

Organizing communication for science learning

Per-Olof Wickman

per-olof.wickman@mnd.su.se

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Stockholm
University

What is the connection between communication and learning?

- Teaching is basically communication for learning
- The teacher is responsible so that new knowledge, skills and values are communicated to students in a way that helps them learn and so grow as persons.
- How then can communication for science learning be organized?

Models for communication

- Through signs
- Signs bring information that represent the world unequivocally
- We are beyond this simple idea of communication
- The meaning of signs is dependent on what the learner already knows
- The meaning of signs is dependent on the context for communication
- How can this be modeled in relation to learning science?

Dependence on what the learner already knows

- *"If I was to narrow down the psychology of education to one single principle, I would say: the factor with the greatest influence on learning is what the student already knows. We need to learn what this knowledge is, and teach the child accordingly."*

(Ausubel et al. 1968, Educational Psychology: A Cognitive View)

If you ask children what they already know? What do they answer?

- To introduce photosynthesis: What do plants need? (Helldén 1992)
- What does the child answer?
- What influences the answer?
- Does the child answer everything it knows about what plants need?
- What do you do to help the child?

Dependence on context

- Pioneering research on situated cognition and knowing as action (e.g. Lave, Rogoff, Säljö, Wertsch etc.)
- John Dewey and Lev Vygotsky

Dependence on context

- How could context be understood?
- An activity with a purpose
- Communication depends on the purpose of the activity in deciding what is relevant and irrelevant to communicate
- For functional communication a teacher depends on activities that are familiar to students ...
- ... and on who they are communicating with? (Crawford, Chen & Kelly, 1997)
- Through the shared activity students can decide what is relevant to do or say because they can evaluate the consequences for the purpose of the activity (Wickman, 2004)

The Role of the Situation

- Helldén enclosed the plant in a plastic container
- He found that students knew more
- How do we decide what is relevant and irrelevant previous knowledge?

How do we learn new things?

- In an activity with a purpose students encounter a problem
- Students can't pursue their purpose using what they already know
- They need to start communicating with others (texts, the teacher, other students etc.) to learn new ways of proceeding according to purpose

John Dewey

- Principle of continuity
- The empirical method (inquiry)

In an activity with a purpose we encounter a problem. How do we solve it?

We take knowledge from whatever previous or current experience may help us to proceed and we try out its consequences for our purpose. If it helps us with our purpose in a way that we value, it gains meaning and becomes continuous in our activity.

Contingent, necessary to study empirically

What do we as science educators demand of a model of communication?

- It should help teachers plan, carry out and assess teaching and learning
- It should consist of entities which teachers can observe and change

Context of communication may be stated as follows (Johansson & Wickman, 2011)

For planning, carrying out and assessing teaching

- Organizing purposes
 - Proximate purpose
 - Ultimate purpose
- Does the proximate purpose become an end in view?
- Do the proximate and ultimate purposes become continuous?

- For longer units additional intermediary purposes may be needed (Firozi & Wickman, 2014)
- Proximate – Intermediary - Ultimate

An example (Johansson & Wickman, 2011)

- Learning about friction through a practical with toy cars with and without tires

Practical epistemology analysis (PEA): A model to see learning as it happens

- How can we see that the proximate purpose becomes an end-in-view?
- How can we see that the proximate and the ultimate purposes becomes continuous?
- We need to have students in situations where they need to communicate

Wickman & Östman (2002), Wickman (2004)

What is learnt here?

M: Really big eyes if you consider.

L: Let's check then.

M: So, big compound eyes then.

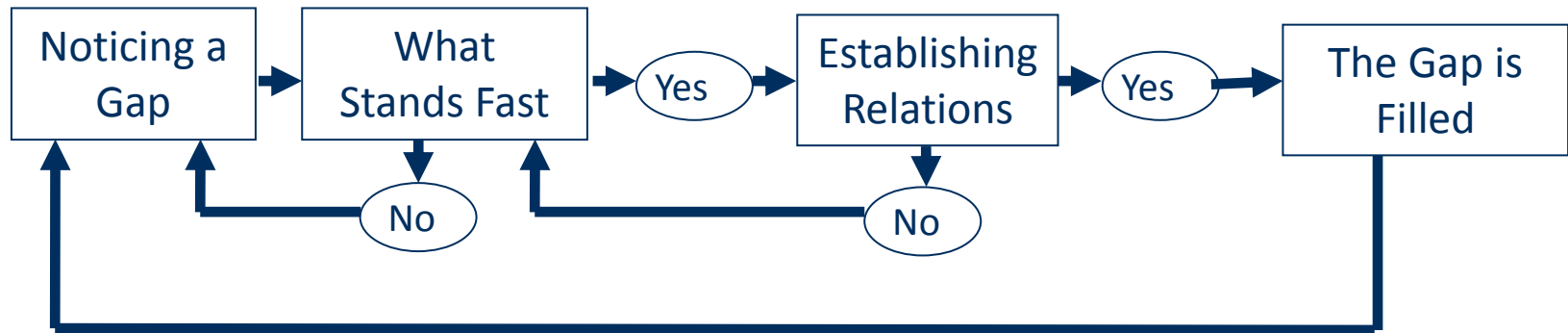
L: Yes. (Laughs)

[...]

M: This one is bigger, isn't it, but has smaller eyes if you compare with the bumblebee.

L: Mmm.

How learning happens: PEA



Encounters
In a situated activity with
purposes

Teaching/learning depends on communication where

- Continuous, relevant relations can be established
- Stand fast: if not, no relations may be possible to construe (Who are students communicating with?)
- Stand fast: what stands fast may need to be questioned
- Gaps: The basic gap is the purpose of the activity
- Gaps: How gaps could be fruitfully ordered
- Gaps: Do students notice relevant gaps?
- Encounters: It is what teachers orchestrate to have students notice and fill gaps with relations

For planning progression (Firozi & Wickman 2014)

- What is the ultimate purpose of the sequence (unit)?
- What component competences are needed for students to partake in doing the ultimate purpose?
- What intermediary purposes can be identified that involve these component competencies?
- What is the order of these intermediary competences in relation to what students already master? Where do we need to start and end to create a progression for students.
- How may the intermediary purposes be broken down into proximate purposes which could work as ends-in-view for students?

For assessing progression (Firozi & Wickman, 2014): Can I see that ...

- the proximate purpose becomes an end-in-view to students?
- the students are noticing relevant gaps in relation to the proximate purposes and eventually the intermediary purpose?
- the students can use what is standing fast to establish relevant relations to fill the gaps?
- the students are making the different proximate purposes continuous (fill gaps with relevant relations)?
- the students eventually use what the intermediary purpose concerns to deal with the gaps that were noticed as part of the proximate purposes, that is, continuity between the proximate and intermediary purposes?
- the students make new intermediary purposes continuous with old ones and eventually continuous with the ultimate purposes of the unit?

If not: What a successful teacher does (cf. Anderhag, Hamza & Wickman, 2014)

- When students are stuck, jointly evaluate expected consequences of relations and so clarifying why a particular action is preferred in respect to purposes, or in other words; support students' reasoning instead of asking for correct answers.
- Before leaving assisted students, check that they continue in accordance with purpose and so confirming that they are given an opportunity to experience how actions could be anticipated in contribution to fulfillment of task.
- For it to be possible, an inquiry of a certain openness, where distinctions can be communicated and negotiated in relation to purpose, is required.

Example: an Australian Year 7 class Hubber, Tytler & Haslam (2010).

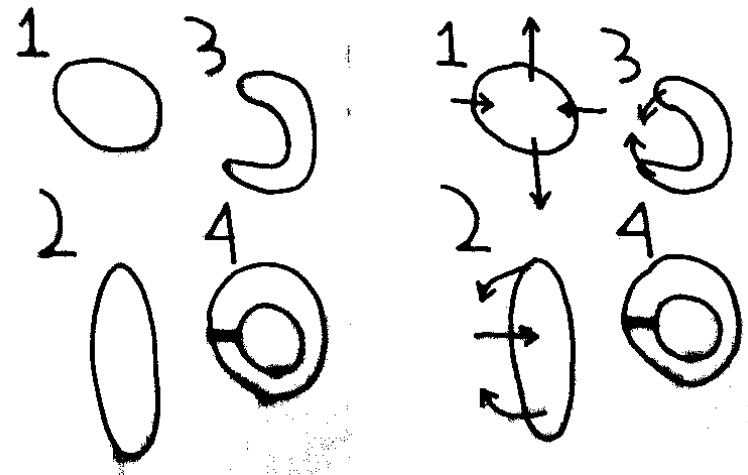
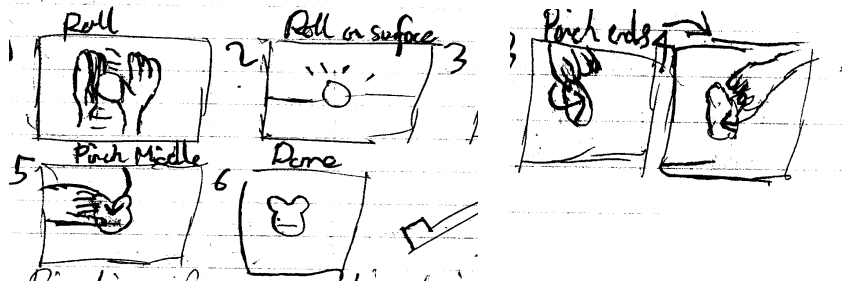
- Ultimate purpose: learn to use the concept of force in a scientific way
- Intermediary purpose 1: To understand force as either push or pull
- Proximate purposes: (1) to mould a piece of plasticine into a certain shape, (2) collect the every-day words the students use, (3) Jointly categorizing them as push or pull
- Does the PPs work as end-in-view?
- How are they made continuous with the intermediary purpose?

Making a paper-and-pencil representation

- Intermediary purpose: representing force with arrows
- Proximate purposes: (1) Students were to represent the change of the plasticine in paper form to instruct another student, (2) The various representations are discussed in relation how well they work to instruct another student, peer review (Kim & Song, 2006), (3) The teacher introduces arrows as a help
- The representation chosen was the one that worked as an end-in-view and made proximate and intermediary purposes continuous.
- The encounter with the teacher and students play different roles in discussing the gaps noticed and relations established in the light of the purposes

Plasticine!

Pulling to break it
squish
twist
roll
squeeze
roll to sausage shape
split top into 2 (so looks like rabbit ears)



Lyn: Which one of these representations worked well in explaining what was done?

Student 1: John's because it showed you exactly what to do. Mine could have ended up anything.

Student 2: It was more visual, you can actually see it is easier to actually see what you did. With the other ones you could make it in different ways.



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Conclusion

1. Knowing is not just a proposition or the production of signs
2. Knowing is purposeful use of signs in communication with others
3. Knowing is action and so also embodied and emotional
4. Learning is seen as a change of habits regarding 1-3
5. Methods for studying learning and organizing teaching have to acknowledge this
6. I have presented models that may be helpful in accomplishing this
 - Organizing purposes
 - PEA

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