

What do the learner know about clouds, precipitation, wind and greenhouse effect; a short review of research from 1883 to 2009

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Motivation for the research question:

David Ausubel (1968)

Educational Psychology: A Cognitive View

If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.

Start: Clouds, Rain, Wind, ...

Granville Stanley Hall (1883)

The Contents of Children's Minds

- | 200 Boston children, age 4 to 8
- | explanation “in its own word” of 112 different objects and concepts:
- | *Per Cent Children ignorant of it:*
 - Dew 78 %,
 - What season it is 75.5%,
 - Seen hail 73%,
 - Seen rainbow 65%,
 - Seen clouds 36%.

The Contents of Children's Minds

Citations:

God keeps **rain** in heaven in a *big sink, rows of buckets, a big tub or barrels, and they run over* or he lets it down with a *waterhose through a sieve, a dipper with holes, or sprinkles or tips it down or turns a faucet*. God makes it in heaven out of nothing or out of water, or it gets up by *splashing up*, or he *dips it up off the roof*, or it *rains up off the ground when we don't see it*.

The **clouds** are *close to the sky; they move because the earth moves and makes them*. They are *dirty, muddy things, or blankets, or doors of heaven*, and are made of *fog, of steam that makes the sun go, of smoke, of white wool or feathers and birds, or lace or cloth*.

The Contents of Children's Minds

Hall's advise:

The best preparation parents can give their children for good school-training is to make them acquainted with natural objects

J. Olsen (1900)

Children's ideas – (Denmark)

- | 5600 pupils at Varde, 1898-1900, age 6-7
- | Percentage of children having somewhat clear idea of the thing in question:

	Girls	Boys
Thunder	72	85
Hail showers	81	93
Moving clouds	81	46
The rainbow	90	78
The dew	30	46

Children's ideas – (Denmark)

Olsen's closing remarks, like Hall's, go to the parents:

In this respect we cannot too urgently say to the parent: - Converse with your children!

Jean Piaget (1896 - 1980)

La représentation du monde chez l'enfant (1926)

1.stage (5 to 6 years): **Clouds** are solids made by men or God (realism). Clouds move because men or God or the clouds themselves want to (animism); or move when we move (participation).

2.stage (6 to 9 years): Clouds are made from smoke, dust, earth or stone (causality).

3.stage (9 to 10 years): Clouds are of entirely natural origin: condensed air or moisture, or steam or heat, etc. (real causality). The development from stage 2 to 3 is influenced by teaching.

La représentation du monde chez l'enfant (1926)

- 1.stage (to 7 years): **Rain** is made by men or God and comes from buckets of water, taps, pipes, sinks, fountains, ... in the sky or in the clouds.
- 2.stage (7 to 9½ / 10 years): Rain comes from human activity, the clouds move about intentionally to wherever rain is necessary and transform themselves into water or melts.
- 3.stage (from 10 years): A mix of learned explanations and more original: clouds are heat, wetness, perspiration, mist ... and rain explains itself

La causalité physique chez l'enfant (1927)

1.Stage (average age 6 years): **Wind** is breath of men or God, or made by men or God by fans, machines, bending trees ...

2.stage (average age 8.3 years): Objects that moves are believed to cause wind and the wind can accelerate itself; wind comes from the sky, sun, moon. Trees, dust, waves and clouds are setting themselves in motion to produce wind – which makes the trees, dust, waves and clouds move (!).

3.stage (average age 9.6 years): The air sets itself in motion in virtue of its own force, the air behind pushing that which is in front

1930 – 2009

support and critic of Piaget's stage theory on clouds, rain, wind ++

Lundeen & Caldwell, 1930; Caldwell & Lundeen, 1932, 1934, 1971; Maller & Lundeen, 1933; Zitz, 1937; Oaks, 1947; King, 1960; Inbody, 1963; Boyd, 1966; Tisher, 1967; Za'rour, 1976; Moyle, 1980; 1st International Conference on School and Popular Meteorological Education (EWOC), 1984, 1989, 1993, 1996, 1999, 2003, 2006; SISS 1984, TIMSS, 1995, 2003; Stepans & Kuehn, 1985; Hansen, 1989, 1996; Proverbio & Lai, 1989; Bar, 1989; Bar & Travis, 1991; Philips, 1991; Nelson, Aron, & Francek, 1992; Kennard, 1993; Mroz & Raven, 1993; Aron, Francek, Nelson, & Bisard, 1994; SAS, 1996, Dove, 1998; Weiler, 1998; Hapkiewicz, 1999; Fraser, 2000; Henriques, 2000; Pinson, 2001; ROSE, 2004; Beaty, 2005; Miller, 2005; Sweetland, 2005; Thompson & Logue, 2006; Fries-Gaither, 2008; Hubisz, 2008; Stepans, 2008; Wetzel, 2008; Wainewright, 2009

Pål J.K. Hansen (1996)

”Everybody talks about the weather ...”

*What do you think a **cloud** is? What does it contain?*

- Percentage of children’s answers by age, before instruction, some weeks after, 2 years after instruction

Children’s conceptions of clouds (Piaget stage P1, P2, P3)	13 years Before in. (n=464)	13 y After (358)	15y (354)
Misconceptions (P1)	25	9	18
Mix (P2-3)	60	50	58
Satisfactory (P3- ...)	15	43	24

”Everybody talks about the weather ...”

Why do you think it’s **raining** from some clouds, but not from all?

- Percentage of children’s answers by age, before instruction, some weeks after, 2 years after instruction

Children’s conceptions of rain (Piaget stage P1, P2, P3)	13 years Before in. (n=464)	13 y after (358)	15y (354)
Misconceptions (P1)	40	32	41
Mix (P2-3)	45	57	42
Satisfactory (P3- ...)	5	11	8

”Everybody talks about the weather ...”

What is **wind**? Why does it start to blow?

- Percentage of children’s answers by age, before instruction, some weeks after, 2 years after instruction

Children’s conceptions of wind (Piaget stage P1, P2, P3)	13 years Before in. (n=464)	13 y after (358)	15y (354)
Misconceptions (P1)	86	55	75
Mix (P2-3)	12	30	14
Satisfactory (P3- ...)	2	15	11

Start: The Greenhouse Effect, ...

Pål J.K. Hansen (1989)

Spørsmål om vær ... [Questions about Weather ...]

Norwegian pupils 15 years, n=348, responses to statement:

The greenhouse effect is necessary for life on the Earth

Agree: 23.3%

Responses to 7 other statements about greenhouse effect and ozone layer (% response)

	n=348
<u>Exchange</u> greenhouse effect with effects of the ozone layer.	26.4
<u>Confuse</u> greenhouse effect with effects of the ozone layer.	18.1
<u>Sum</u> of Exchange and Confusion	44.5

Edward Boyes and Martin Stanisstreet (1992)

Student's Perceptions of Global Warming

- | Constructed a scheme of 36 statements about
 - consequences(12), causes(12), action to reduce(12)
 - also to be used in 1993 and so on ...
- | 218 first-year British undergraduate students in biology, age 18-20 years
- | Confusion of global warming and ozone layer depletion (ca.60%)
 - also found in secondary school pupils (1993)

1990 two new reports; 1993 – 2009 support and development of Boyes and Stanisstreet's works ++

van Marion, 1990; Hocking, Sneider, Erickson, & Golden, 1990; Boyes & Stanisstreet, 1993; Francis, Boyes, Qualters & Stanisstreet, 1993; Hansen, 1993, 1996, 2003, 2009; Moran & Morgan, 1993; Boyes et al., 1995; Morgan & Moran, 1995; Batterham, Stanisstreet, & Boyes, 1996; Christidou & Koulaidis, 1996; Dove, 1996; Fisher, 1996, 1998a, 1998b, 1998c; Hillman, Stanisstreet, & Boyes, 1996; Mikkelsen, 1996; Potts, Stanisstreet, & Boyes, 1996; Smith & Ford, 1996; SAS, 1996, Rye, Rubba, & Wiesenmayer, 1997; Koulaidis & Christidou, 1999; Henriksen, 1998; Mason & Santi, 1998; Boyes, Stanisstreet & Papantoniou, 1999; Cordero, 1999; PISA, 1999, 2000, 2006; 2001; Groves & Pugh, 1999; Meadows & Wiesenmayer, 1999; Andersson, 2000; Andersson & Wallin, 2000; Beatty, 2000; Fraser, 2000; Jeffries, Stanisstreet, & Boyes, 2001; Henriksen & Jorde, 2001; Khalid, 2001; Gayford, 2002; Matkins, Bell, Irving, & McNall, 2002; Kerans & Carlson, 2003; TIMSS, 2003; Turmo, 2003; Daniel, Stanisstreet, & Boyes, 2004; Papadimitriou, 2004; ROSE, 2004; Schreiner, Henriksen, & Hansen, 2005; Ekborg & Areskoug, 2006; Gautier, Deutsch, & Rebich, 2006; Kerr & Walz, 2007; Lee, Lester, Ma, Lambert, & Jean-Baptiste, 2007

The End?: The Greenhouse Effect, ...

Pål J.K. Hansen (2009)

Knowledge about the Greenhouse Effect ...

Norwegian pupils 15 years, responses to statement:

The greenhouse effect is necessary for life on the Earth

Agree: 1989 23.3%, 1993 30.5%; 2005 *75.0%

Responses to 7 other statements about greenhouse effect and ozone layer (% response) (*Significant increase ($\alpha < 0.5\%$) 1993-2005.)

	1989 n=348	1993 n=354	2005 n=440
<u>Exchange</u> greenhouse effect with effects of the ozone layer.	26.4	17.5	19.3
<u>Confuse</u> greenhouse effect with effects of the ozone layer.	18.1	32.8	*51.1
<u>Sum</u> of Exchange and Confusion	44.5	50.3	*70.4

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