Conference sub-theme :
Developping educational tools

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

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Plan

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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

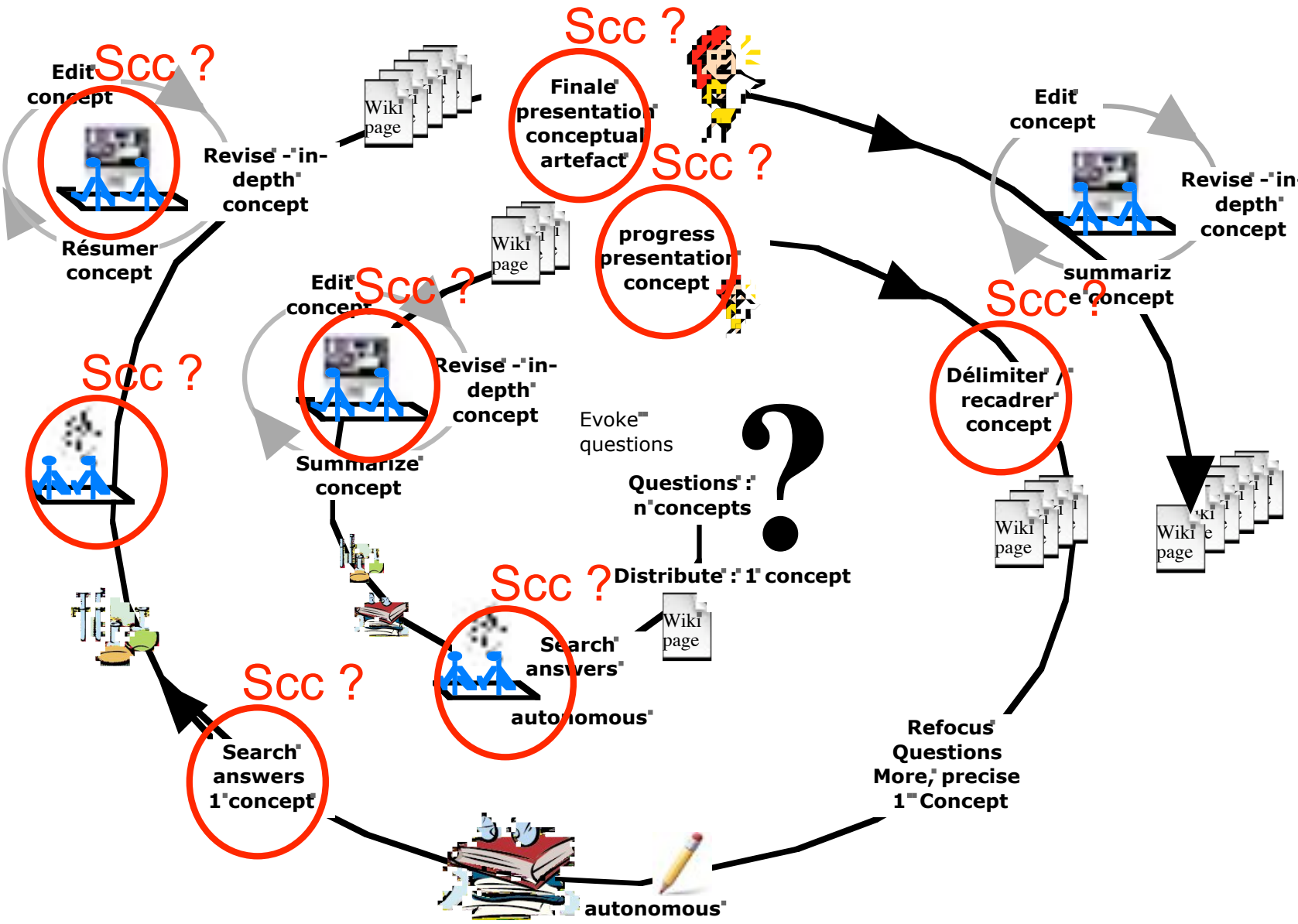
- University : vocational teacher training
- High school biology teaching
- Mostly :
  - 4 BI OS : Matric year, biology major,
  - 4 periods / week
  - School tolerated,
    - political context defiant of research and « University interfering in schools ».
  - N= 14-16 * 7years + other designs
- Design 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.
  - Design Based Research Collective (2003).
- N.B: Learning Environment includes but > IT artefact (Wiki, blog, web2 portal)
  - Kobbe, L. (2006). Framework on multiple goal dimensions for computer-supported scripts: Knowledge Media Research Center (KRMC). pp 9-11


Scc ?
Edit concept
Revise -"in-depth" concept
Résumer concept
Wiki page
Finale presentation conceptual artefact
progress presentation concept
Edit concept
Revise -"in-depth" concept
summariz e concept
Edit concept
Summarize concept
Revise -"in-depth" concept
Evoke questions
Questions : n concepts
Distribute : 1 concept
Search answers autonomous
Search answers 1 concept
autonomous
Refocus Questions More, precise 1 Concept
Délimiter / recadrer concept

4 Paradigm change : IT-enhanced Biology 4 facets

- Genomes & 'omics'
- Georeferenced & othe
- 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).
- Socio-cognitive conflict conceptual change (Astolfi & Develay, 2002; Hammer, 1996; Joshua & Dupin, 1993; W. A. Sandoval, 2003))
- -> 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

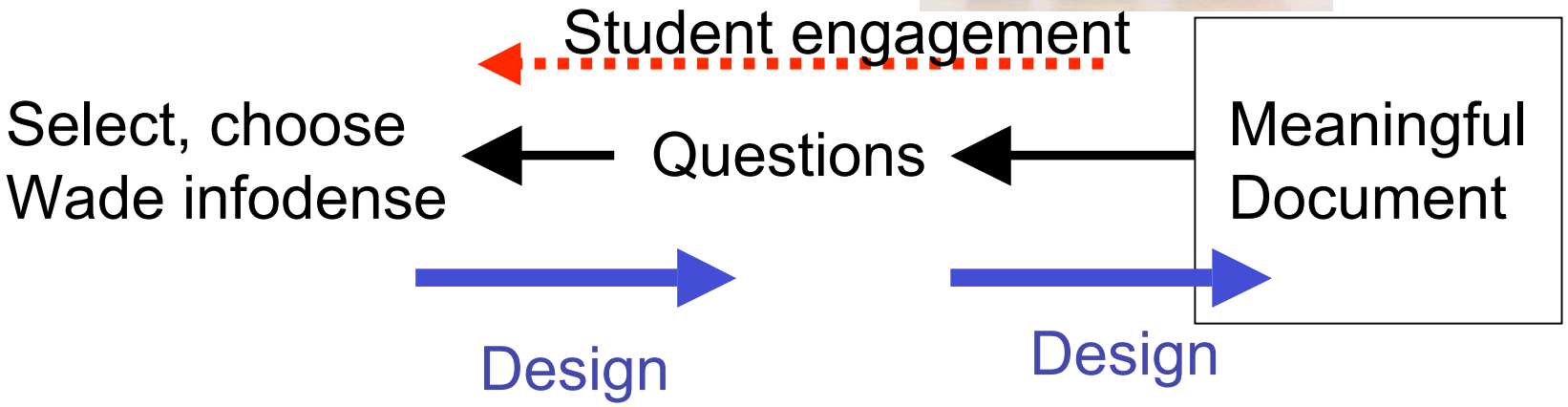
- + If learning not “show-off” goals (Mastery. Ability)
  - ≠ compare, marks, competition. ∑=K
  - Nor avoidance of incompetence.
    - Darnon et al. (2003) showed that when students are instructed to master the task, conflicts appear to be beneficial for learning. Under performance instruction, conflicts 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



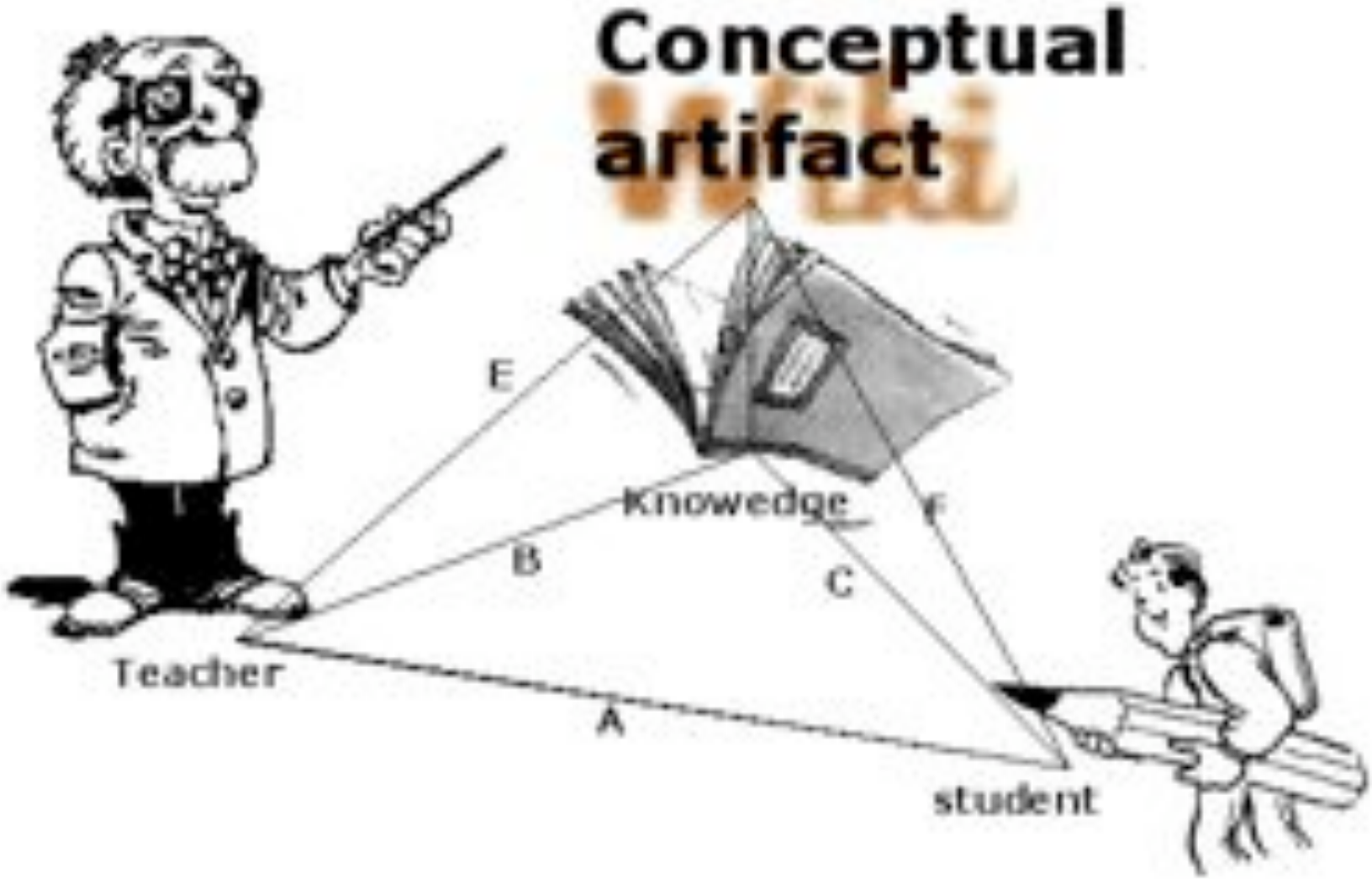
- **-> Meaningful production**

Meaningful document

- A)Replication (writing to the teacher)
  ≠
- B)Translation (writing to students),

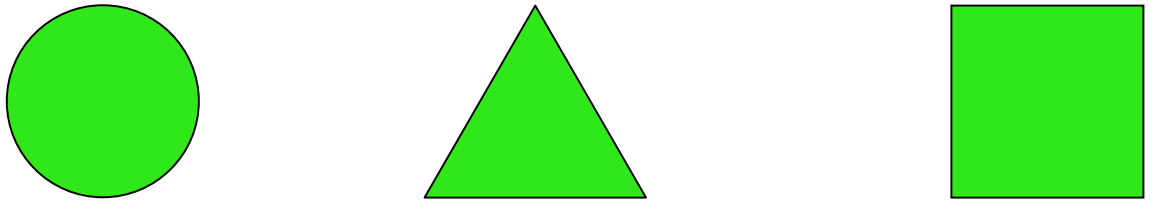
- B) -> more conceptual growth (Gunel, Hand, & McDermott, 2008)

5 Conceptual artifacts can scaffold knowledge building confrontation

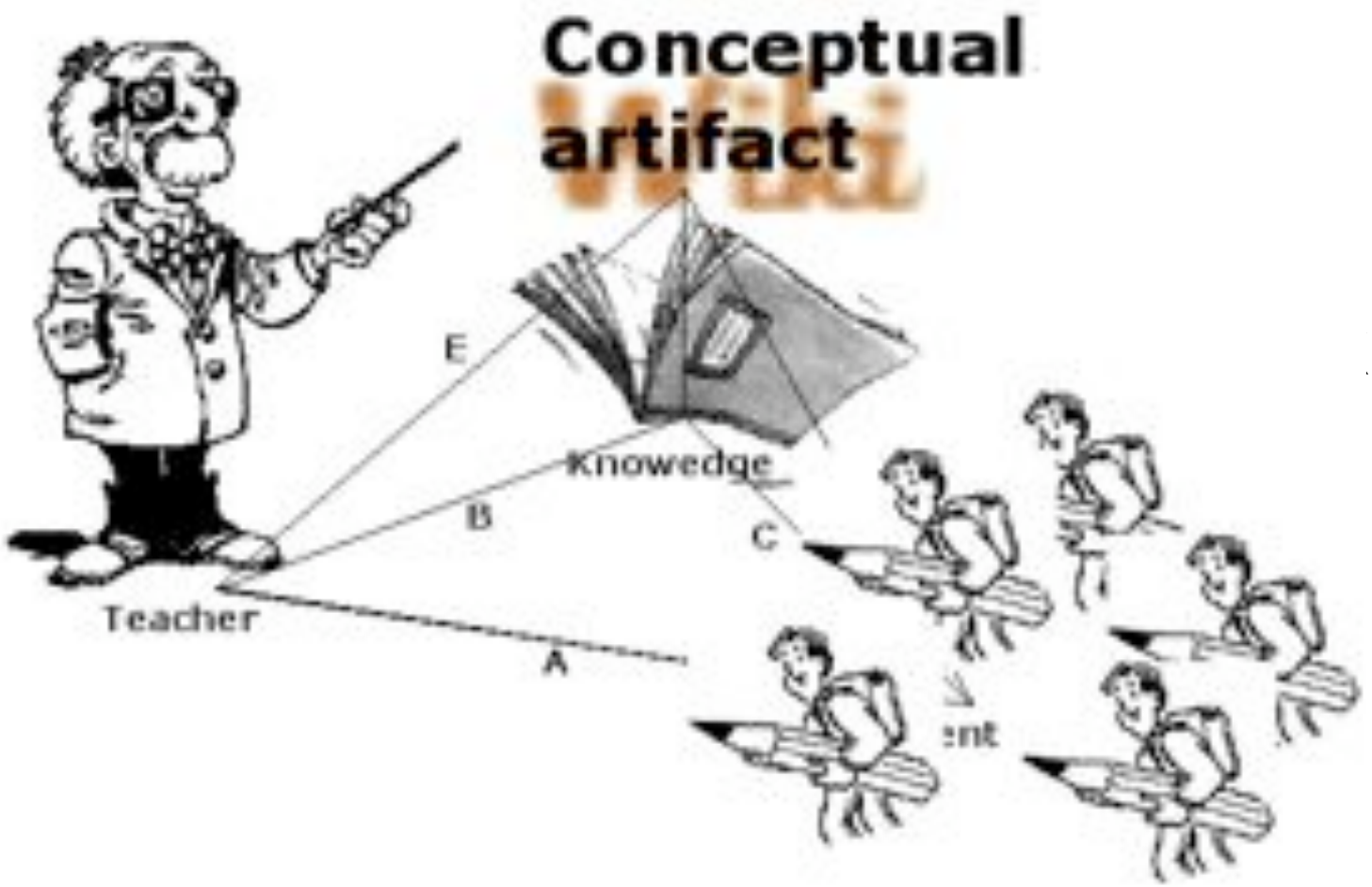


Conceptual artefacts

- What real object can project as a circle, a triangle a square ?



Class organized as a knowledge building community



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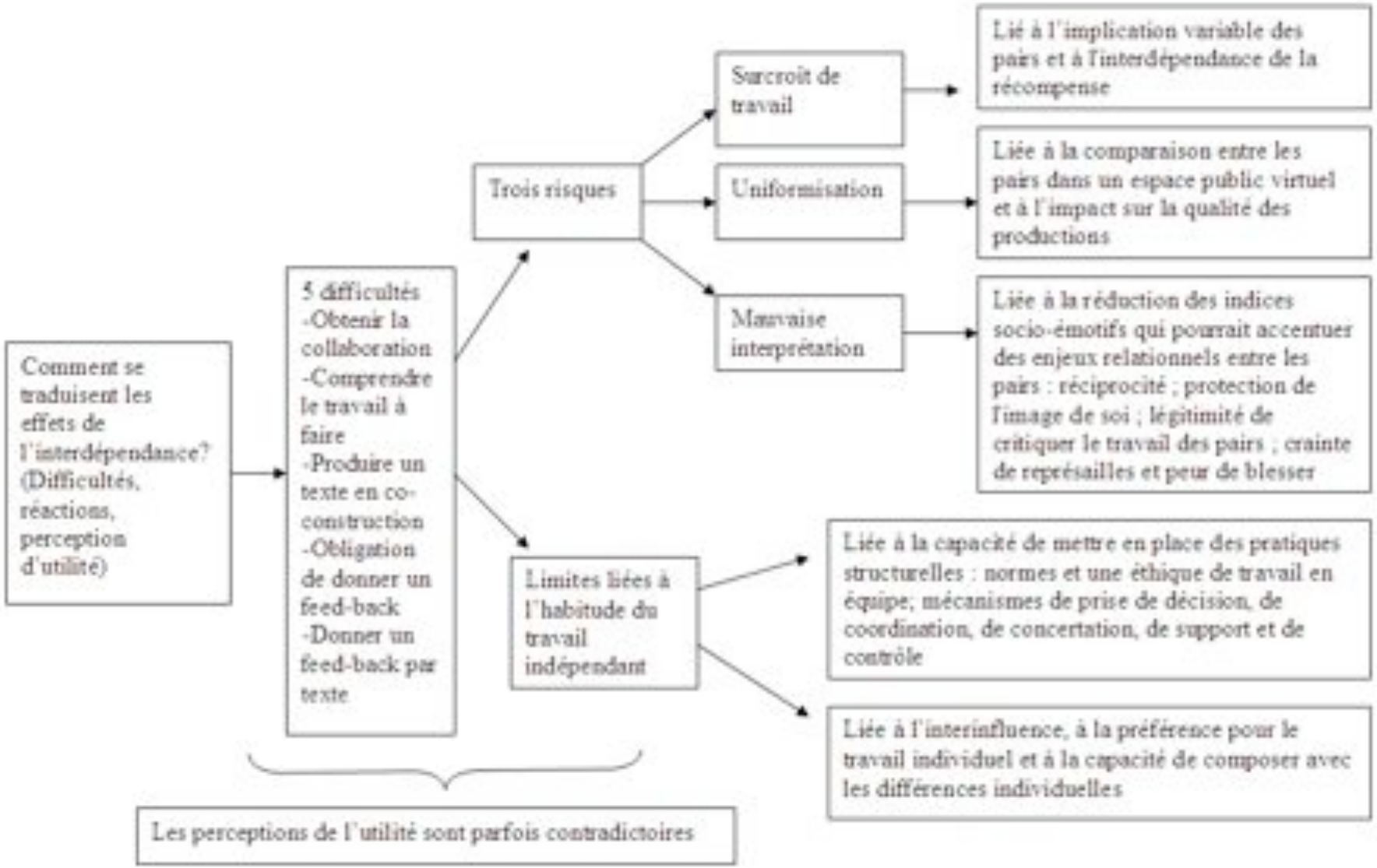
Human interdependency



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Horman perceptions of

	Changement d'habitude	Relation entre les pairs	Risques	Perception d'utilité
Co-construction en équipe virtuelle	Passage 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.	Exige plus d'implication des pairs dans la production du travail. Exige une capacité à vivre l'interinfluence (composer avec les différences, construire à partir des idées des autres).	Risque de dépasser ce qui est concevable par les étudiants : exigence non réalisée et/ou non perçue. Risque de surcroît de travail pour obtenir la collaboration ou faire le travail à la place des autres.	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'interinfluence.
Partage de texte dans un espace public virtuel numérique	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.	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.	Risque d'uniformisation par conformité au groupe des pairs. Les étudiants pourraient avoir tendance à produire des travaux similaires à ceux des autres étudiants.	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 l'avait remis seulement au professeur.
Échange de feed-back médiatisé par l'ordinateur	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 feed-back. La forte réaction à l'obligation de donner et recevoir du feed-back indique que la pratique de l'échange de feed-back pourrait être une habileté à développer.	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.	Risque de mauvaise interprétation par les pairs liée à la CMO. Les étudiants ont réagi fortement à la forme textuelle du feed-back.	Ouverture au feed-back des pairs. Perception par les étudiants d'un potentiel d'amélioration des productions. La perception d'utilité de l'échange de feed-back 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.

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

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 (μ=3.62 (scale:4) σ= .650)
  - Perception of confrontation of ideas and their enrichement 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.

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, &

• **Quel est le rôle des lymphocytes Ta dans l'immunité ?**

Les Ta jouent un rôle central d'activation dans l'immunité humorale ainsi que dans l'immunité à médiation cellulaire.

***Comment les Ta sont-ils activés et comment agissent-ils une fois activés ?**

A mesure que le CMH II nouvellement synthétisé se dirige vers la surface du macrophage ayant phagocyté l'antigène, il capture l'un des fragments bactériens (c.à.d. une des parties de l'antigène qui a été coupé lors de la phagocytose et qui se trouve maintenant dans le macrophage)dans son sillon récepteur d'antigènes et elle le transporte à la surface de la membrane plasmique, ce qui signale la présence d'un antigène étranger au Ta. L'interaction entre le CPA et le Ta est grandement facilitée par la **protéine CD4** qui se trouve à la surface du Ta. Cette dernière s'attache à une partie de la molécule du CMH II. **Cette liaison entre le CPA et le Ta aide à l'activation de ce dernier.**

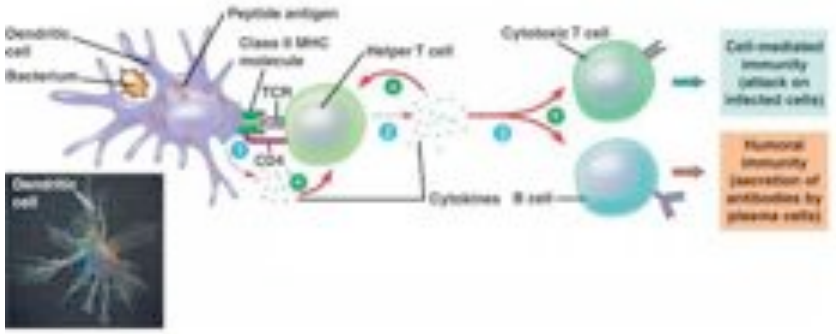

Figure 12: schéma du mécanisme d'action des T4 :

1.CPA phagocyte 1 bactérie et en transporte 1 fragment vers sa membrane plasmique grâce à une molèc. de CMH II.

2.Un Ta spécifique est activé par sa liaison au complexe CMH-antigène. Un lien se crée donc entre le CMH II et le TCR du Ta; cette opération est favorisée par la protéine CD4 ainsi que par l'IL-1 sécrétée par la CPA.

3.Ta activé prolifère : donne naissance à 1clone de cellules identiques dont les récepteurs sont spécifiques à la combinaison CMH-antigène présente. Ces dernières cell sécrètent des cytokines.

4.Cytokines stimulent encore plus les Ta et aident à activer les lymphocytes B et les Tc. Il faut cependant noter que à chaque invasion méthodique pas tous nos lymphocytes Tc ne sont activée.

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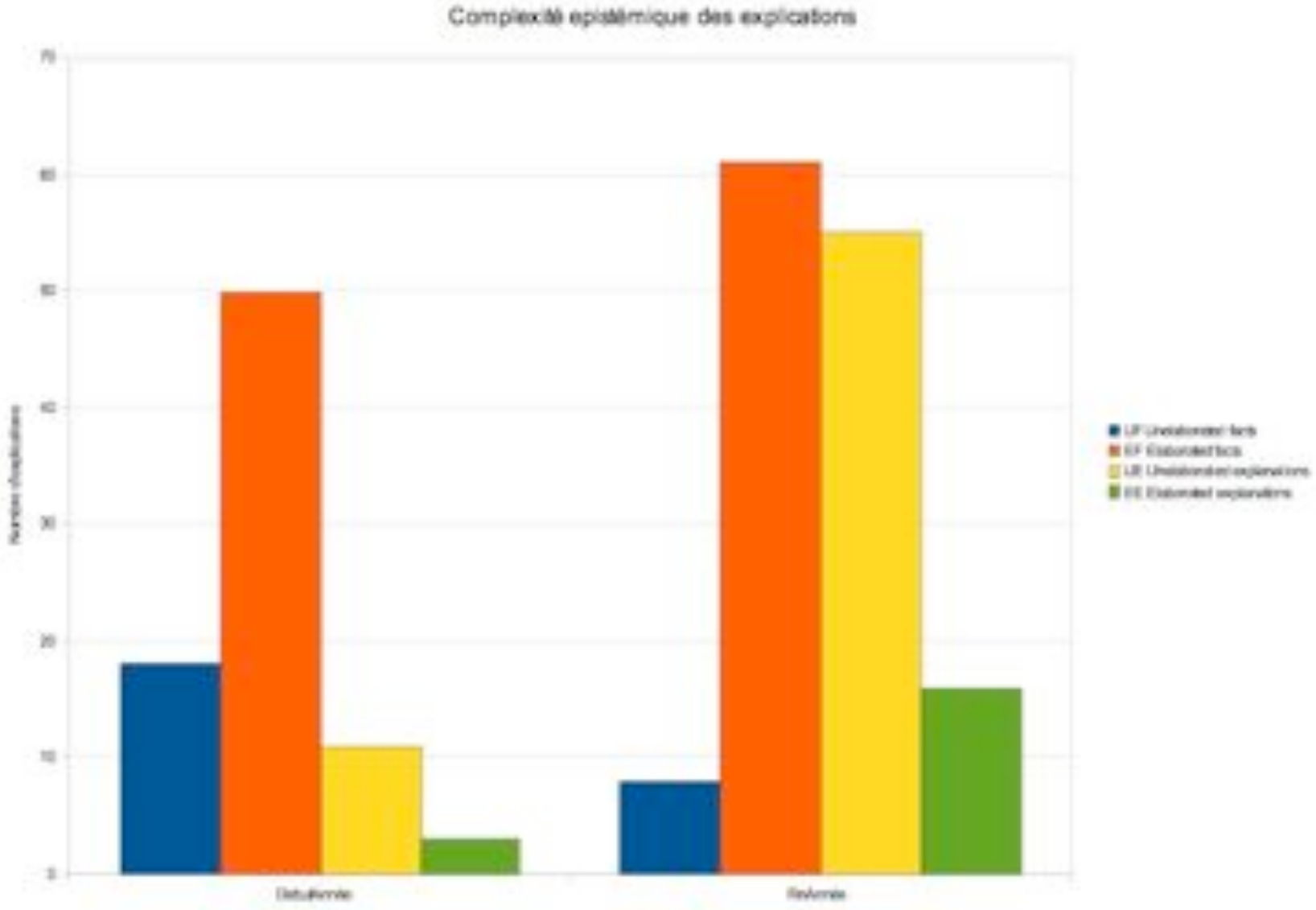
7.1 Epistemic complexity



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.

g

4 BiOS Student March 09

7.3 Meaningful document

- Focus on meaningful document
  - Focus on common understanding of document role.
  - Cleary 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 (μ= 3.6 (scale:4) σ = .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

9.3 Design for autonomy

- Constrain for autonomy :
  - Robustly scaffolded around Q° (info workflow)
  - Scaffold goals, Q° elaboration, iterative knowledge improvement,
  - Freedom ownership / responsability 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
- Hyp. Teacher attitude to knowlege building linked to goals of students Butler, R., & Shibaz, L. (2008).
- 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
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