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:

<table>
<thead>
<tr>
<th></th>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thunder</td>
<td>72</td>
<td>85</td>
</tr>
<tr>
<td>Hail showers</td>
<td>81</td>
<td>93</td>
</tr>
<tr>
<td>Moving clouds</td>
<td>81</td>
<td>46</td>
</tr>
<tr>
<td>The rainbow</td>
<td>90</td>
<td>78</td>
</tr>
<tr>
<td>The dew</td>
<td>30</td>
<td>46</td>
</tr>
</tbody>
</table>
**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;
Beaty, 2005; Miller, 2005; Sweetland, 2005; Thompson & Logue, 2006; Fries-Gaither, 2008; Hubisz, 2008; Stepans, 2008; Wetzel, 2008; Wainewright, 2009
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

<table>
<thead>
<tr>
<th>Children’s conceptions of clouds</th>
<th>13 years Before in. (n=464)</th>
<th>13 y After (358)</th>
<th>15 y (354)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misconceptions (P1)</td>
<td>25</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Mix (P2-3)</td>
<td>60</td>
<td>50</td>
<td>58</td>
</tr>
<tr>
<td>Satisfactory (P3- ...)</td>
<td>15</td>
<td>43</td>
<td>24</td>
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"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

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<th>Children’s conceptions of <strong>rain</strong> (Piaget stage P1, P2, P3)</th>
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<td>Misconceptions (P1)</td>
<td>40</td>
<td>32</td>
<td>41</td>
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<tr>
<td>Mix (P2-3)</td>
<td>45</td>
<td>57</td>
<td>42</td>
</tr>
<tr>
<td>Satisfactory (P3- …)</td>
<td>5</td>
<td>11</td>
<td>8</td>
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“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

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<td>75</td>
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<td>12</td>
<td>30</td>
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Start: The Greenhouse Effect, ...


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%

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<th>Responses to 7 other statements about greenhouse effect and ozone layer (% response)</th>
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<td>18.1</td>
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<td>Sum of Exchange and Confusion</td>
<td>44.5</td>
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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 ++

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%

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<th>2005 n=440</th>
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<td>Sum of Exchange and Confusion</td>
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<td>50.3</td>
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</tr>
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</table>
A general approach that views learning as an active mental process of acquiring, remembering, and using knowledge. Domain-Specific Knowledge. Information that is useful in a particular situation or that applies mainly to one specific topic. General Knowledge. Information that is useful in many different kinds of tasks; information that applies to many different situations.