Cooperative learning: theories, processes, mechanisms

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Building bridges

Theories of (communicative) interaction
They are rarely designed for understanding the elaboration of cognition

Theories of (cooperative) learning
They rarely specify the forms of interaction

Dialogue
Cognition
Forms of cooperation
Cooperative learning mechanisms
Learning: a (too) general definition

- Learning is a (positive) modification of a subject's capacity to carry out a task, under the effect of an interaction with the environment.

- Could there be a general theory of learning?
  - In cognitive terms, no:
    - No mechanisms, cerebral faculties specific to learning
    - Identification, discrimination, memorisation, inference … of information distributed across memory, perception, action
    - Activation of these processes depends on what the system must do (resolve a problem, understand a text, …)
  - Search for general theory of learning abandoned
Elements of learning theories

- The subject: a modification of what or whom?
  - “inside” or “outside” the subject, in its interactions with the environment, within the environment?
  - Learning mechanisms: cognitive, linguistic, relational, social, … processes

- The object: what is to be learned?
  - Behaviour, knowledge, social practices?
  - “un-learning”, simultaneous co-existence of different capacities or areas of knowledge

- The environment: with what is it to be learned?
  - Source of stimuli, feedback, meaning, …?
  - “Forms” of learning (associated with specific theories) refer to characteristics of environment
    - E.g., learning by doing, by being told, by discovery, …

- The interaction subject-environment: how is it to be learned?
  - A “pipeline” for knowledge?
  - A learning process per se?

A meta-model of learning theories
Learning ≠ teaching

Cooperative learning
Cooperative learning: theoretical frameworks

Three main frameworks

a) Neo-Piagetian ("constructivist")
b) Neo-cognitivist
c) Socio-cultural
a) Neo-Piagetian

Genetic psychology

Biological-cognitive individual

Milieu: constraints on action, source of feedback

Response adapted to milieu:

O

S

E

O

E

subject

object

environment

actions-schemas

assimilation

accommodation

equilibration

ignoring

t₀

t₀

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Socio-cognitive conflict
(Doise, Mugny, Perret-Clermont, Gilly, …)

- Socio-constructivism
  - Piaget too centred on actions of solitary individuals?
  - Extension of Piagetian notion of disequilibrium between subject’s schemas and inanimate milieu to domain of social interaction
  - Negative feedback leading to accommodation = disagreement
    - More difficult to ignore (social pressures)
- Mechanism
  - Recognition of different responses, social situation \(\Rightarrow\) doubt
    - Inter-individual dis-equilibrium: social pressure requires resolution
  - \(\Rightarrow\) Intra-individual dis-equilibrium
    - \(\Rightarrow\) emotional activation \(\Rightarrow\) epistemic curiosity \(\Rightarrow\) desire to resolve cognitive dissonance
  - Search for going beyond inter-individual disequilibrium \(\Rightarrow\) going beyond intra-individual dis-equilibrium
  - \(\Rightarrow\) Cognitive progress!

Confirmation bias

- People tend to consider only things that confirm their ideas and to ignore things that invalidate them
- Presence of other people increases probability of taking into account invalidating data
S-c conflict: where are we?

- Although conflicts must be verbalised in order to lead to progress, they are in fact quite rare …
- Some results showing lack of correlation between socio-cognitive conflicts and cognitive progress (Blaye)
- Throw out the baby with the bathwater?
  - Simple puzzle-like tasks leave no room for productive discussion
  - Conjecture
    - « The contrast between explanation in terms of conflict and in terms of co-construction has been widely drawn upon …, but these studies leave us with the question of whether this dichotomy is real or false. Is conflict itself sufficient as an “active ingredient”, or is it the co-constructed resolution of such conflict which is effective? » Maverech & Light (1992)
- Need to analyse argumentative interactions

b) Neo-cognitivism

 Extension of cognitive psychology to case of group
Symbolic cognitivism

- **Resolving closed problems**

  - **Symbolic information processing system**
  - **Source of perceptions, place where actions performed**

  - **Increased performance in problem solving**

Social and distributed extensions

- **Distributed cognition (Hutchins)**
  - Cognition is distributed across people and their tools, these forming a single system (cf. Bateson, blind and cane)
  - Tools reorganise mental functioning

- **Socially shared cognition (Roschelle & Teasley, 1995; Resnick et al., 1991)**
  - Knowledge elaborated in social interaction
  - Tools allow externalisation of shared problem space
Mechanism 1:
self-explanation, peer tutoring

- When A explains something to B, B can acquire understanding, but so can A
  - "self-explanation effect" (Chi et al.; Bielaczyc) — explanations elicited by experimenter
  - Effects of verbalisation, reflection, knowledge restructuring

- Tutorial explanations
  - « peer tutor » role (imposed or spontaneous)
  - Explanations must be « elaborated » and adapted (Webb, 1989, 1991)

Mechanism 2:
Sharing cognitive load

- Spontaneous division of responsibilities for subtasks facilitates problem-solving provided that roles not too rigid
Mechanism 3:
Mutual regulation

- Necessity to reach agreement leads to expression of strategic decisions
- After collaborative problem-solving, individuals have better self-regulation

Mechanism 4:
Grounding (Clark & Shaefer, 1989)

- Attempt to understand interlocutor’s utterances leads to productive cognitive work
- Subjects learn to think interactively
- Grounding
  - Criterion
    - “The contributor and the partners mutually believe that the partners have understood what the contributor meant to a criterion sufficient for current purposes”
- Conversation = set of contributions
  - contribution = presentation / acceptance
  - acceptance = a presentation
    - recursive structures
  - Signs of continued understanding
    - Continued attention, relevant continuation, feedback, repetition
  - Patterns of contribution
    - Turns, successive episodes, collaborative completion
Hypothesis

- For learning, must go beyond the grounding criterion
  - “understanding … sufficient for current purposes”
- Shallow and deep grounding
- Pragmatic and semantic grounding
  - What are you trying to say to me about x? (pragmatic)
  - What does x mean? (semantic)

Example: “When smart groups fail”

- 4 groups of 3 students (6th grade)
- Problem: « Cedar Creek » video
  - Buys a boat, how can it be brought home that day?
    - Headlights don’t work, enough petrol, etc. ?
- Results
  - No sig. Relation learning, prior knowledge, correct solutions
  - Groups who learned less
    - Ignore or reject correct solutions
    - Incoherent conversations
  - Groups who learned more
    - Discuss and accept correct solutions
    - Coherent conversations
- **Grounding a condition for improved collaborative learning**
c) The socio-cultural approach

Activity theory
(Vygotsky, Leont’ev, Wertsch, …)

- In transforming the world, Man transforms his species-being
  - … (who said that?)
- Activity is “conscious” and goal-oriented
  - Complexity of tool-mediated social organisation
  - Indirect relation between orientation of action and goal
    - Flint axe maker and hunting (hunger)
    - Architect and plan
- Activity is mediated
  - Tools not add-ons to preformed activity, they constitute the activity
- Development from interpersonal to intrapersonal …
  - “Every function in the child’s cultural development appears twice: first on the social level, and later on the individual level; first between people (interpsychological), and then inside the child (intrapsychological)”. (Vygotsky, 1978: 57)
- … within the ZPD
  - Learning a potential, not a state
Digression

Is Parvaneh’s cat “conscious”, in this sense?

(This is not, I think, Parvaneh’s cat: it is the ‘May cat’ from ‘Cats of the month’, called ‘Frisky’)

Activity theory
mechanisms: *internalisation*

- Transition from interpersonal to intrapersonal (internal dialogue interne), mediated by language
- ≠ “a fax in the mind” = autonomisation
- conditions:
  - Concepts in ZPD
  - Less competent person must participate actively

mechanisms: *externalisation*

- Integration of an action in an activity that transforms it
- ≠ simple verbalisation ou manifestation) = dissemination
- Stable integration of new practices on the level of the group
  - Example (Engeström) of postoffice in Finland
mechanisms: appropriation

- 2 agents, A & B; B more competent in a task to be carried out in collaboration
  - A performs action $\alpha$
  - B integrates $\alpha$ in own activity, thereby transforming it: $\alpha'$
  - A re-interprets $\alpha$ with respect to $\alpha'$ and activity of B => appropriation of activity of B by A

Example
- Appropriation of discourse genres (Wertsch/Bahktine)

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Voices of the mind (Wertsch, 1991)
Appropriating a discourse genre in a “show and tell” session

<table>
<thead>
<tr>
<th>N</th>
<th>Loc</th>
<th>Dialogue</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>F</td>
<td>Danny (C1), please come up here with what you have. (piece of lava)</td>
</tr>
<tr>
<td>(4)</td>
<td>C3</td>
<td>Where did you get it?</td>
</tr>
<tr>
<td>(5)</td>
<td>C1</td>
<td>From my mom. My mom went to the volcano and got it.</td>
</tr>
<tr>
<td>(11)</td>
<td>C1</td>
<td>I’ve always been, um, taking care of it.</td>
</tr>
<tr>
<td>(12)</td>
<td>F</td>
<td>Uh hum</td>
</tr>
<tr>
<td>(13)</td>
<td>C1</td>
<td>It’s never fallen down and broken.</td>
</tr>
<tr>
<td>(14)</td>
<td>F</td>
<td>Uh hum. Okay. Is it rough or smooth?</td>
</tr>
<tr>
<td>(15)</td>
<td>C1</td>
<td>Real rough and it’s … and it’s … and it’s sharp</td>
</tr>
<tr>
<td>(16)</td>
<td>F</td>
<td>Okay. Why don’t you go around and let the children touch it. Okay? (C1 takes it round). Is it heavy or light?</td>
</tr>
<tr>
<td>(17)</td>
<td>C1</td>
<td>It’s heavy</td>
</tr>
<tr>
<td>(18)</td>
<td>F</td>
<td>It’s heavy</td>
</tr>
<tr>
<td>(19)</td>
<td>C1</td>
<td>A little bit heavy</td>
</tr>
<tr>
<td>(20)</td>
<td>F</td>
<td>In fact, maybe they could touch it and hold it for a minute to see how heavy it is</td>
</tr>
</tbody>
</table>
Scaffolding (Bruner)

- Foundations
  - Bruner = Piaget + Vygotsky
    - constructivism with human intervention (social constructivism)
  - Means by which adult/specialist helps someone less competent, taking control of elements of the task that exceed novice’s capabilities, thus allowing him to concentrate his efforts on the elements within his competence (Bruner 1976)
  - Minimal intervention by tutor, gradually “fading out” support, devolving responsibility to student
- Scaffolding techniques
  - Enrolment (interest, motivation, commitment)
  - Reducing degrees of liberty (simplifying task)
  - Maintaining orientation
  - Indicating determining characteristics
  - Controlling frustration.
  - Demonstration

- What about scaffolding groups rather than individuals?

Situated learning
(Lave, Suchmann, Greeno)

- Foundations
  - Critique of cognitivism
    - Knowledge not in the head, situated in social practices
  - Perception, action, thinking intertwined
    - There is only society and the brain (Clancey)
- Learning mechanisms
  - Socialisation in communities of practice, “legitimate peripheral participation” (Lave)
  - “Cognitive apprenticeship” (Collins & Brown)
  - Relatively stable change in form of discourse across situations (Greeno, Roschelle)
    - Learning to be a mathematician is becoming accepted in the community of mathematicians and appropriating their discourse
Situated learning

Socio-cultural approaches: critique

- Activity
  - A general framework rather than a theory, model?
  - Everything is a « tool »?
- Situated learning
  - Circularity?
    - Research is itself a practice
  - Behaviourism is back?
  - More to learning than participation?
    - How many Californians needed to change a light bulb?
Preliminary conclusion

Theories and mechanisms of cooperative learning

Cooperative learning mechanisms: summary

<table>
<thead>
<tr>
<th></th>
<th>Neo-Piagetian</th>
<th>Neo-cognitivist</th>
<th>Socio-cultural</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject</strong></td>
<td>(Inter-)individual Cognitive-biological</td>
<td>Individual Cognitive</td>
<td>Person-plus-tools Social group</td>
</tr>
<tr>
<td><strong>Object</strong></td>
<td>Action/response adapted to milieu</td>
<td>Knowledge</td>
<td>Tools Practices</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td>Source of inanimate and/or social feedback/pressure</td>
<td>Shared tools, interactions, representations</td>
<td>Culture</td>
</tr>
<tr>
<td><strong>Learning mechanisms (interaction [S-E-O])</strong></td>
<td>Socio-cognitive conflict</td>
<td>Self-explanation Peer tutoring Sharing cognitive load Mutual regulation Grounding</td>
<td>Internalisation Externalisation Appropriation Participation</td>
</tr>
</tbody>
</table>
Three key points

1. **Unit of analysis**
   - Change of object of study, unit of analysis, timescale
2. **Tools**
   - Emphasis on role of tools, artefacts
3. **Interaction**
   - Emphasis on role of communicative interaction

From the point of view of learning theories, what productive interactions?

![Productive interactions]

- Optimal socio-relational pressure
- Optimal intersubjectivity
- Cooperative resolution of verbal conflicts
- Self and other- explanation
- Flexible alternation and sharing out of roles
- Optimal grounding
- ...

To what extent do these correspond to ‘real’ interactive processes?