Knowledge confrontations for deep understanding: findings from 7 years' experience in designs

François Lombard
TECFA, IUFE, LDES UniGeneva

francois.lombard@unige.ch
Plan

1. Context
2. Methodology DBR: focus on design features
3. Science is social confrontation of ideas
4. Biology Change, Infodense world
5. Knowledge confrontation is efficient for learning
6. Conceptual artifacts can scaffold knowledge building confrontation
7. Design features for socio-cognitive confrontation
8. Selected Results
9. Discussion
Research context

- Biologist.
- Vocational training iIT lecturer coordinator 10yrs
- Lecturer: biology / science teachers UniGE
- Thesis research in Educational sciences:
  - Biology evolution / IT-Rich biology -> knowledge building
- Teacher High school.
Design context

- University: vocational teacher training
- High school biology teaching
- Mostly:
  - 4 BI OS: Matric year, biology major,
  - 4 periods / week
  - School tolerated,
    - political context defiant of research and « University interfering in schools ».
- N = 14-16 * 7 years + other designs
- Design not discussed *per se*
Research 2002-2009 focus on

- 02 -> Design validation: produces appropriate knowledge?
- 03 -> Q° Teaching -> Q° ... IBL
- 05 -> Designing around teacher or including Teacher: dependant variable
- 06 -> Writing 2 Learn (W2L)
- 08 -> Social dimension: Socio-Cognitive Conflict / Cooperative learning
2 Methodology DBR: focus on design features

- Design is object of research (not result)
- Results are design features
- Ethical: best available design delivered.
- N.B: Learning Environment includes but > IT artefact (Wiki, blog, web2 portal)
Knowledge confrontations for deep understanding: findings from 7 years' experience in designs
4 Paradigm change: IT-enhanced Biology 4 facets

- Genomes & ‘omics’
- Georeferenced & other
- Simulations, Systems Biology
- Knowledge building infodense world

-> Use information management tools
2 Which Q° is « more scientific » ?

- Discuss with neighbour (2 ’)

- A) What is the role of T Lymphocytes in fighting H1N1 virus ?

- B) Why should we vaccinate if H1N1 is no worse than seasonal flu ?
  - Vote A/B
2 Science is social confrontation of ideas

- **Science : NAS**
  - 1 Know, use, and interpret scientific explanations of the natural world
  - 2 Experimenting : generating evidence
  - 3 Analyse evidence and explanations
  - 4 Publish : peer-review

- Shift from science telling to science doing?
  (William A. Sandoval & Reiser, 2003)
Science as discourse?

- Science is a way of validating knowledge based on confrontation with data and alternative explanations (W. A. Sandoval & Morrison, 2000)
- “…science as a process of building theories and models using evidence, checking them for internal consistency and coherence, and testing them empirically.” (Duschl, Schweingruber, & Shouse, 2007)
- -> Discuss evidence and confront ideas
3 Knowledge confrontation is efficient for learning

- Learning is scaffolded by others (Bruner, 1960)
  Vygotsky, L. S. (1934).


- -> Discuss and confront ideas
“Two types of conflict elaboration — epistemic and relational

- **Epistemic** elaborations focus students on task resolution leading to positive cognitive outcomes, and correspond to a cooperative relationship.

- **Relational** elaborations focus students on competence differentials and lead either to compliance or to competitive confrontations.” (Buchs, et al., 2004)

- -> Confrontation of knowledge not person.
Learning goals Issue

+ If learning not “show-off” goals (Mastery. Ability)
  ▪ ≠ compare, marks, competition. ∑=K
  ▪ Nor avoidance of incompetence.
    ▪ Darnon et al. (2003) showed that when students are instructed to master the task, conflicts appear to be beneficial for learning. Under performance instruction, conflicts tend to deteriorate it.
    ▪ “Promote the search for the correct response instead of the quest for recognition of positive competence.” or avoidance of negative.
  ▪ “Orient students towards mastery of the task—instead of demonstrations of performance—when they discuss conflictual issues.”
Positive Interdependance / Individual Responsability

- Key issues to promote:
- PI + IR
- Positive Interdependency / Individual Responsability (Buchs, et al., 2004)
- -> Build together responsibility
The “learn to select” Myth?

- **Matrioschka Russian doll model**

Select, choose Wade infodense

Questions

Design

Student engagement

Meaningful Document

- **Meaningful production**
Meaningful document

A) Replication (writing to the teacher)

B) Translation (writing to students),

B) -> more conceptual growth (Gunel, Hand, & McDermott, 2008)
5 Conceptual artifacts can scaffold knowledge building confrontation

Knowledge confrontations for deep understanding: findings from 7 years' experience in designs

Knowledge building pedagogy is based on the premise that authentic creative knowledge work can take place in school classrooms.

Conceptual artefacts

- What real object can project as a circle, a triangle, a square?
Class organized as a knowledge building community

- Knowledge confrontations for deep understanding: findings from 7 years' experience in designs

Class organized as a knowledge building community

- Activity revolves around knowledge building: reading, observing, synthesizing, presenting

- Supported by conceptual artefact: wiki

- Artefact = tetrahedron summit

- Computer mediated interaction
Knowledge confrontations for deep understanding: findings from 7 years' experience in designs

Horman interdependency

- Surcroît de travail
- Uniformisation
- Mauvaise interprétation

Trois risques

Surcroît de travail
- Lié à l'implication variable des pairs et à l'interdépendance de la récompense

Uniformisation
- Liée à la comparaison entre les pairs dans un espace public virtuel et à l'impact sur la qualité des productions

Mauvaise interprétation
- Liée à la réduction des indices socio-émotifs qui pourrait accentuer des enjeux relationnels entre les pairs: réciprocité; protection de l'image de soi; légitimité de critiquer le travail des pairs; crainte de représailles et peur de blesser

5 difficultés
- Obtenir la collaboration
- Comprendre le travail à faire
- Produire un texte en co-construction
- Obligation de donner un feedback
- Donner un feedback par texte

Limites liées à l'habitude du travail indépendant

Liées à la capacité de mettre en place des pratiques structurelles: normes et une éthique de travail en équipe; mécanismes de prise de décision, de coordination, de concertation, de support et de contrôle

Liées à l'interinfluence, à la préférence pour le travail individuel et à la capacité de composer avec les différences individuelles

Les perceptions de l'utilité sont parfois contradictoires

Comment se traduisent les effets de l'interdépendance? (Difficultés, réactions, perception d'utilité)

Workload, standardisation, Misinterpretation

Work habits change
<table>
<thead>
<tr>
<th>Changement d’habitude</th>
<th>Relation entre les pairs</th>
<th>Risques</th>
<th>Perception d’utilité</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-construction en équipe virtuelle</td>
<td>Passager du travail par division des tâches à un travail en association avec les autres : aucune équipe n’a produit un texte final en co-construction et la moitié des équipes ont eu de la difficulté à obtenir la collaboration.</td>
<td>Exige plus d’implication des pairs dans la production du travail. Exige une capacité à vivre l’interférence (composer avec les différences, construire à partir des idées des autres).</td>
<td>La CMO, comme espace de partage de ressources, est appréciée. Le travail en équipe dépend de l’implication. La CMO est moins pertinente pour les gens qui se fréquentent régulièrement et limite la capacité d’interférence.</td>
</tr>
<tr>
<td>Partage de texte dans un espace public virtuel numérique</td>
<td>Nouvelle façon de travailler : écrire un texte destiné aux pairs et non seulement au professeur. Ceci a introduit une complexité et une difficulté à comprendre le travail à faire.</td>
<td>Le caractère public des productions a introduit des possibilités de comparaison entre les pairs. Ceci a été vécu comme de l’incertitude ou un support.</td>
<td>Le caractère public des productions a introduit une possibilité de qualité accrue (texte plus précis, plus élaboré, mieux structuré, jugement critique). Cependant les étudiants disent que leur texte n’aurait pas été meilleur s’il avait tenu seulement au professeur.</td>
</tr>
<tr>
<td>Echange de feedback médiatisé par l’ordinateur</td>
<td>L’habitude de faire le travail à la dernière minute et de le remettre au professeur sans relecture contraste avec la pratique de l’échange de feedback. La forte réaction à l’obligation de donner et recevoir du feedback indique que la pratique de l’échange de feedback pourrait être une habitude à développer</td>
<td>Exigence de réciprocité entre les pairs (effort et intérêt). Enjeux relationnels entre les pairs : la protection de l’image de soi, la légitimité de critiquer le travail des pairs, la crainte des représailles de la part des pairs et la peur de blesser.</td>
<td>Ouverture au feedback des pairs. Perception par les étudiants d’un potentiel d’amélioration des productions. La perception d’utilité de l’échange de feedback est conditionnelle à l’implication des pairs. L’interaction médiatisée par le texte soulève des enjeux relationnels et exige plus d’effort que dans les situations de face à face.</td>
</tr>
</tbody>
</table>
7 General results: design efficiency

- Effectively Build complex knowledge not coming from teacher: consistently over 7 years.
- Effectively capable of selecting and appraising quality of sources. (e.g. Wikipédia -> Janeway)
- Not afraid of large books anymore
  - Exhaustivity -> data-mining strategy
- Over half declare having efficient learning strategy next year at university.

See all 4 OS results here

Lombard F. 19 XI 09
7 Design features for socio-cognitive confrontation.

- Groups (4) common sub-theme
- Present together at early stage.
- Iterative writing (5-10 revisions) / 3-4 weeks / round
- New : signature of contribution (IR) check.
  - Risk of focussing on ability( avoidance ) rather than learning goals PI.
- Improvement of other group’s page (sometimes)
- Presentation common.
Features for socio-cognitive confrontation results

- Mosaic work!
  - Teamwork perceived as very important for future ($\mu=3.62$, scale:4) $\sigma= .650$)
  - Perception of confrontation of ideas and their enrichment linked to quality of team work.
  - Valuing groupwork correlates with appreciating autonomy and feeling responsible for learning (.620*.014)
  - Appreciated autonomy correlates with feeling responsible for their learning (.652*.011)

- Perception of confrontation of ideas and their enrichment linked to quality of team work.
- Nagging feeling that student insecurity about own validation prevents trusting group.
Knowledge confrontations for deep understanding: findings from 7 years' experience in designs

7.1 Design for Science learning: build own ideas

- Self validating encouraged. Progressively relinquished by T.
- Assessment explicitly linked to knowledge validation, referencing example here
- Epistemic complexity encouraged. Assessed for, Marked for
7.1 Epistemic complexity results

- Hakkarainen's four-point scale epistemic complexity of ideas (Zhang, Scardamalia, Lamon, Messina, & Reeve, 2007)

Evidence that design leads students to address complexity.
Knowledge confrontations for deep understanding: findings from 7 years' experience in designs

7.1 Epistemic complexity
7.2 Design for science as validation.

- Early Presentation of student’s understanding of knowledge being learnt
  - Discussions focused Q° on knowledge improvement.
  - Climate tolerant of error, improvement.
  - Acknowledging of limits of assessed, -> validate
  - Assessment focussed on improvement.
  - Teacher validation fading out.
7.1 Design for science as validation results:

Je suis toujours un peu inquiète de savoir si ce que je dis ou trouve est juste ou faux mais comme j'arrive mieux à trier mes lectures j'arrive aussi mieux à juger par moi même la qualité de l'explication. Quelque chose de trop simple maintenant ne me convient plus j'ai toujours envie d'aller plus loin dans l'explication par exemple.

4 BiOS Student March 09
7.3 Meaningful document

- Focus on meaningful document
  - Focus on common understanding of document role.
  - Clearly framed as exam-preparing brochure (F. Lombard, 2008)
- Meaningful: confirmed to current by previous students’ questionnaire results, occasional visits, postings in portal.
7.3 Role of document results

- Validated by previous students’ questionnaire results.
- Role of wiki for synthesis / as exam preparing strategy strongly noted ($\mu = 3.6$ (scale:4) $\sigma = .646$)
7.4 Autonomy in validating?

- Appreciated freedom (avg 3.1 (scale:4) σ 1.16) and autonomy but felt sufficiently supported (avg 3.0 (scale:4) σ 1.07).

- Perception of importance of questions correlates with valuing autonomy (.783** .001), and responsibility (.507* .045)
9 Discussion

- Teacher design features:
  - Science: Relinquish content authority to allow science doing.
  - Autonomy: Relinquish content ownership of text.
  - Drive to adequate content by knowledge confrontation not authority.
  - Deploy rich resources guide students: strategy not content.
  - Assert teacher workflow authority, very explicit assignments, criteria.
  - Feed-back, feed-back, *ad nauseam*
9.2 Discussion validation is key?

- As students come to feel capable of validating, they can trust
  - An unusual design
  - Information brought by others of doubtful competence
  - Information of various sources
  - Empowerment, fading out of scaffolding

- Design should offer opportunities to develop trust in capacity for validating as efficient to build knowledge in a scientific way

Lombard F. 19 XI 09
9.3 Design for autonomy

- Constrain for autonomy:
  - Robustly scaffolded around $Q^\circ$ (info workflow)
  - Scaffold goals, $Q^\circ$ elaboration, iterative knowledge improvement,
  - Freedom ownership / responsibility text
- Consider teacher as part of design
Design for Trust in design: involvement appraisal

- Attitudes towards collaboration paradoxical
- Autonomy in developing own ideas / validating scientific knowledge by evidence rather than authority.
- The effects of some design features on attitude to interdependency and personal responsibility and the type of learning goals seems decisive.
- Disappearing Scaffolding
- Autonomy <-> confrontation
Question

- Teacher authority vs new role influences involvement of learners (?)
- As teacher role changes, and authority of knowledge less forefront (?)
- Mistrust in design is self fulfilling prophecy
- Move from knowledge validating-authority to scientific validating control.
What teacher authority?

- How does perceived scientific authority of teacher influence involvement of students?

- Design for strong scientific validation by students.

- Transfer credibility of T -> design: empower students.
Thankyou for your attention

- More
- http://doiop.com/flopublications
- francois.lombard@unige.ch
- Google lombardf
Acknowledgements

- This research has been supported by the Département de l'Instruction Publique de Genève.
- The research is a doctoral research at TECFA and with LDES.
- The support of my mentors Daniel Schneider and Mireille Betrancourt is critical.
- The discussions and insight shared with Elodie Sierra, Lionel Regad and Pierre Brawand were of a great help during the initial phases of the design development.
- Céline Buchs for help in designing cooperation for learning features.
- The numerous students who gave feedback should be thanked too.