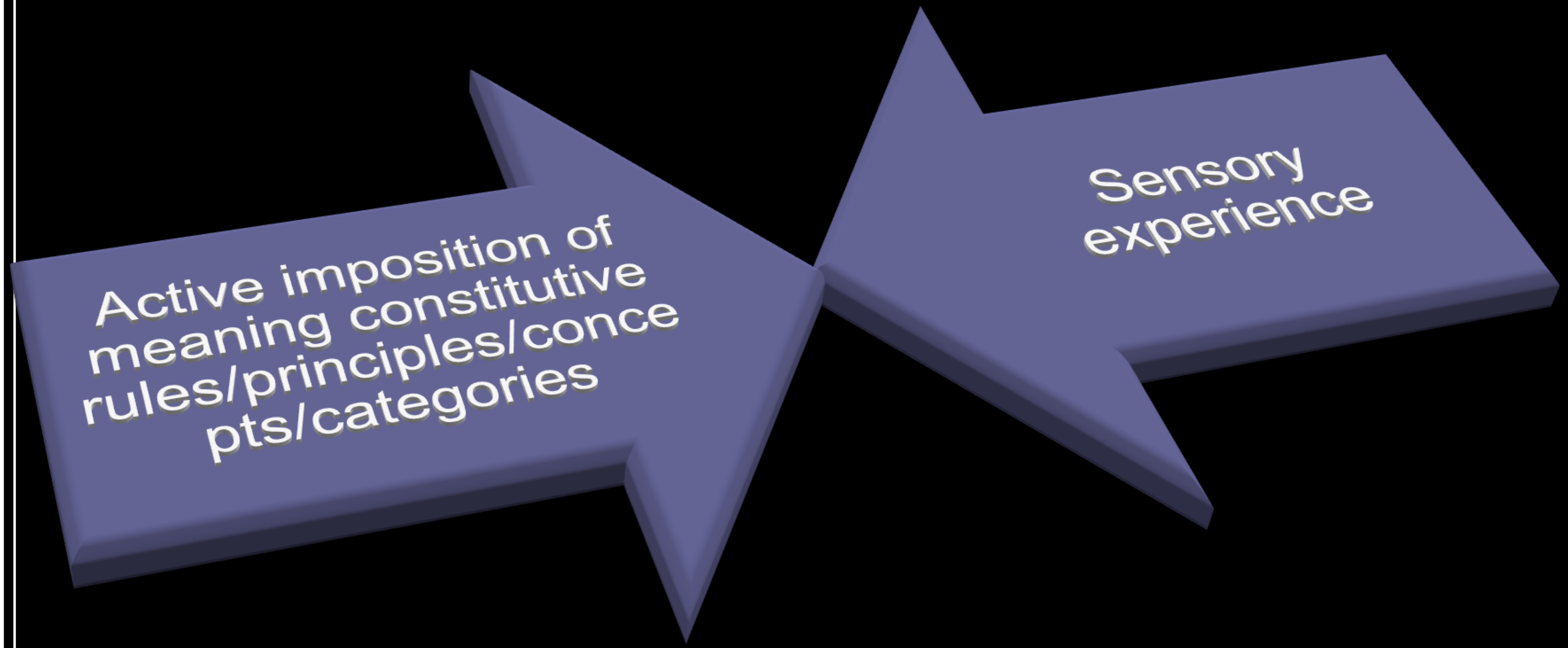
- If the aim is: Understanding
- Understanding: Meaning

Understanding:: Meaningful experience:: Sense (physical/phenomenal) experience organised by mind! “intelligence organizes the world by organising itself” Jean Piaget



- Do we practice empiricism in the name of constructivism?

- Purpose, rules, categories are not abstracted out from that experience

  In fact, they are imposed on the sensory experience to structure (organise) it and hence make it meaningful!

- “Philosopher of science Karl Popper (1972)…: observation and classification each presume ‘interests, points of view, problems’ (p. 46). Without focus and purpose, the task becomes ‘absurd’”.

- **“Wellman and Gelman (1988)…: ‘when we ask children simply which objects belong together, we are neglecting the deeper question of whether the grouped objects form a motivated category, and what the consequences are of having such a category…**
- **“… children's deeper understanding of categories must be probed by asking them to reason about categories, rather than simply to report which things belong together” (p. 116).**

(Metz, 1995, p.100)

- Science educators commonly assume that

  “elementary school children are ‘concrete thinkers’, whose reasoning is tied to concrete objects and their manipulations.

  Abstractions, ideas not tied to the concrete and manipulable, are beyond their grasp.

  Therefore, the argument goes, we need to largely restrict children's science curricula to concrete and ‘hands-on’ activities, and postpone abstractions until higher grade levels.” (Metz 1995, p. 103)

What did Piaget meant by ‘concrete’?

- Piaget “**viewed concrete operational thought as concrete in the sense that the child's mental operations are applied to some aspect of external reality, present or mentally represented”**
- **“Although [Piaget] believed that the elementary school child's thinking is based on some concrete referent, Piaget made no claim that the product of the child's thinking is concrete”**
- **For example, “Piaget et al. claimed that children develop [the] understanding of cardinal number, an idea that clearly transcends the concrete, around 7 or 8 years of age. (Metz 1995, pp. 103-4)**

Recent research tells us that the so called concrete-operational children have theories

- **“In her study of the development of children's scientific concepts, Carey (1985b) concluded that by 9 years of age children have constructed the idea of ‘a biological essence’; that is, the idea that ‘each animal has properties determined by its own unique solution to common biological problems, and properties of parents are passed on to children’(p. 179)” (Metz 1995, p. 105)**

Recent research tells us that the so called concrete-operational children have theories

- **“Karmiloff-Smith (1988) concluded that beginning at about 6 years of age, children construct theories that mediate their actions and interpretations. These children attempt to construct a unified theory to account for all events.**

- For example, given the task of balancing a large variety of blocks, symmetrically and asymmetrically weighted,

  [6- and 7-year-olds] go beyond the successful goal attainment of the young children, build a theory to explain how the blocks balance and thereby create a conceptual domain of block balancing....

- … By their overt actions of attempting to balance all blocks at their geometric centre, 6 and 7 year olds show that they have built a theory-the 'things-balance-in-the-middle' or geometric centre theory-and they rigidly apply their theory to all their balancing attempts.... The 6 to 7 year old treats negative feedback as if she, the child, were in difficulty, not if the theory were at fault.” (p. 186)” (Metz 1995, p. 108)

- “Science instruction could begin to introduce children to those aspects of the culture that would support their reflection upon theories and theorizing, including exploration of the constructs of theory, evidence, laws, the aesthetics of parsimony, and so on.”
- “Science instruction could capitalize on the social context of the classroom to facilitate children's explication of their theorizing and theories.” (Metz 1995, 108)

- **"children at the concrete operational level are presumed to identify different variables, seek to determine causality, and achieve fundamental improvements in their ideas" (Metz 1995, 112)**

- “young children frequently begin exploration with a success orientation, interpreting events in terms of whether or not an action succeeded (e.g., a block balanced). After some period of interaction with the materials, children's orientation frequently shifts to an interpretation of events in terms of accordance with or violation of their theories-in-action” (Metz 1995, p.115)

- "A building-blocks curricular structure underlies this approach to science instruction:

  identify the easiest aspects of scientific inquiry and begin by teaching those, then gradually add more complicated aspects until, at the junior or senior high school level, students are almost acting like scientists.

  The observation and description of concrete objects, followed by their organization using seriation and categorization, is frequently considered the place to begin because it is presumed to be so rudimentary."

- “We [Metz] **question the assumption that scientific object description is the place to start learning science… adequate scientific description is not trivial**
- **“Karl Popper (1972) asserted, ‘Observation is always selective. It needs a chosen object, a definite task, an interest, a point of view, a problem’ (p. 72).**
- **“Popper and Kuhn both emphasize ... the intimate and inevitable entanglement of scientific observation with scientific theory**

- “The objects of science are not the phenomena of nature but constructs that are advanced by the scientific community to interpret nature.

- **“the symbolic world of science is… populated with entities such as atoms, electrons, ions, fields and fluxes, genes and chromosomes; it is organized by ideas such as evolution and encompasses procedures of measurement and experiment. These ontological entities, organizing concepts, and associated epistemology and practices of science are unlikely to be discovered by individuals through their own observations of the natural world.**

- “Scientific entities and ideas, which are constructed, validated, and communicated through the cultural institutions of science, are unlikely to be discovered by individuals through their own empirical enquiry
- “learning science thus involves being initiated into the ideas and practices of the scientific community and making these ideas and practices meaningful at an individual level.

  (Driver et al. 1994, p.5-6)

- “The fact that young children can abstract properties from objects and organize them accordingly implies nothing about the scientific value of their descriptions or classifications; nor does it imply that in implementing this skill children are doing science.

- “Decontextualization constitutes a fundamental problem with this building- blocks approach in general, and, in particular, with this initial emphasis on the description and organization of the directly perceivable and concrete.
- “Scientific description can only be derived and evaluated in relation to a context of inquiry and goal structure.

- “For example… Color categorizations give the child practice with the classification logical structure, but with minimal possibility of subsequent elaboration of deeper scientific knowledge.
- “Motivational problems may also arise from this manner of decontextualization. Where children practice object categorization apart from a rich context of purpose and meaning, they may well experience science as uninteresting”

(Metz 1995, pp. 115-119)

- **“[The adult/scientific] world is a symbolic world in the sense that it consists of conceptually organized, rule bound belief systems about what exists, about how to get to goals, about what is to be valued.**

  There is no way, none, in which a human being could possibly master that world without the aid and assistance of others for, in fact, that world is others. (Bruner, 1985, p. 32)”

- **“Learners need to be given access not only to physical experiences but also to the concepts and models of conventional science.**

  The challenge lies in helping learners to appropriate these models for themselves, to appreciate their domains of applicability and, within such domains, to be able to use them.

  If teaching is to lead students toward conventional science ideas, then the teacher's intervention is essential, both to provide appropriate experiential evidence and to make the cultural tools and conventions of the science community available to students…

  there are special challenges when the science view that the teacher is presenting is in conflict with learners' prior knowledge schemes.” (Driver et al. 1994, p. 7)

- **“Learning science involves young people entering into a different way of thinking about and explaining the natural world…**

- The quoted text in this presentation is from the following papers:

Metz, K.E. (1995). Reassessment of developmental constraints on children's science instruction. *Review of Educational Research*. 65 (2), 93-127.

Driver, R. et al. (1994). Constructing Scientific Knowledge in the Classroom. *Educational Researcher.* 23 (7), 5-12.