

The Four Pillars of Educational ICT Research

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Credits

- ❑ Presenting here a collective & collaborative work with (alpha order): Mihai Dascalu, Benoît Lemaire, Sonia Mandin, Stefan Trausan-Matu, Angélique Vernier, Emmanuelle Villiot-Leclercq, Virginie Zampa
- ❑ Partly supported by the French Ministry of Research & the EC-funded LTfLL Project (7th PCRD, ICT-STREP)

Goals of the Talk

- ❑ To provide instances of the way theoretical foundations have impact on the design/use of ICT in educational settings
- ❑ Focus on
 - ILEs, Life-long Learning, writing activity, experimentations in real-world settings
- ❑ Emphasis on (instructional & learning) design
- ❑ Give some research directions to be discussed

The 4 Pillars of Educ. ICT Res. [after Spector '08]



Pillars as Foundations [Spector '08]

- ❑ *Psychology of learning*: Understand the nature of thought to devise appropriate means/methods to train it (Dewey, Piaget, Bruner, etc.)
- ❑ *Instructional design*: Devise human strategies/methods to implement effective teaching (Gagné, Reigeluth, van Merriënboer, etc.)
- ❑ *Communication theory*: The use of language in learning (Vygotsky). The use of cognitive tools that communicate
- ❑ *HCI*: Because of the use of computer, refine the way to exchange information between humans/computer (Merrill, Rosson & Carroll, etc.)

Links between Writing & Learning

- ❑ "Essays are one of the most useful tool to assess learning outcomes" [Valenti et al. '03]
- ❑ Both activities – Emerge from symbolic cognitive processes, – are fostered and allowed by self-provided feedback, – use/provide connections between concepts – are successful if engaged, active and self-rythmed [Emig '77]

Writing & Feedback

□ Focus on writing:

- 25% teacher's time spent on grading written assignments [Vigilante '99]
- Students spend a lot of time waiting assessment or advice
- Interactions at a distance increase this time waste

□ Need of computer-based feedback

Presence vs Distance Situations [Villiot-Leclercq & Dessus '09]

Presence

- On-line learning activity. *T* gets on-the-fly information on *S*
- Intensive & explicit *S*'s shared attention & social relations
- *S*'s questions as part of the interaction
- Explicit/negotiated instructional scenario

Distance

- Partly on-line learning activity. *T* relies on preselected tracks
- Difficult to track *S*'s shared attention & social relations
- *S*'s questions often considered as intrusive
- Instructional scenario partly depends on the system

S: Students
T: Teacher

Likely Solution

□ Devise systems (interactive learning environments) that

- embed instructional & learning activities in the ILE
- model high-level cognitive processes like summarizing, understanding, dialog acts, etc.
- help students build knowledge instead of simply learn/repeat text

Main Thesis & Outline of the Talk

□ If we intent to design efficient educational ICT, theories from these 4 pillars have to be *jointly* taken into account. Test efficiency experimentally

□ Outline

I. The Four Pillars

II. Research Projects



Bad news: Teachers use Pencil/paper-based Cognitive Tools



Easy of use
Very robust and cheap
Portable
Standard



Computer-based Cognitive Tools

□ As previous non-computer-based tools

- Help & foster action (teaching, learning)
- Easy to use
- Decreases cognitive load
- Represent what (remains) to do

I. The Four Pillars

I.1 Psychology of Learning & Instructional Design

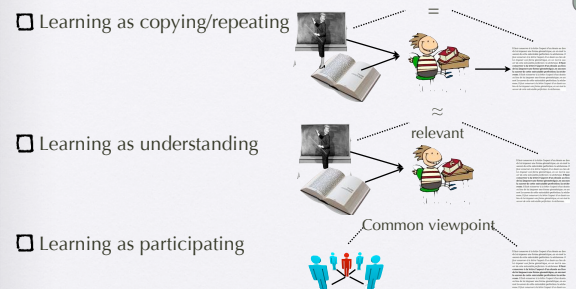
First Two Pillars

Psychology of Learning & Instructional Design [after Spector 08]



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Views of Learning [Sfard 98]



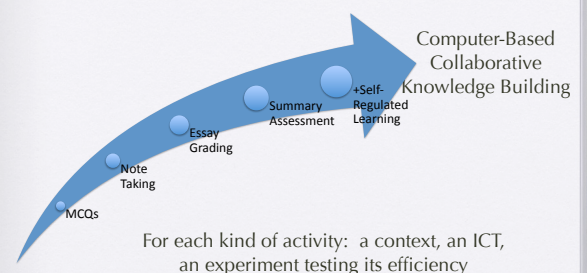
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Psychological Models of Learning

- ❑ Evolved from associationism-behaviorism (rote learning) to constructivism (freely interact with an environment)
- ❑ Foster three kinds of students' abilities [Chi '09]
 - active: doing an engaging activity physically
 - constructive: product output that go beyond presented information
 - interactive: dialoguing with peers & taking their viewpoint into account

I.1 Psyc/ID

Research Genealogy



For each kind of activity: a context, an ICT, an experiment testing its efficiency

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1. Multiple Choice Questionnaires 1/2

- Context
 - Teacher provides valid content and Student tries to distinguish it from fake
- Easy to design
- Assess factual knowledge
- For Teacher: difficult to find likely answers yet wrong for avoiding Student guess
- Tons of MCQ software: *Hot Potatoes*, *eXe*

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1. Multiple Choice Questionnaires 2/2 [Dessus '00]

MCQ in epistemology:

- Les principes de la causalité naturelle sont...
 - Des principes causaux qui existent réellement dans la nature
 - Des principes que tous les scientifiques utilisent
 - Des principes des scientifiques modernes
 - Des principes qui ont fait leur preuve mais qu'on n'utilise plus beaucoup
 - Des principes inexacts qu'on a naturellement tendance à appliquer

2. Note Taking 1/2

- Context
 - A student jots down text when attending a course
 - Not just a summary
- Keeps track of content, thoughts, understanding
- Fosters two main processes
 - encode/link new information (within text, external: with prior knowledge)
 - external storage

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2. Note Taking 2/2 [Mandin et al. '05]

The diagram shows a 'Page de cours' (Course Page) on the left and a 'Note-taking Space' on the right. The 'Note-taking Space' is divided into 'Course Text' and 'Espace de prise de notes' (Note-taking Space).

3. Essay Writing 1/2

- Context:
 - Student attends a course, then writes out an essay about a given topic
 - Teacher compares the essay content to the course content, gives a grade
- Allow students to express their own ideas
- Assessment is time-consuming

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3. Essay Writing 2/2 [Lemaire & Dessus '01]

The screenshot shows an essay writing interface. The top window displays the essay text: "Les effets-école. Voici mon premier avis sur les effets-école. Ce n'est pas encore élaboré mais j'y travaille. Les travaux input-output. Là-dessus, je sais plus de choses, mais il me faut un peu plus de temps pour le taper." The bottom window shows the score: "NOTE GÉNÉRALE : 7,9 / 20".

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4. Summary Writing 1/2

Context:

- Students write out a summary or a synthesis of the course
- The teacher (or the computer) can help students summarize
- Students have to grasp what is important. Multi-source learning. Rote learning not useful
- Individual performance. Very difficult to assess

4. Summary Writing 2/2 [Mandin et al. '07]

Résumez le texte ci-dessous en X mots.

TEXTE À RÉSUMER

Ah, le cauchemar des premiers cheveux blancs, des rides au coin des yeux, des muscles qui ne suivent plus nos envies. Un mauvais rêve d'autant plus angoissant qu'il on sait que ce ne sont que les préliminaires. La sélection naturelle, d'habitude, fait tout pour fabriquer des individus au top, armés pour survivre aux conditions les plus extrêmes. Mais pourquoi a-t-elle conservé au cours de l'évolution un mécanisme qui rend les êtres vivants de plus en plus fragiles avec l'âge ? Et ce, dans la quasi-totalité des espèces.

La première idée qui nous vient, c'est que la vieillesse n'a été inventée que pour nous faire mourir. En effet, le vieillissement est inscrit dans nos gènes. Il fait qu'avec l'âge nos cellules s'usent, arrêtent de se diviser, de se réparer. A un moment donné, il n'y en a plus assez qui fonctionnent correctement pour faire tourner nos organes vitaux. Le clou, le résumé.

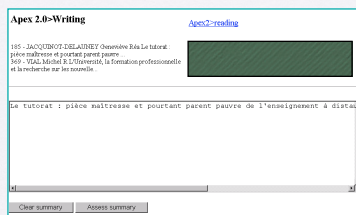
RÉSUMÉ
Ah, le cauchemar des premiers cheveux blancs, des rides au coin des yeux, des muscles qui ne suivent plus nos envies. La vieillesse est inévitable et conduit à la mort à cause de la dégénérescence de nos cellules.

Nombre max. de mots restant : 13

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5. Adding SLR functionalities [Dessus & Lemaire '02]

- Same situation as 3. Essay Writing. Compare computer-based judgment with this of the student



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Research Questions

- Learning design ≠ Instructional design. How to make closer relations between *learning* design and *instructional* design? Solution: scenario-based design [Rosson & Carroll '01]
- Software mostly focused on augmenting learning rather than reorganizing it [Pea '85]. Devising reorganization-based software?
- Psychological processes account. Solution: Computational psychology [Sun '08]

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I.2 Communication Theory Third Pillar

Communication Theory [after Spector '08]



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