DSV-KTH, K2lab, April-June 2005
Course "Interaction, cognition and CSCL", Lecture 3

Cooperative learning: theories, processes, mechanisms

Michael Baker

LEAPLE Lab, CNRS & Université Descartes Paris 5 (Sorbonne)
michael.baker@vjf.cnrs.fr

Visiting professor, DSV-KTH k2lab
mbaker@dsv.su.se,

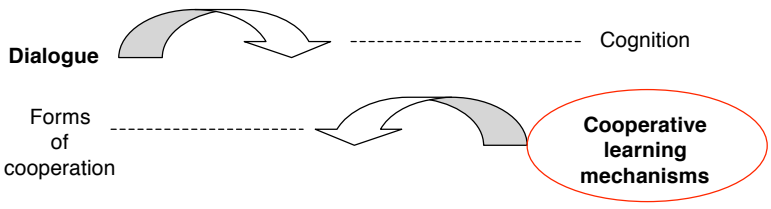
Building bridges

Theories of (cooperative) **learning**

They rarely specify the forms of interaction

Theories of (communicative) **interaction**

They are rarely designed for understanding the elaboration of cognition



Learning

Generalities

Learning: *a (too) general definition*

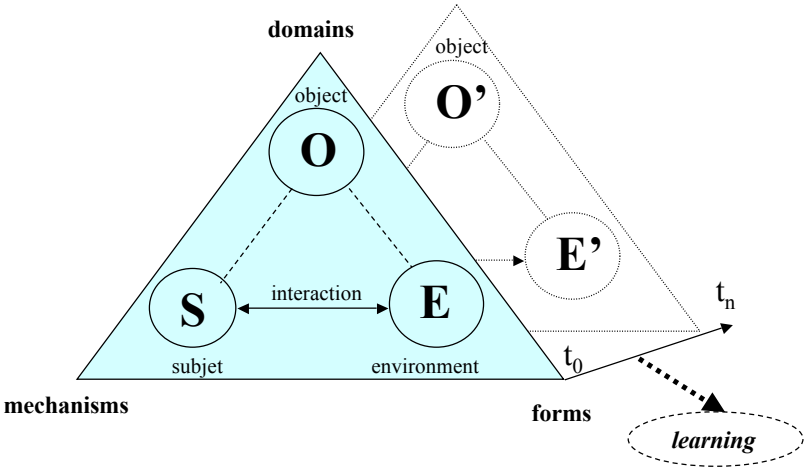
- Learning is a (positive) modification of a subject's capacity to carry out a task, under the effect of an interaction with the environment

- 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 <u>of what</u> 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: <u>what is</u> to be learned?
  - Behaviour, knowledge, social practices?
  - "un-learning", simultaneous co-existence of different capacities or areas of knowledge
- The environment: <u>with what</u> 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: <u>how</u> is it to be learned?
  - A "pipline" for knowledge?
  - A learning process *per se*?

A meta-model of learning theories



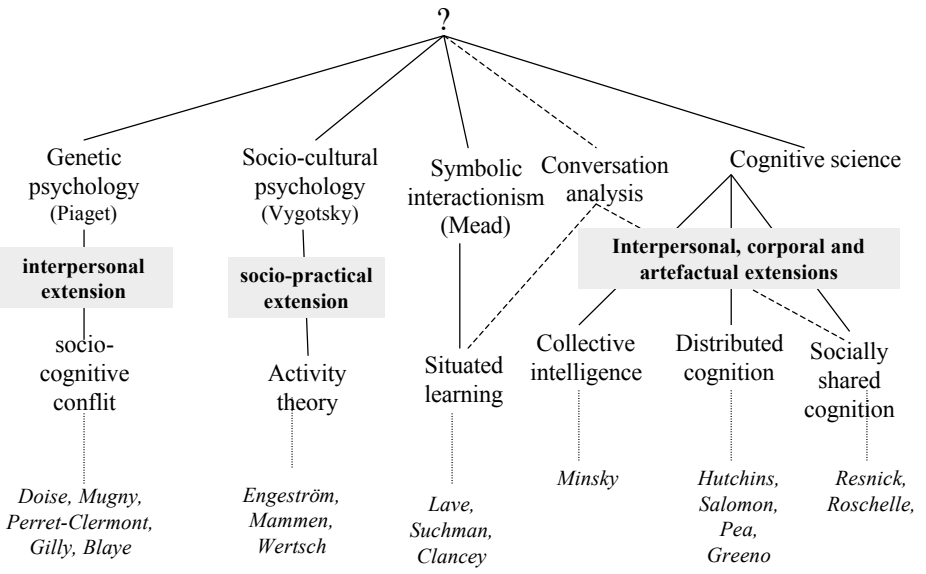
Learning ≠ teaching

teaching

learning

Cooperative learning

Cooperative learning: theoretical frameworks

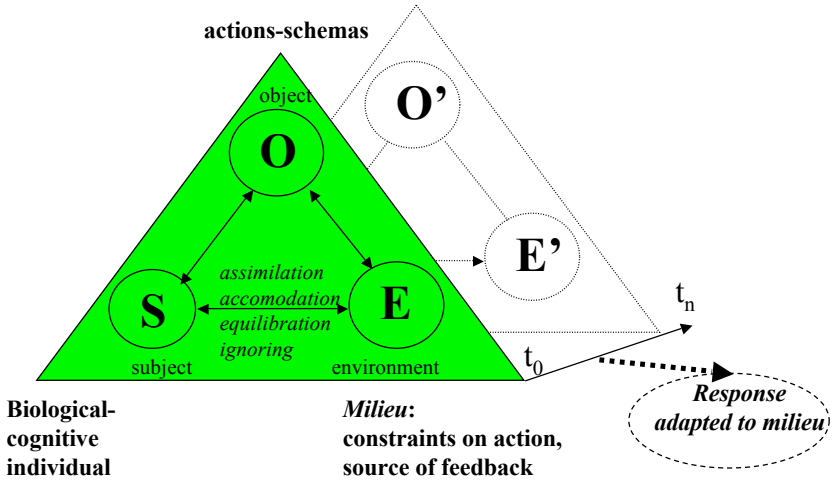


Three main frameworks

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

a) Neo-Piagetian

Genetic psychology



michael.baker@vjf.cnrs.fr — May 2005

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 accomodation = disagreement
    - More difficult to ignore (social pressures)
- Mechanism
  - Recognition of different responses, social situation ==> doubt
    - *Inter-individual dis-equilibrium*: social pressure requires resolution
  - *==> Intra-individual dis-equilibrium*
    - --> emotional activation -> epistemic curiosity -> desire to resolve cognitive dissonance
  - Search for going beyond i*nter-individual disequilibrium* --> going beyond *intra-individual dis-equilibrium*
  - ==> 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

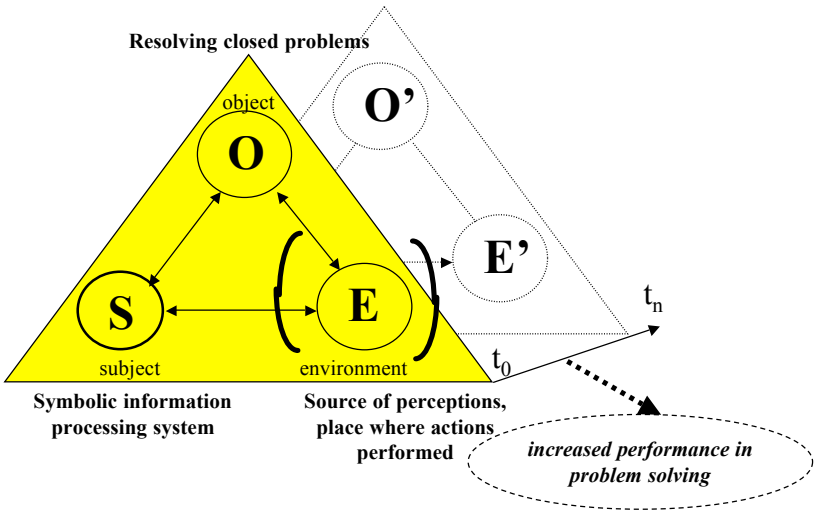
S-c conflict: where are we?

- 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



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, reflexion, 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 responsabilities 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 contributer 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"

Barron, B. (2003). *The Journal of the Learning Sciences*, 12(3), 307-359

- 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, …)

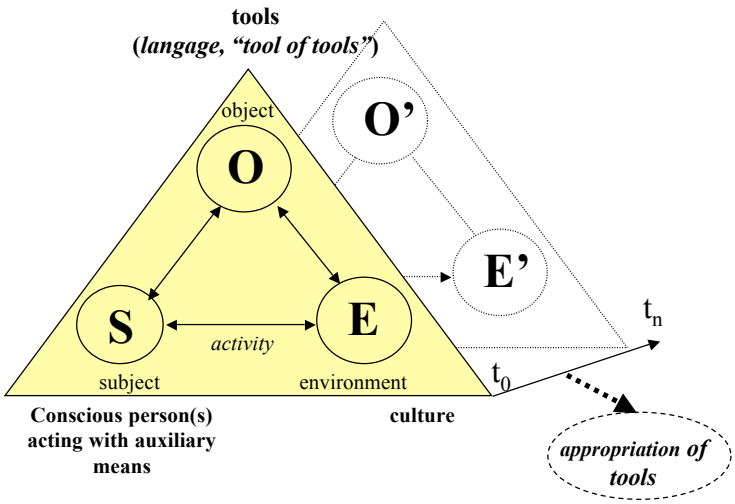
- In transforming the world, Man transforms his species-being
  - … (who said that?)
- Activity is "conscious" and goal-oriented
  - Complexity of tool-mediated social organisation
  - Indirect relation between orientation of action and goal
    - Flint axe maker and hunting (hunger)
    - Architect 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 α
  - B integrates α in own activity, thereby transforming it: α‘
  - A re-interprets α with respect to α‘ and activity of B => appropriation of activity of B by A
- Example
  - Appropriation of discourse genres (Wertsch/Bahktine)

Voices of the mind (Wertsch, 1991)

Appropriating a discourse genre in a “show and tell” session

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

Scaffolding (Bruner)

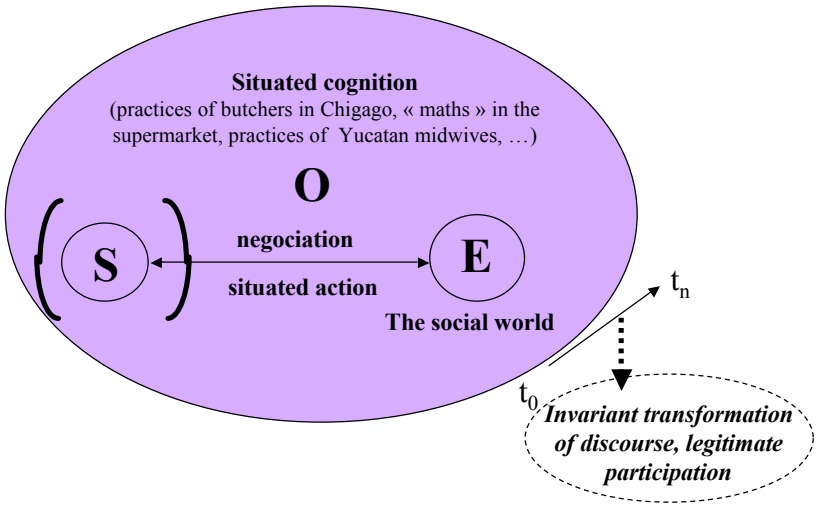
- Foundations
  - Bruner = Piaget + Vygotsky
    - constructivism with human intervention (social constructivism)
  - Means by which adult/specialist helps someone less competent, taking control of elements of the task that exceed novice's capabilities, thus allowing him to concentrate his efforts on the elements within his competence (Bruner 1976)
  - Minimal intervention by tutor, gradually "fading out" support, devolving responsibility to student
- Scaffolding techniques
  - *Enrolement* (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*

- Activitiy
  - 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

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

michael.baker@vjf.cnrs.fr — May 2005

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?

?

To what extent do these correspond to 'real' interactive processes?

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
- …