No more LOGIN !

Which tools facilitate classroom orchestration?

schmountz

Pierre Dillenbourg

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

DUET - Dual Eye-Tracking
Pair programming experiment

Low gaze recurrence

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

P. Jermann, M.-A. Nüssli & P. Dillenbourg

Supported by the Swiss National Science Foundation
(grants #K-12K1-117909 and #PZ00P_126611)

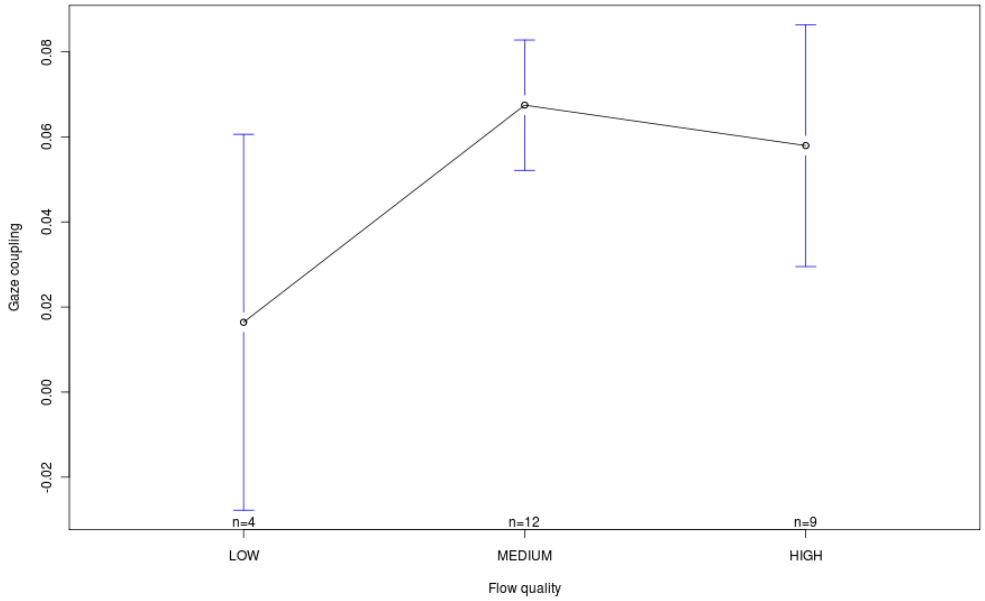
DUET - Dual Eye-Tracking
Pair programming experiment

High gaze recurrence

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

P. Jermann, M.-A. Nüssli & P. Dillenbourg
© CRAFT – http://craft.epfl.ch/

Supported by the Swiss National Science Foundation
(grants #K-12K1-117909 and #PZ00P_126611)



classroom.

Designing artefacts that would be relevant for any learning task would be as difficult as inventing 'the new table'. Conversely designing an artefact only useful for one specific task (e.g. electrical circuits) would not be convincing, as a school would not buy and install - for instance - a different table for each single course. We therefore target an intermediate scope, that is families of tasks that are present in several (but not all) educational situations, both formal and informal. We hereafter consider three elements that could constitute the basis of a scriptable classroom: desks, lamps and displays.

Desks

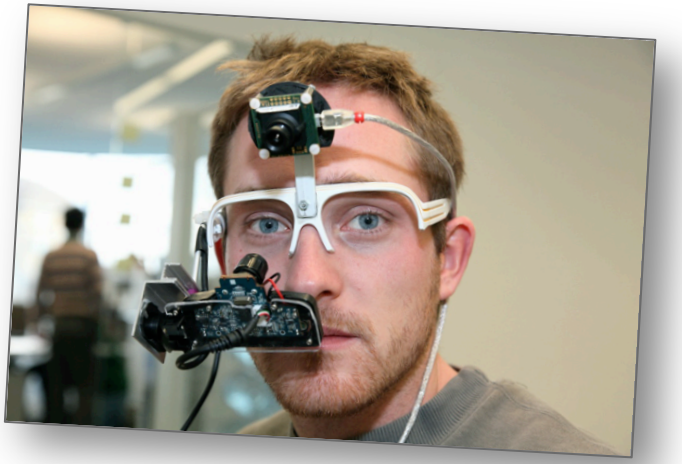
A classroom needs some objects to write on and to work around. In our example of scriptable classrooms, the basic element could be a triangular desk designed to be used by a single student (Figure 3). On the surface of the table a LED display is embedded under a thin layer of wood. The LED can be alternatively controlled by a central program or by a circuit embedded in each table. In addition, the desk is equipped with 3 electrostatic buttons and a RFID reader. These can be used to get input from students, perform a quick survey, question, etc. The Desk is also equipped with a tiny microphone array for localized sound detection. Optionally, there are various ways of making the surface of the desk interactive. One possibility is to install pressure sensors under each desk feet. Another one is to use sound propagation inside the material (temporal reversal of acoustic waves technologies (Ing & Fink 1998) permitting to turn common objects into tactile screens). However, our vision is not that a future desk should include all possible sensors but instead a reduced set of multi-purpose elements that enable the scenarios we present here.

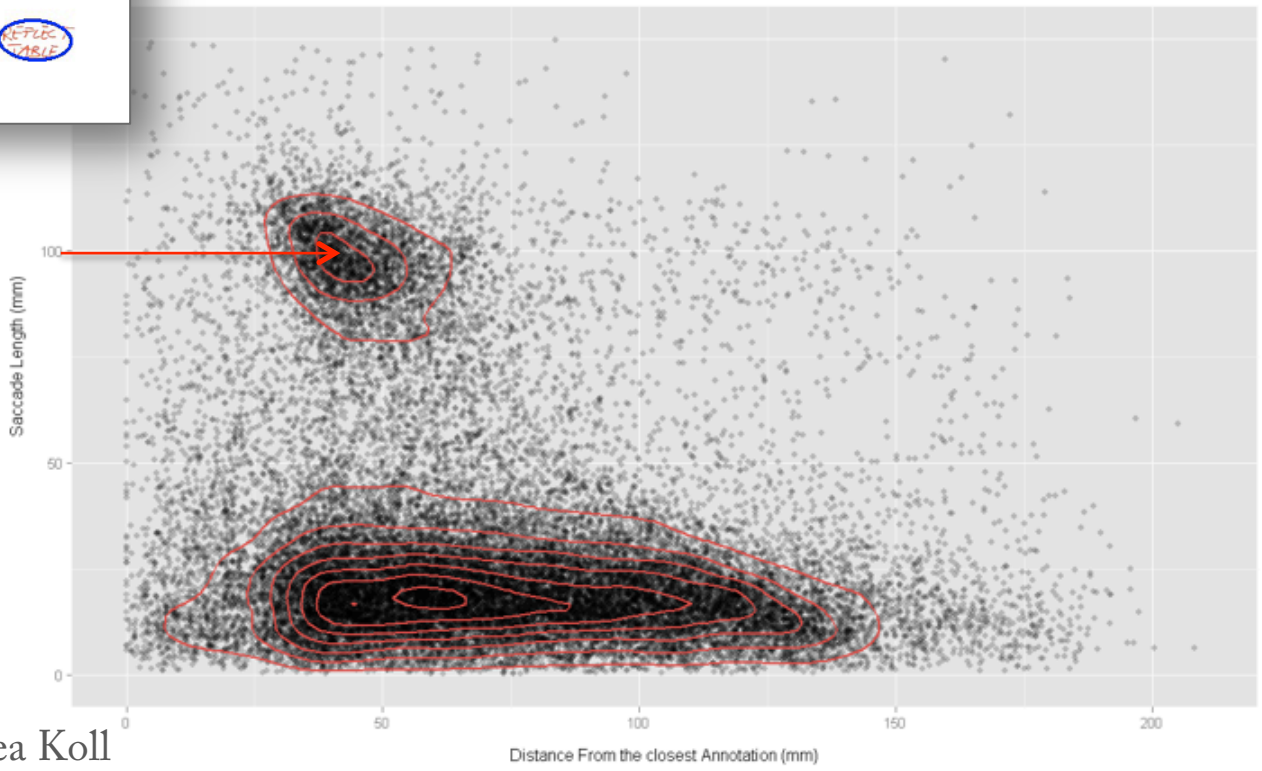
Each desk has three connectors that permit to connect it to another desk (see figure 3). The connector provides both low-voltage power and acts as a serial bus, permitting to exchange data and commands in a network of desks (see figure 4, for an early prototype of the electronic circuits permitting such a network).

Connected desks can form various types of configurations. Figure 5 shows a classroom configurations using 36 tables. Figure 6 shows how the same number of tables can be used to form various kinds of individual and group tables for 2, 4 or 6 students. Figure 6 shows two examples of larger configurations adapted to roundtable discussions involving the entire class.

The embedded LED array on each desk can be used for a broad variety of purposes. Figure 7 shows various examples of these possible uses, illustrating both retroactive and anticipative design of interactions. One example of retroactive design is to provide feedback about the on-going conversations dynamics occurring around the table. This can be done for instance by displaying the amount of speech each participant has produced (Figure 7a) or identifying who speaks with whom

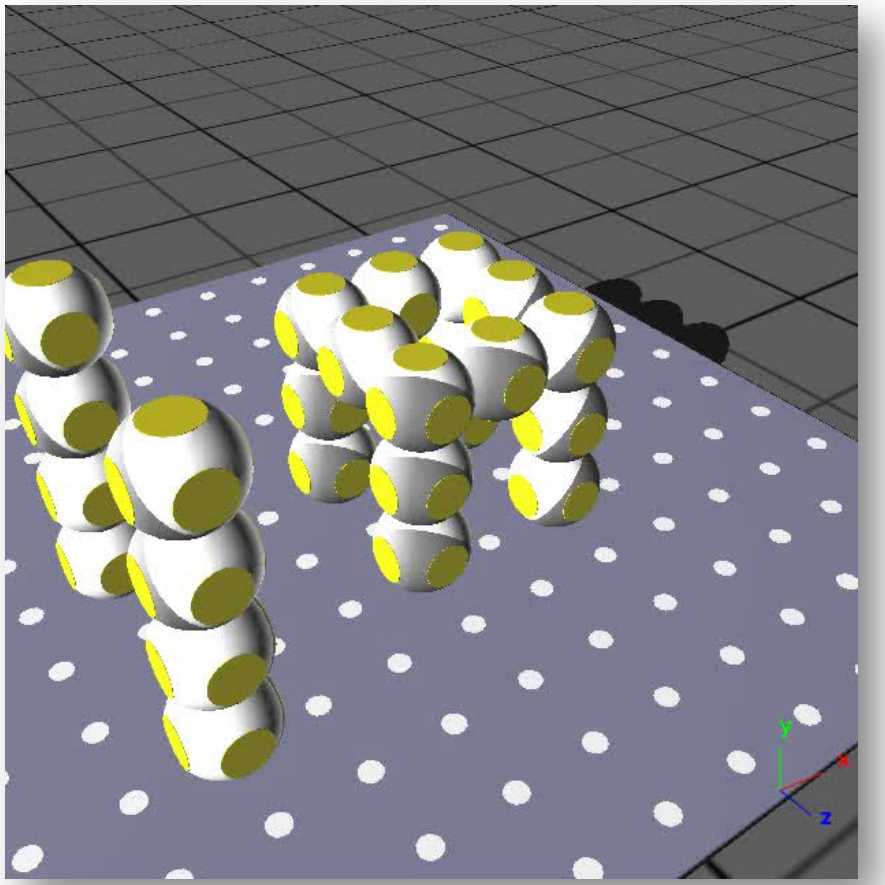
A.N. Other, B.N. Other (eds.), Title of Book, 00-00.





Andrea Mazzei, Youri Marko, Tabea Koll

EPFL Rolex Learning Center

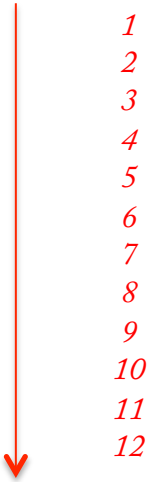


Roombot

Ranger

Julia Fink, Auke Ijspeert, Stéphane Bonardi, Francesco Mondada

Gadgets that 'work well' = *dbr* (5,20)

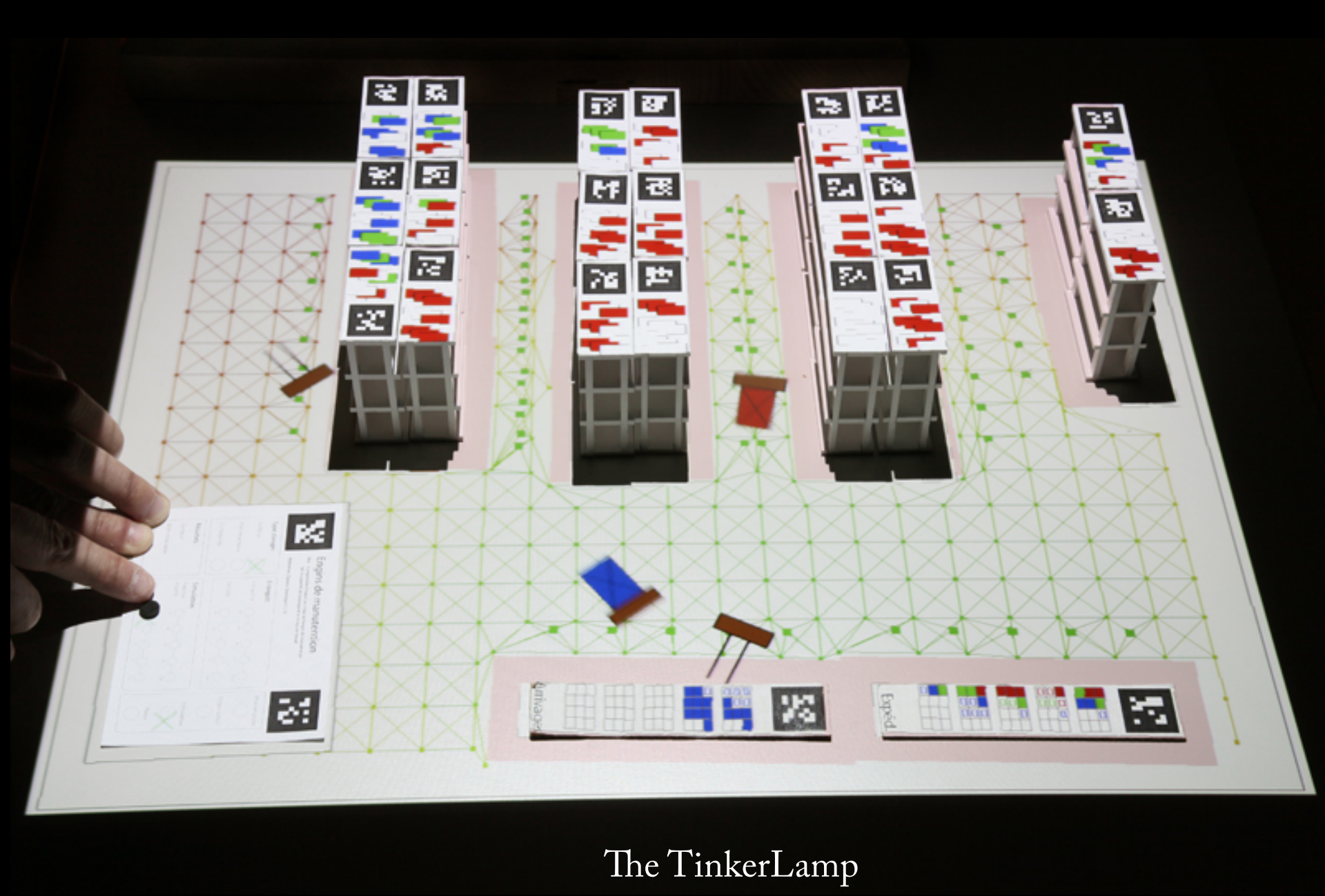


orchestration load = *f* (design)

~~orchestration~~ *schmountz*

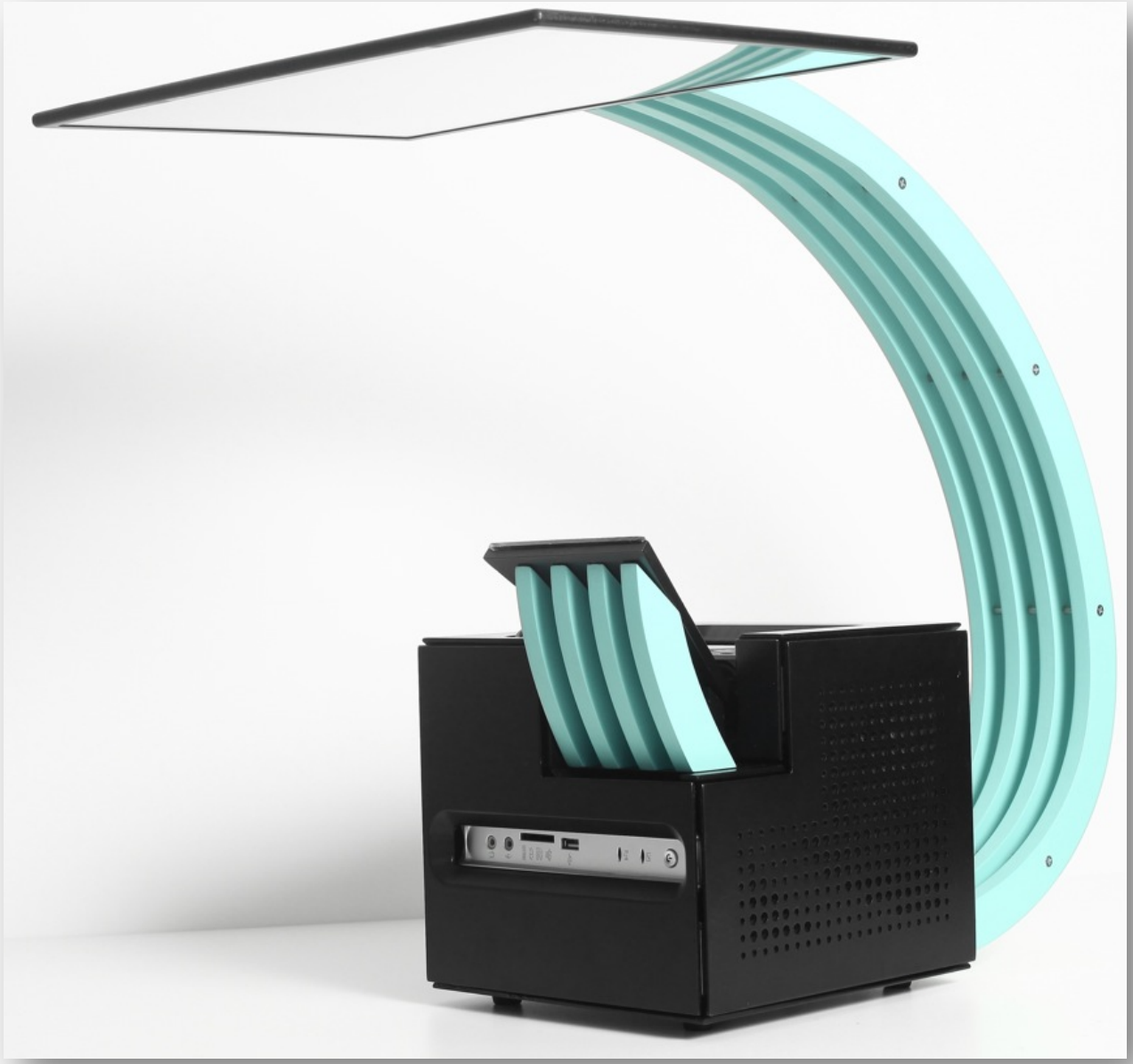
Vocational education : Dual system : Logistics assistants (warehouse)


KOSMOS
KOSMOS
KAEFER-ROBOTER
ART. NR. 658014
INHALT: 5 STK.
MADE IN CHINA
KOSMOS
GEHEIM-PERISKOP
ART. NR. 658618
INHALT: 5 STK.
MADE IN CHINA
Geheim-Periskop
Elektro-Krokodil
Roboter Käfer

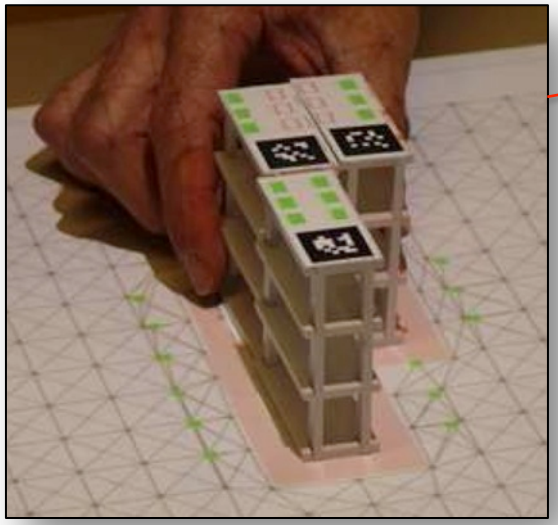


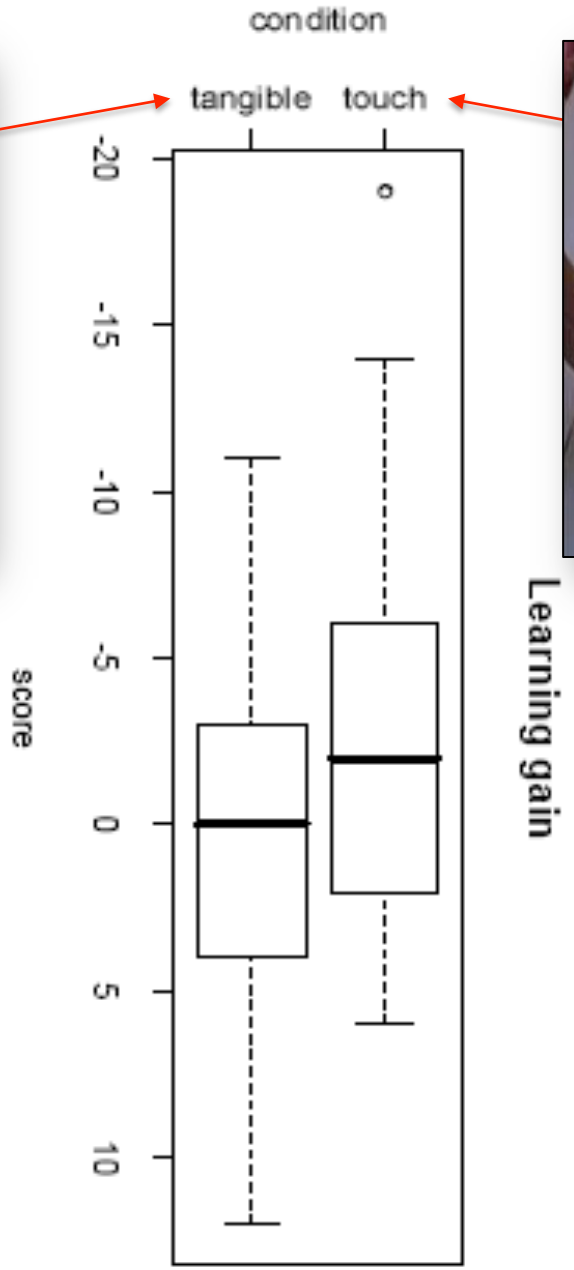
The TinkerLamp

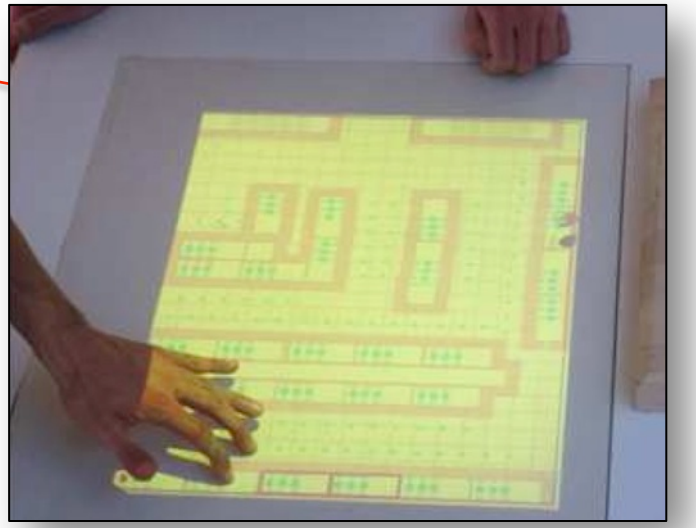
Guillaume Zufferey, Patrick Jermann




Simpliquity







Learning gain

$F(1,37) = 6.68, p < .05$

Gerbeur

20 étages

20 mini

SB = 288 m²

SBST = 244 m²

Degré d'utilisation 84%

S1 = 50 m²

Degré 2 : 17%

Degré 3 : 20%

surface brut de stockage : 240 m²

degré d'utilisation (1) : 83%

surface net de stockage : 68 m²

20 mini

surface net de stockage / brut = 23%

net de stockage / brut de stockage = 28%

Contre poids

22 ch. = 45 m² 15 étage.

14 m 40

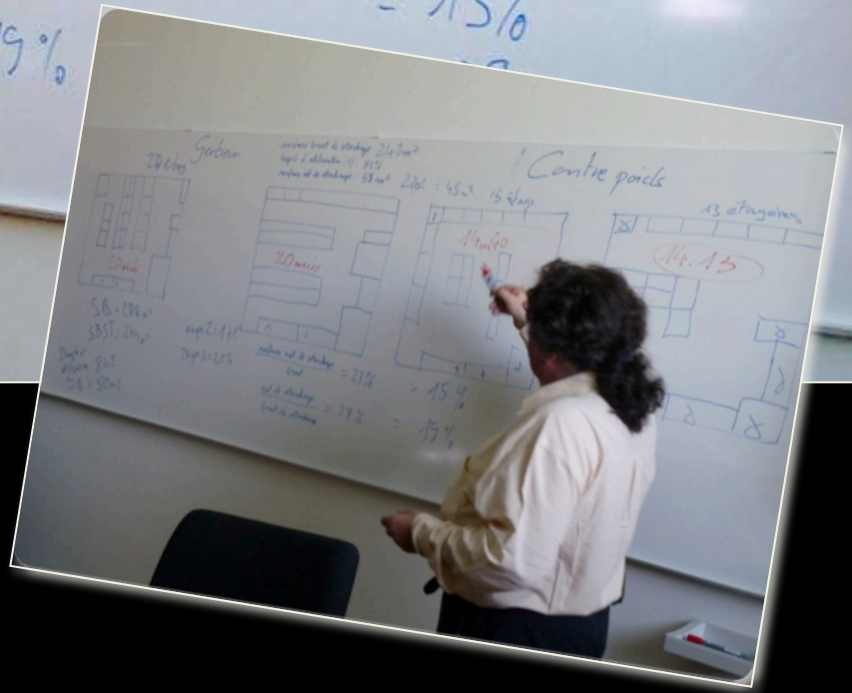
= 15 %

= 19 %

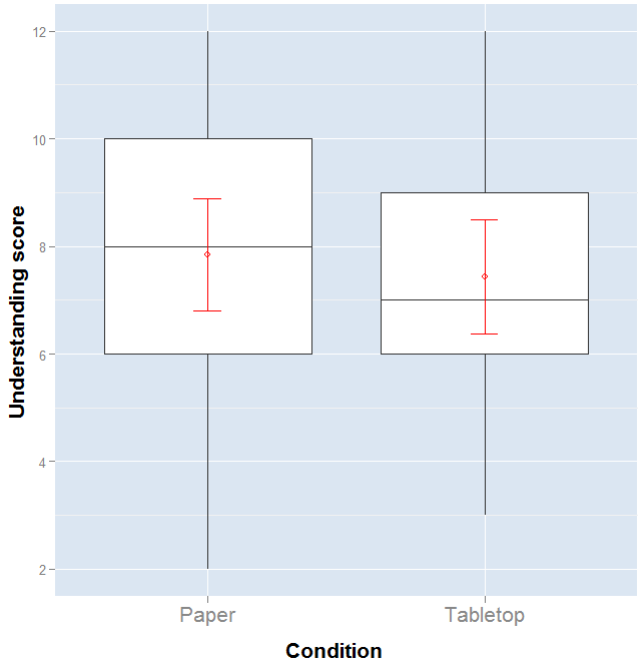
13 étages

14.13

= 13%

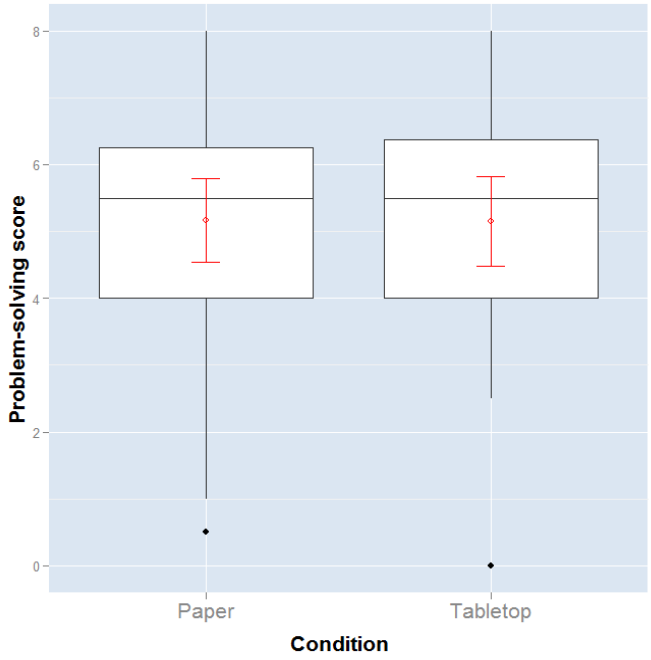


No sign. effect in understanding



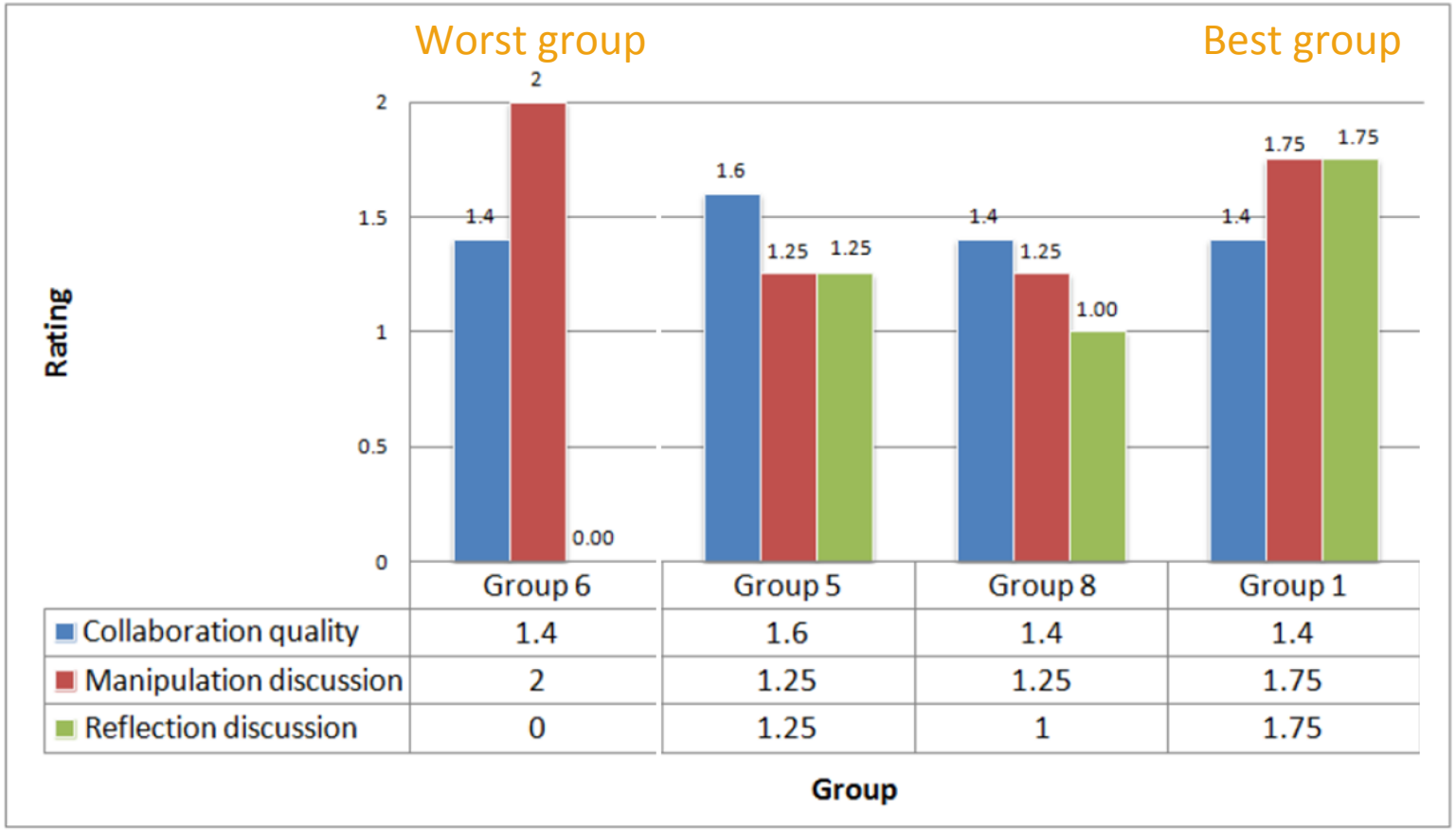
mean = 7.84 vs. mean = 7.43
F(1,14) = .25; p > .05

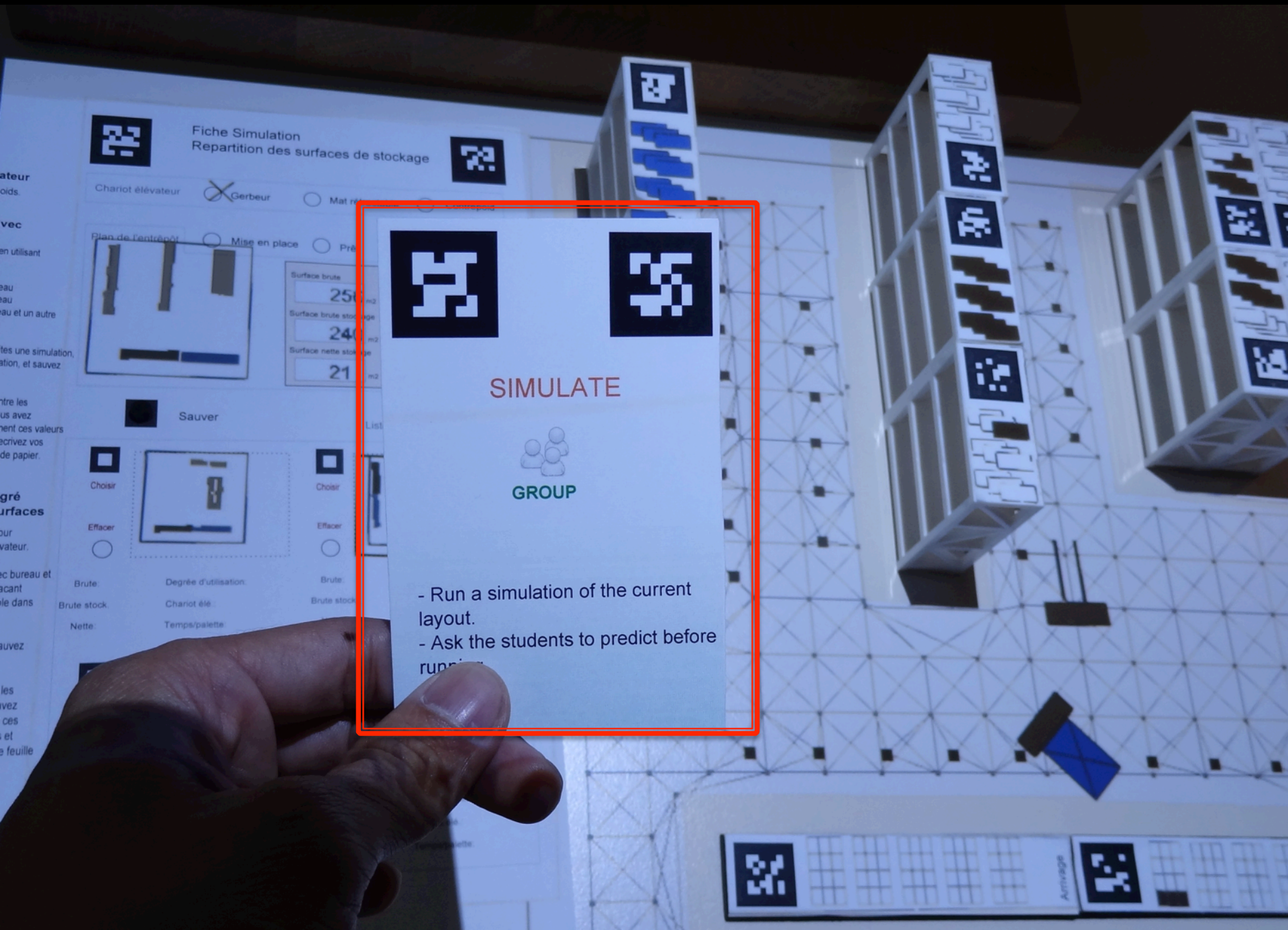
No sign. effect in problem-solving

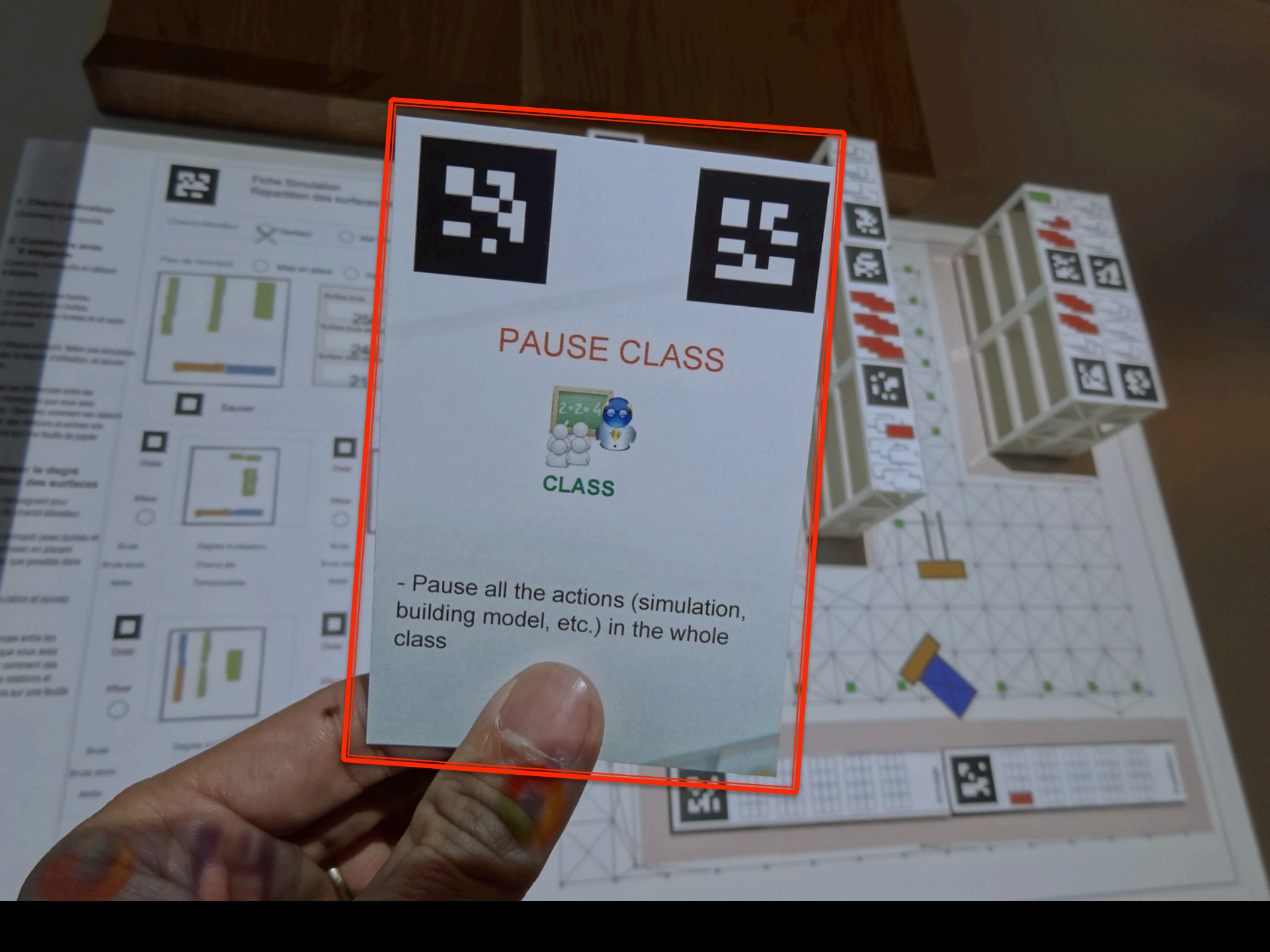


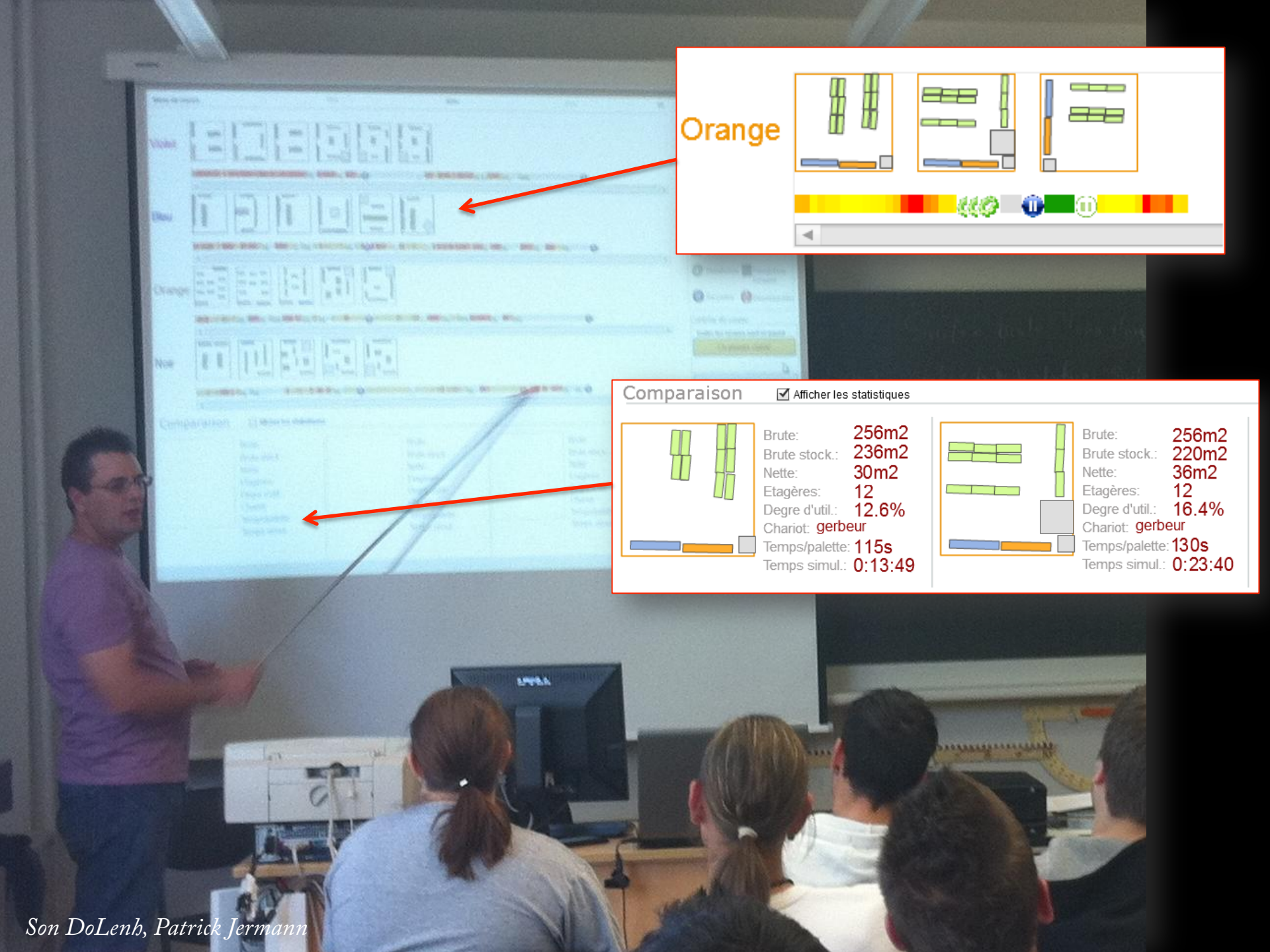
mean = 5.16 vs. mean = 5.15
F(1,14)=.06, p>.05

“Manipulation temptation”!




Fiche Simulation
Repartition des surfaces de stockage
Chariot élévateur
Gerbeur
Mise en place
Surface brute
Surface nette stockage
Sauver
Choisir
Effacer
Brute:
Brute stock:
Nette:
Degrée d'utilisation:
Chariot élé:
Temps/palette:
SIMULATE
GROUP
- Run a simulation of the current layout.
- Ask the students to predict before

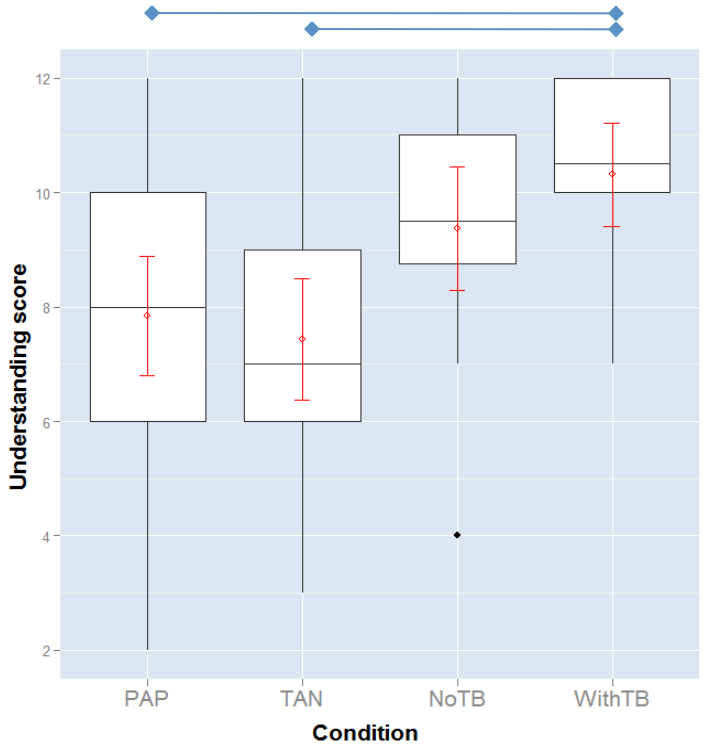

PAUSE CLASS
CLASS
- Pause all the actions (simulation, building model, etc.) in the whole class



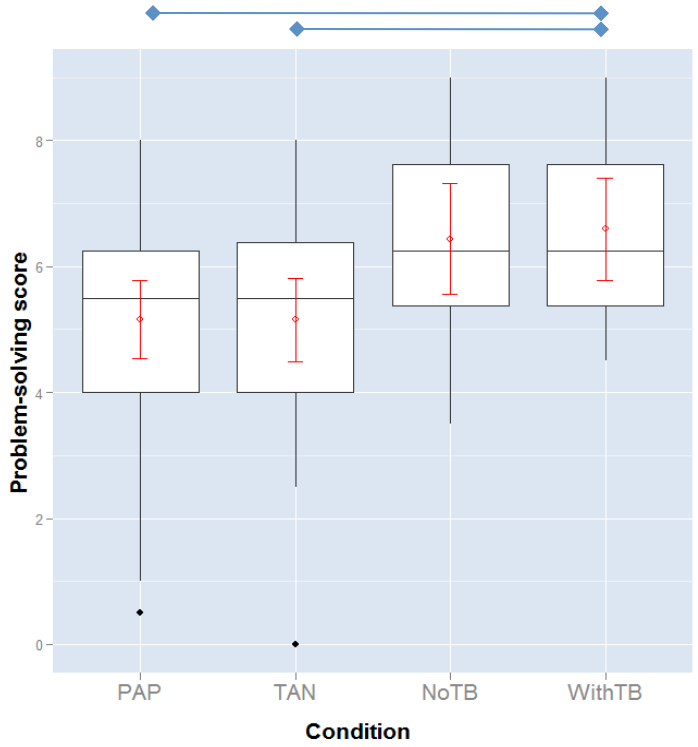
Son DoLenh, Patrick Jermann

Post-test

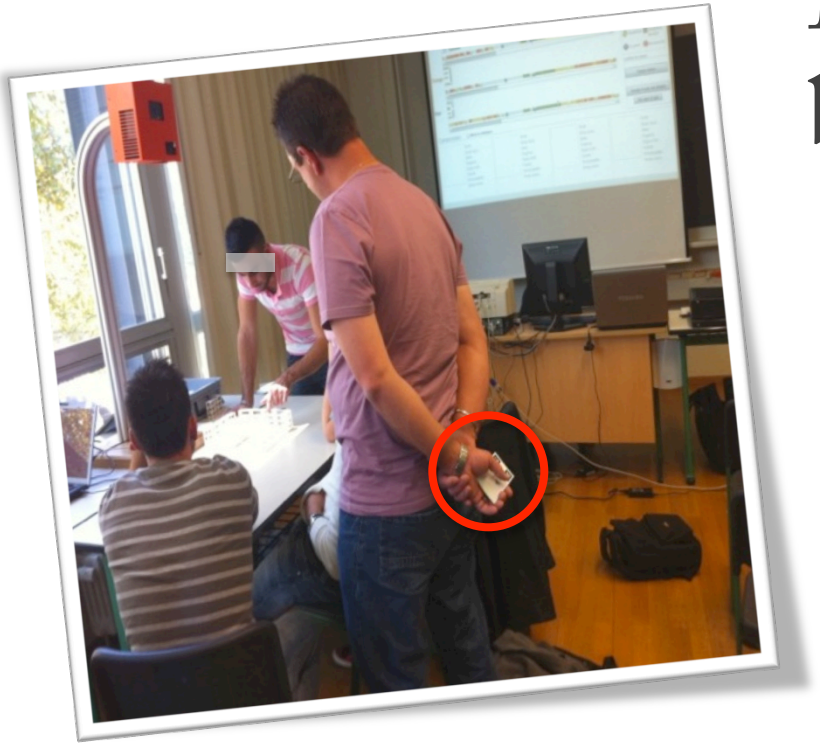
Sign. effect in understanding



Sign. effect in problem-solving

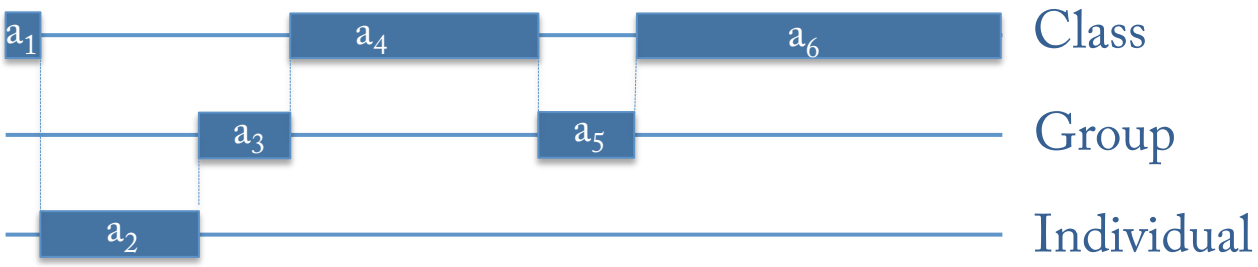


Measures	Warehouse study's conditions		Evaluation of TinkerLamp 2.0 conditions	
	Paper/pen	TinkerLamp 1.0	TinkerLamp 2.0 WithTinkerBoard	TinkerLamp 2.0 NoTinkerBoard
Understanding score	7.84(2.85)	7.43(2.82)	9.38(2.03)	10.31(1.70)
Problem-solving score	5.16(1.70)	5.15(1.78)	6.44(1.65)	6.59(1.53)



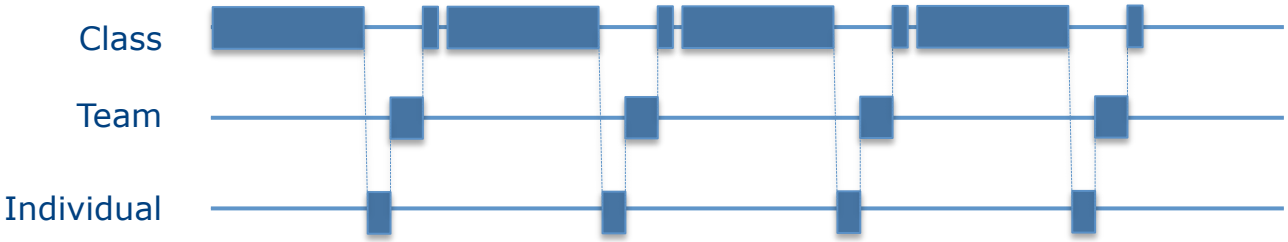
Merci DBR,
but why does it work ?

[Step 1] A simple notation…

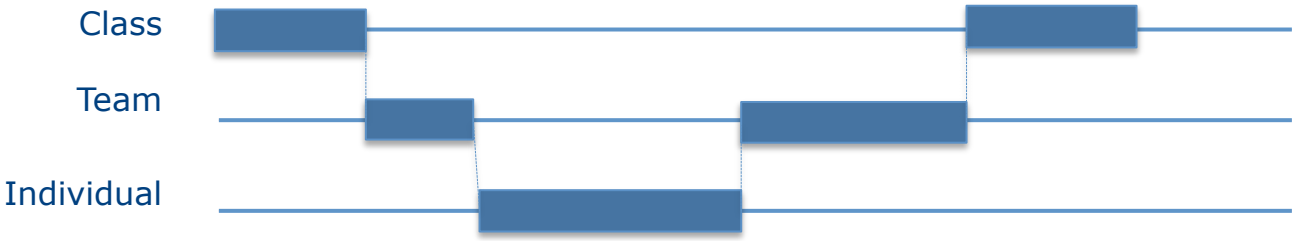


Orchestration is the real-time management of multi-plane multi-layer activity graphs
that maximize constraints satisfaction and minimize entropy

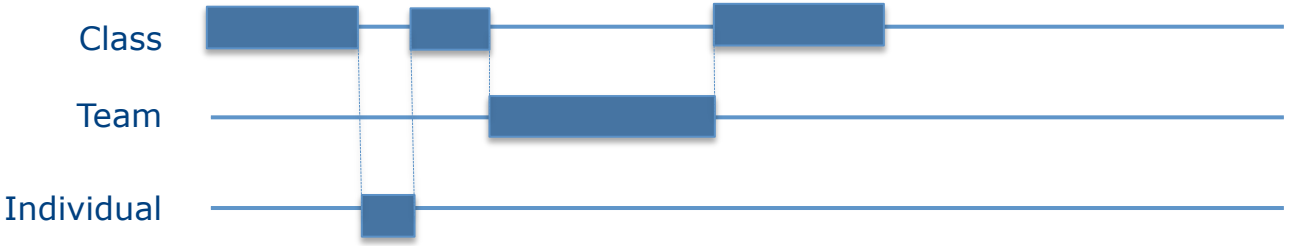
Standard lecture



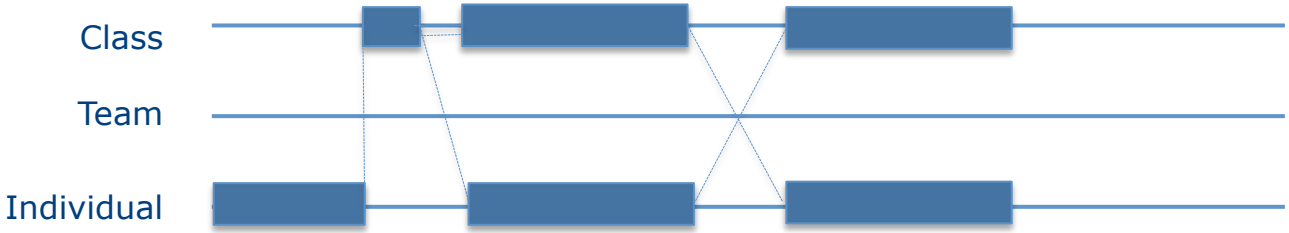
Ckiclers+ Lecture
(Mazur's PeerTutoring)



PBL



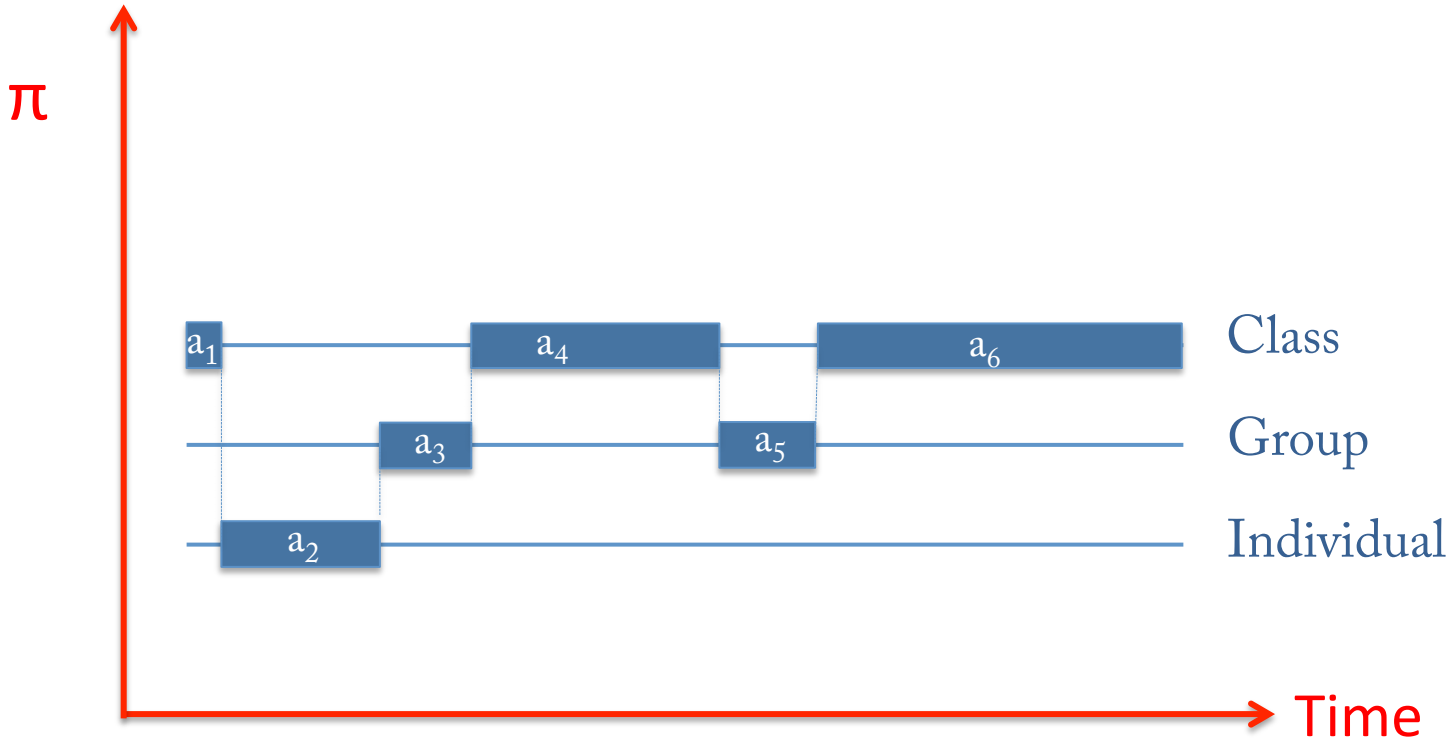
Discovery learning
(Gijlers & de Jong)

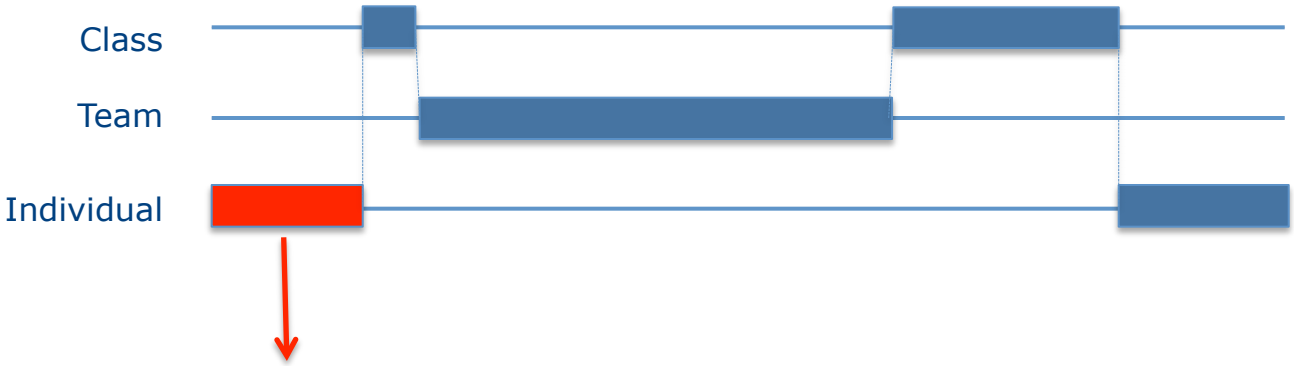


Sub-classes

[Step 1] An integrated learning scenario can be modeled as a directed graph :

- vertices are learning activities a_i (…)
- edges represent dataflow (…)
- embedded on π x t (…)





Question 1

Question: *In large city marathons, should drug testing be applied to participants that finish two hours after the winner?*

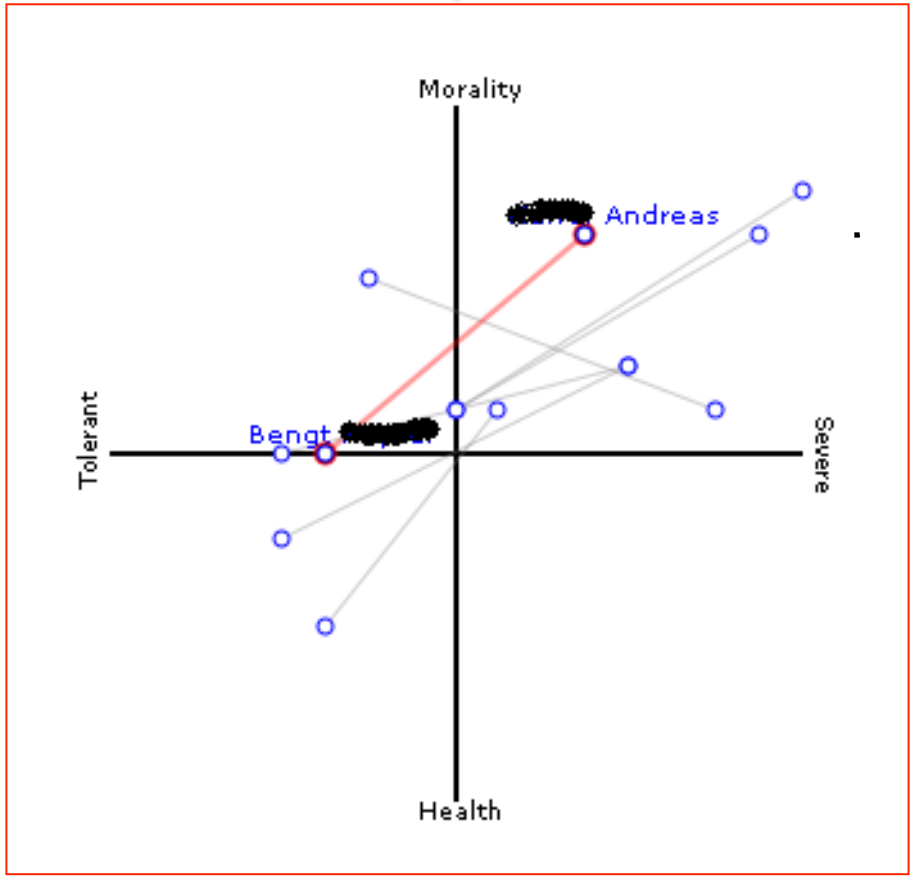
Answer:

- ○ Yes, because cheating should always be punished
- ○ Yes, because any runner taking drugs damages her health
- ○ No, because they run for themselves, not for rankings
- ◉ No, because people have also the right to smoke and to drink alcohol

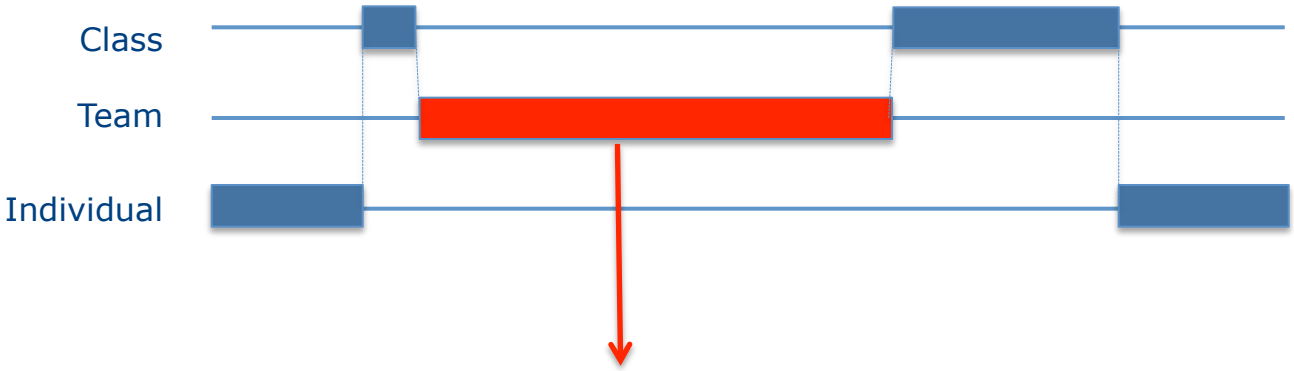
Enter your arguments: I believe in individual freedom

ArgueGraph


Class
Team
Individual


Morality
Andreas
Tolerant
Severe
Health

ArgueGraph



Question 1 :

Question: *In large city marathons, should drug testing be applied to participants that finish two hours after the winner?*

Answer:

- ○ Yes, because cheating should always be punished
- ○ Yes, because any runner taking drugs damages her health
- H ○ No, because they run for themselves, not for rankings
- B ◉ No, because people have also the right to smoke and to drink alcohol

Bengt [redacted]	Harrer [redacted]
None	For the people that are not relevant for the result lists, it's their own responsibility if they risk damage to their health. Yet, still they are cheating the other clean runners. To require a test from every amateur (while

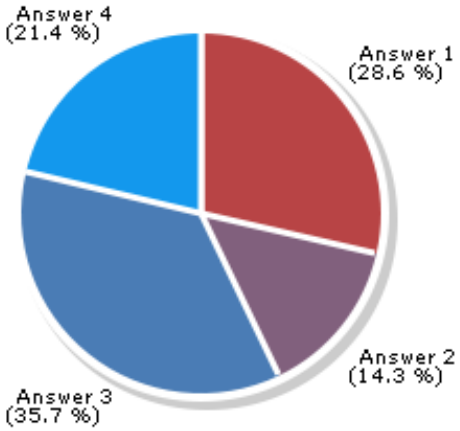
Enter your arguments:

We consider self-responsibilty an important quality for sportlers. Yet, it does not apply to participants getting prize or medals.

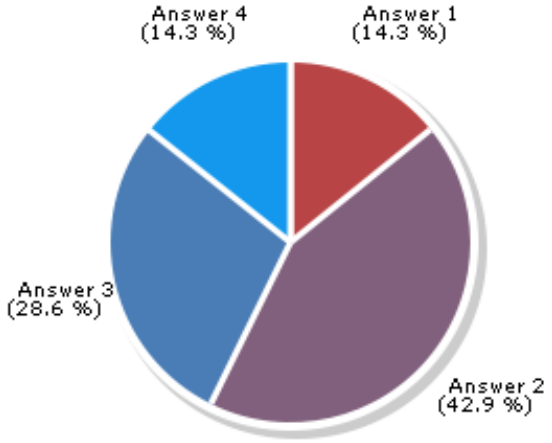
Question: In large city marathons, should drug testing be applied to participants that finish two hours after the winner?

Possible answers:
1) Yes, because cheating should always be punished
2) Yes, because any runner taking drugs damages her health
3) No, because they run for themselves, not for rankings
4) No, because people have also the right to smoke and to drink alcohol

Solo Block



Duo Block



ArgueGraph

ArgueGraph

Question 1 : *In large city marathons, should drug testing be applied to participants that finish two hours after the winner?*

Your answer and synthesis of known arguments :

Reminder

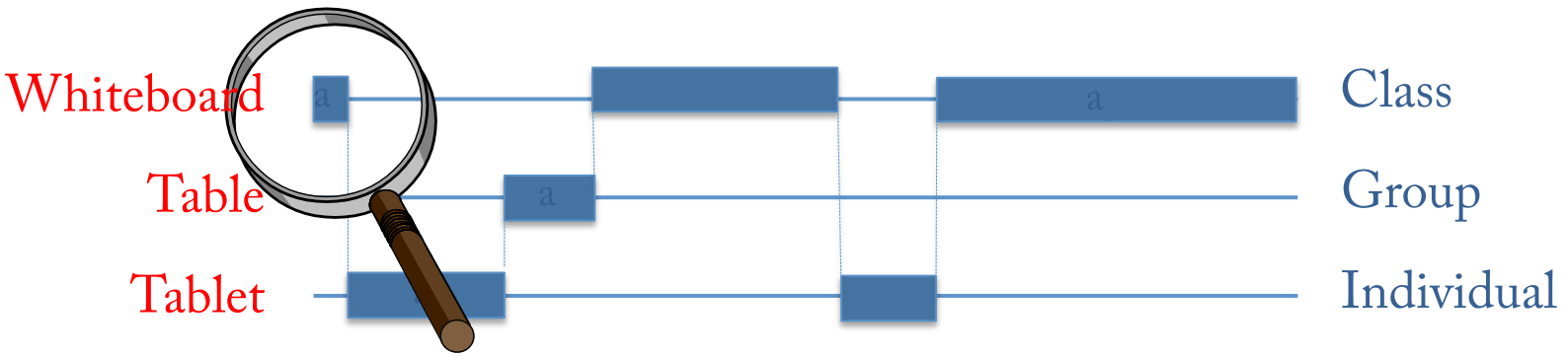
Individual :

Your arguments :

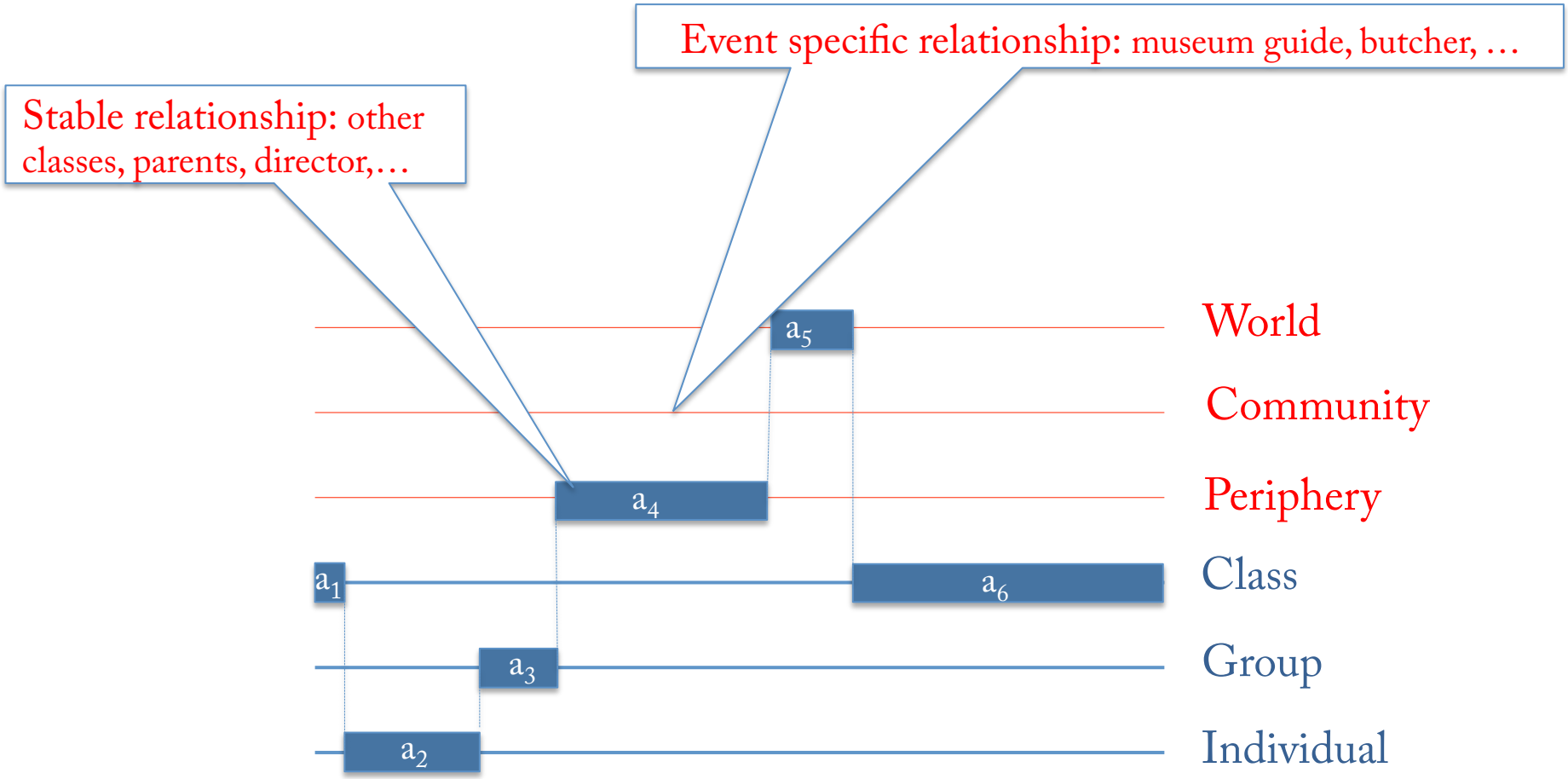
None

Individual arguments of students :

- No one would ever make the effort to run a marathon without being on drugs. *from* [redacted] *Nils*
- Someone who is two hours late this time could be the winner next time and the run before; in addition, it does not exclude drug use *from Frank* [redacted]
- For the people that are not relevant for the result lists, it's their own responsibility if they risk damage to their health. Yet, still they are cheating the other clean runners. To require a test from every amateur (while probably almost all of them are clean) would setup a system of total control and non-trust. *from* [redacted] *Andreas*
- Cheating should always be punished but in particular when it is useless. *from Pierre* [redacted]
- Even though a person runs a marathon for herself, she should be in favor of banning the use of drugs and willingly take the test *from Pantelis* [redacted]
- You should make sure that the winners do not use drugs. No need to test the loosers who are rather running for themselves. *from Armin* [redacted]

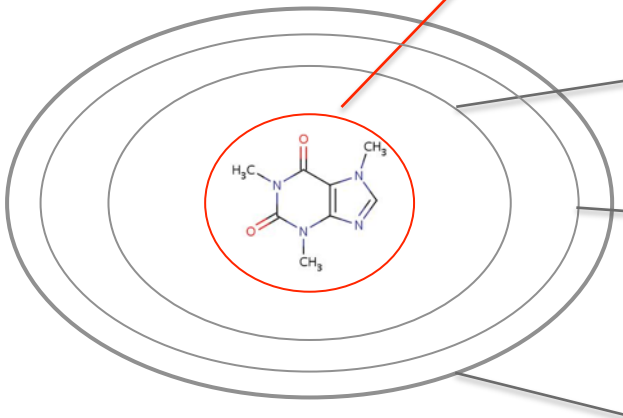


Pedagogical integration + Technological integration



pedagogical + technological integration

[Step 2] How to package Alzheimer pills ?



active substance (pharmaceutics)

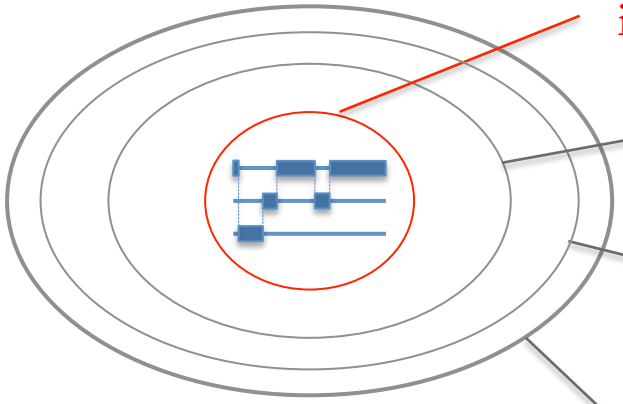
excipients

dosage form

packaging

Anziadherents
Binders
Coatings
Disintegrants
Fillers
Flavours
Lubricants
Glidants
Sorbents
Preservatives
Sweeteners

Oral
Pill, tablet, or capsule
Specialty tablet like buccal, sub-lingual, or orally-disintegrating
Thin film (e.g. Listerine Pocketpaks)
Liquid solution or suspension (e.g., drink or syrup)
Powder or liquid or solid crystals
Natural or herbal plant, seed, or food of sorts (e.g., marijuana such as that found in "special brownies")
Paste (Colgate)
Inhalational
Aerosol
Inhaler
Nebulizer
Smoking (often in natural herb (e.g., tobacco, marijuana) or freebase powder form (e.g., cocaine, methamphetamine))
Vaporizer (usually to vaporize natural herbs like marijuana)
Parenteral Injection
Intradermal (ID)
Intramuscular (IM)
Intraosseous (IO)
Intraperitoneal (IP)
Intravenous (IV)
Subcutaneous (SC)
Intrathecal (IT) injection into the spinal column
Topical
Cream, gel, liniment or balm, lotion, or ointment
Ear drops (otic)
Eye drops (ophthalmic)
Skin patch (transdermal)

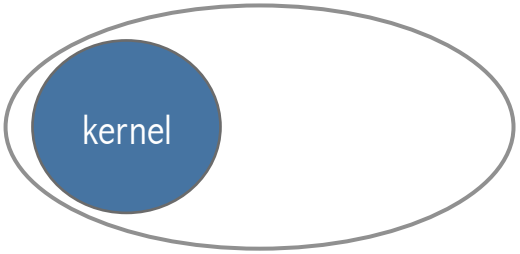


instructional design (learning theory)

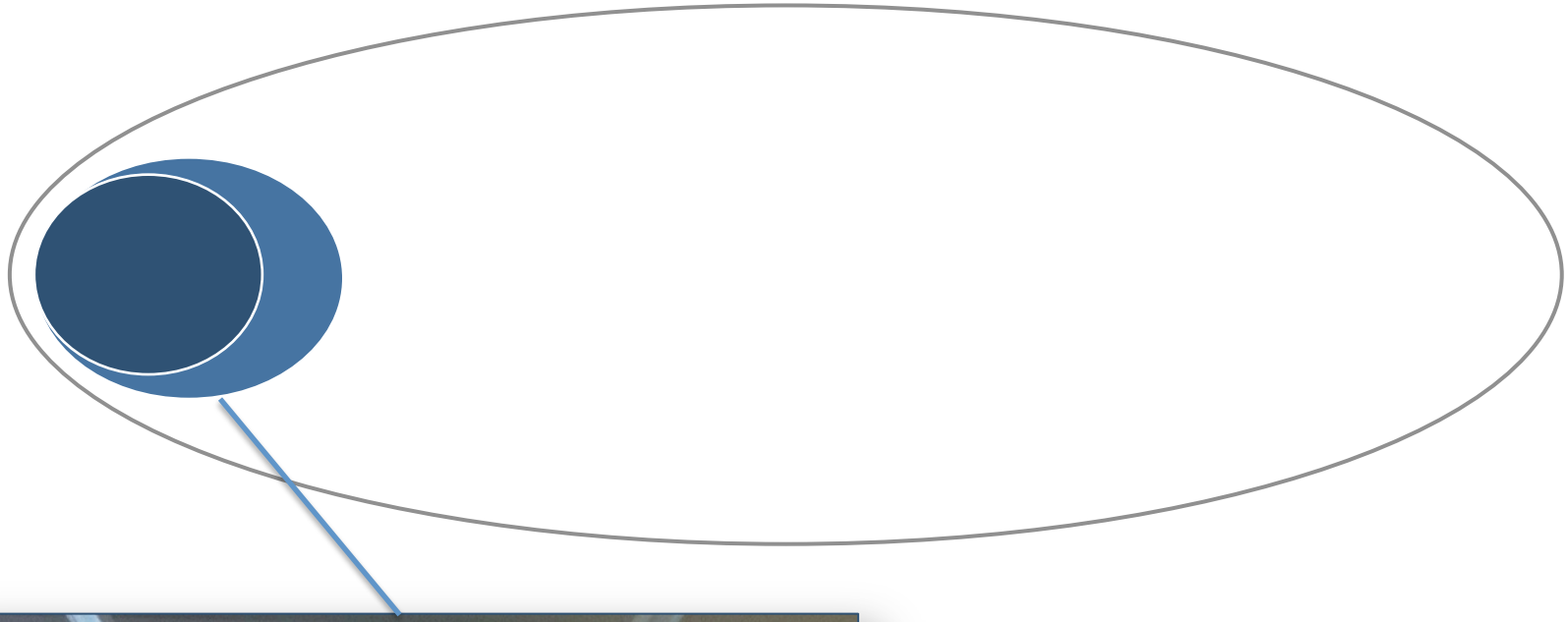
?

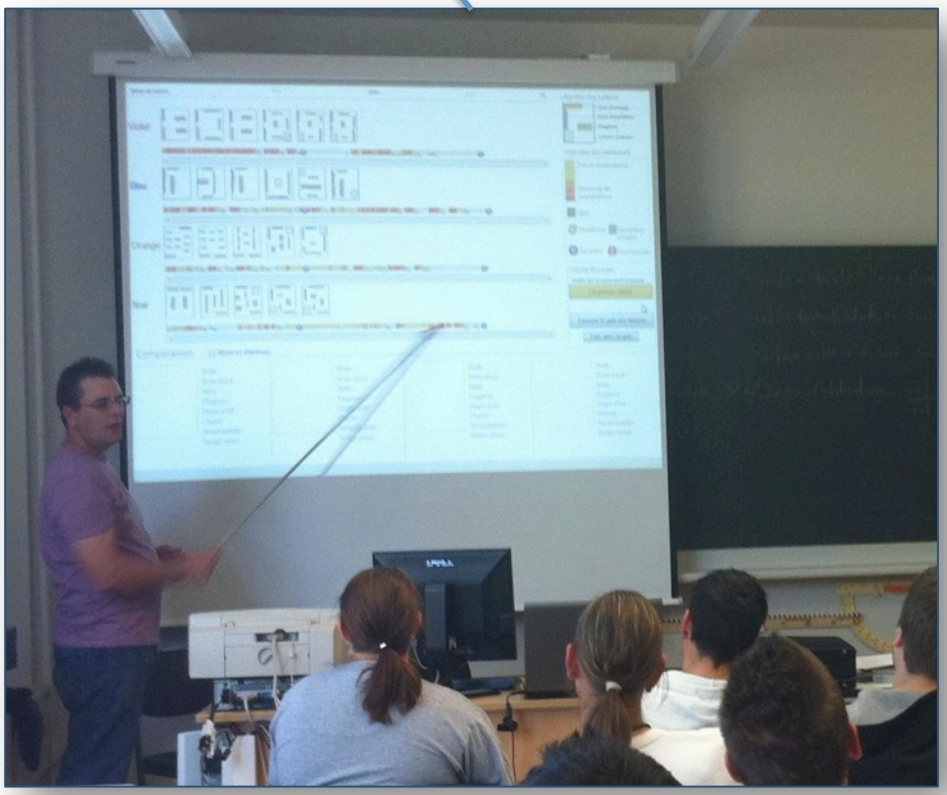
?

?



[Step 2] Kernel activities ● are designed from learning theories while orchestration also covers other activities ◯ , less directly related to instructional design, but should nonetheless be technically integrated.



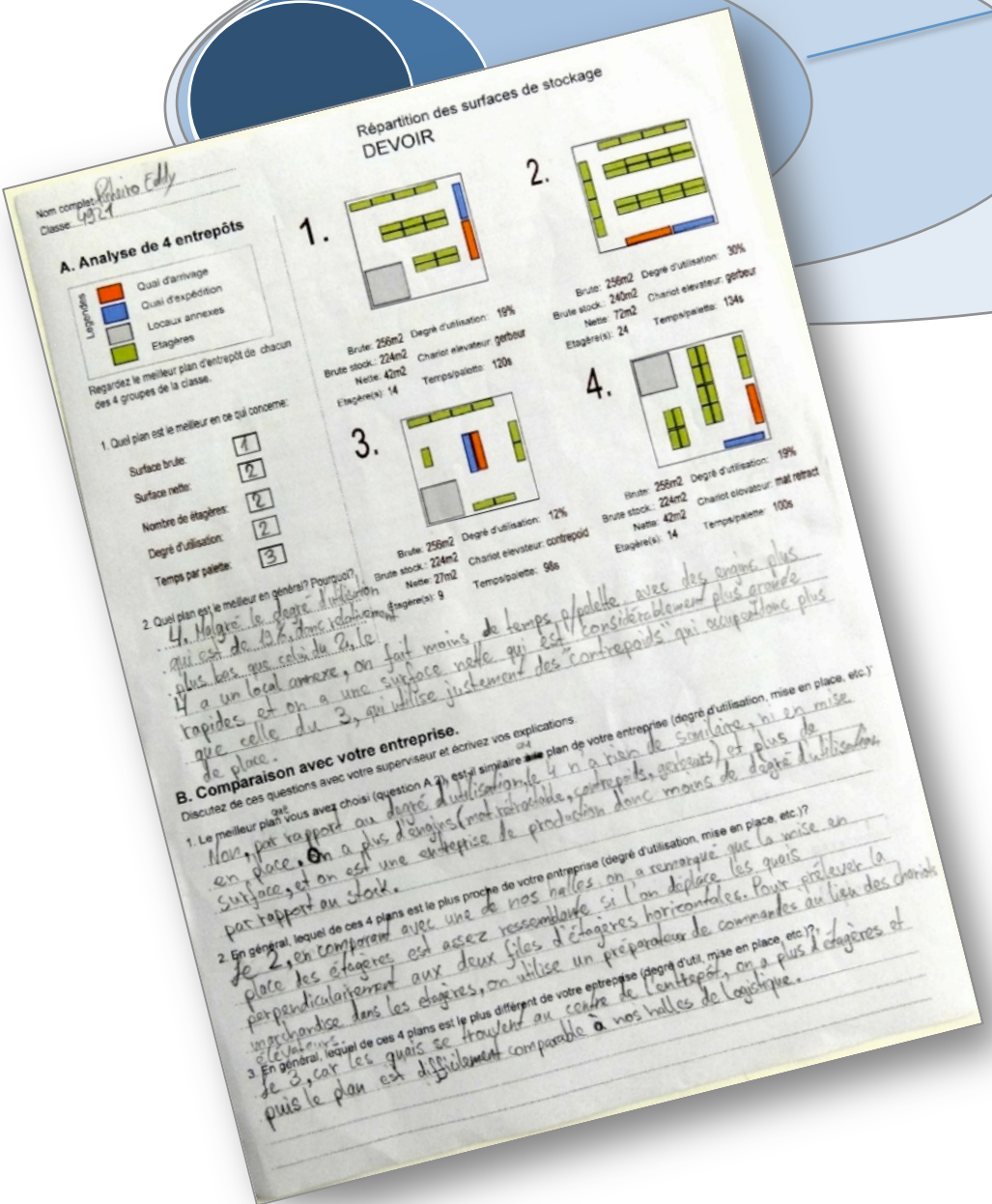


Debriefing activities
(designed but undetermined)

re-visit

homework

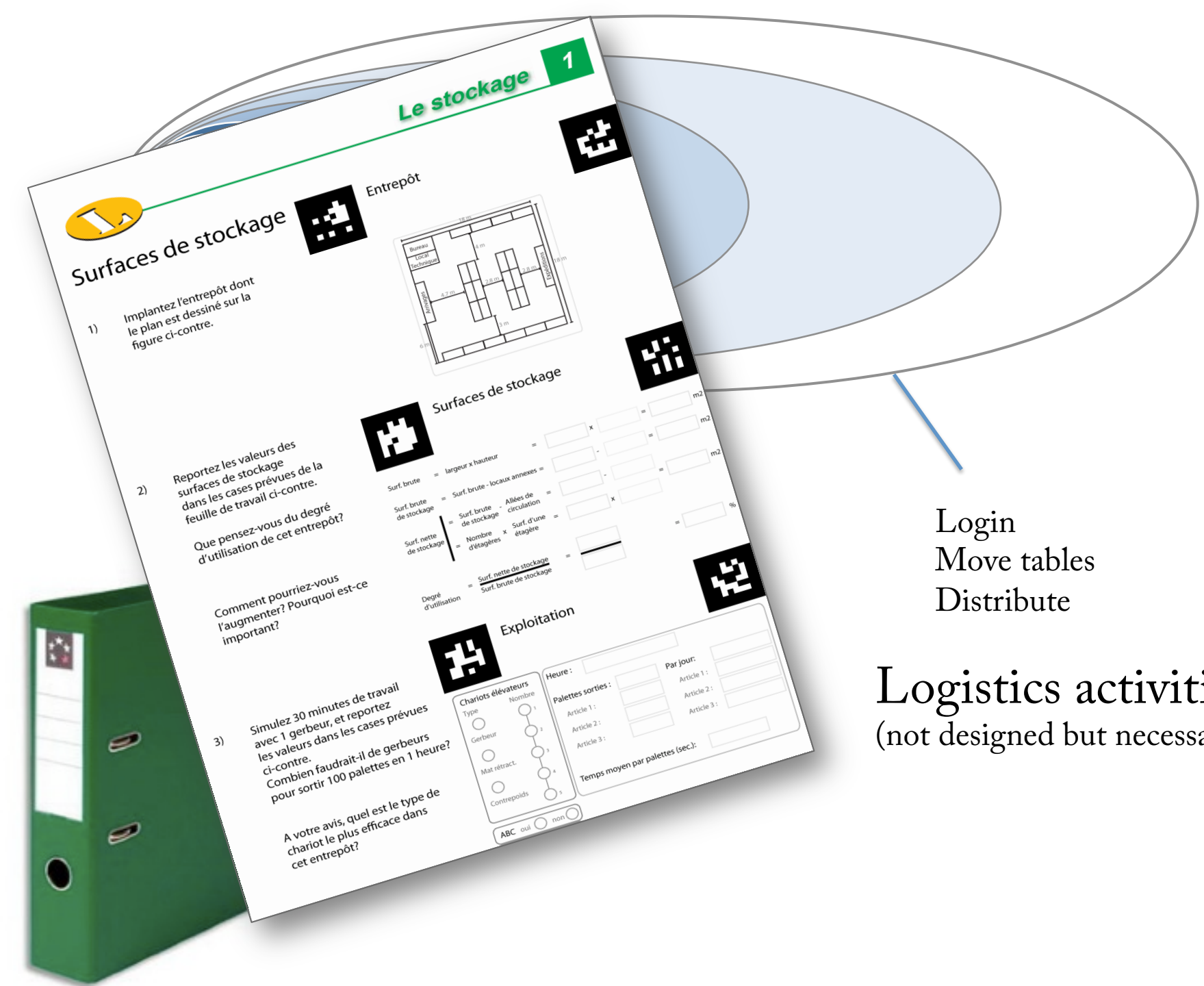
copy


Répartition des surfaces de stockage
DEVOIR
A. Analyse de 4 entrepôts
B. Comparaison avec votre entreprise.

School Routines

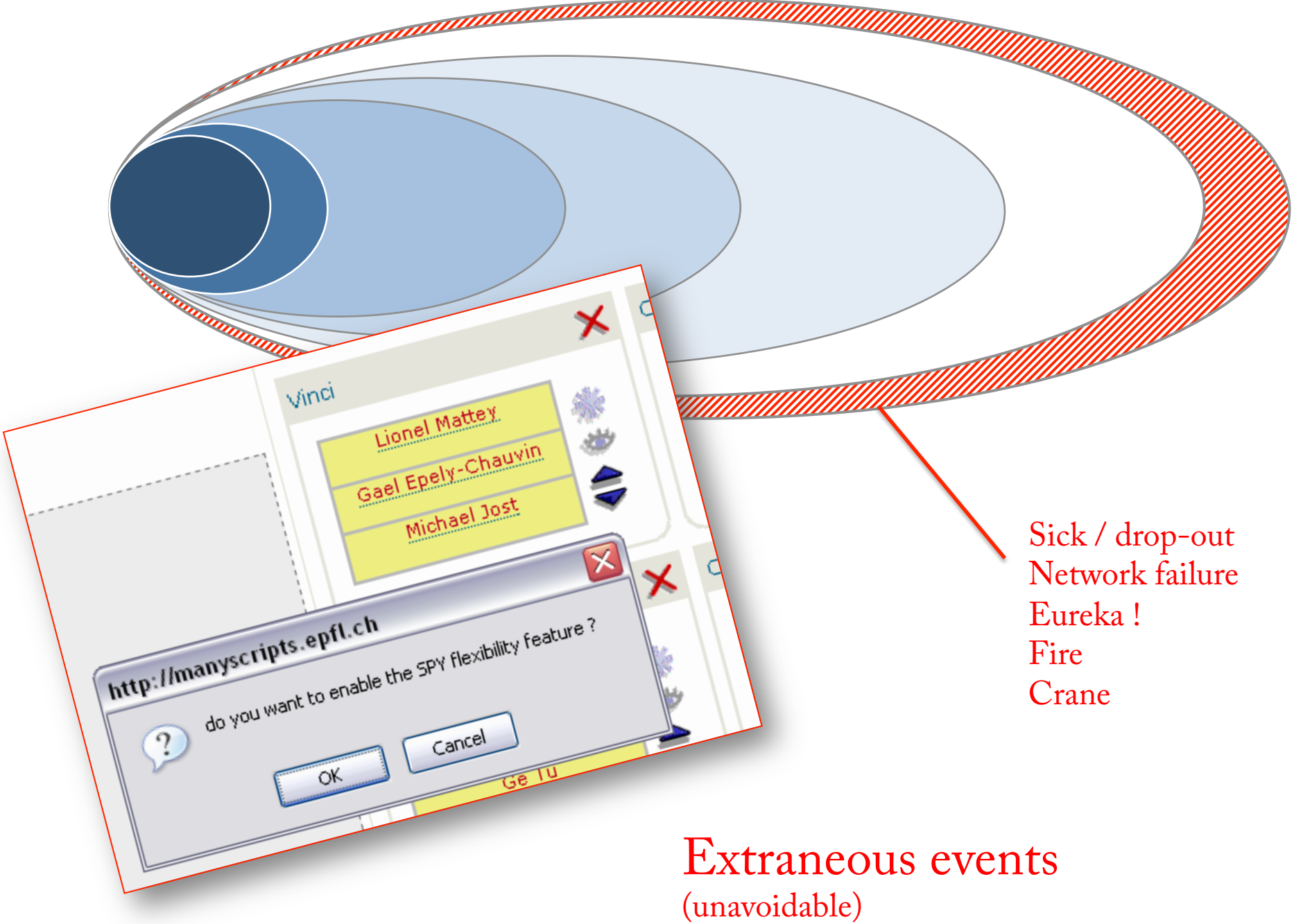
(non designed, fill the time)

- 90% (54/60) done
- 82% discussed with supervisor



Login
Move tables
Distribute

Logistics activities
(not designed but necessary)

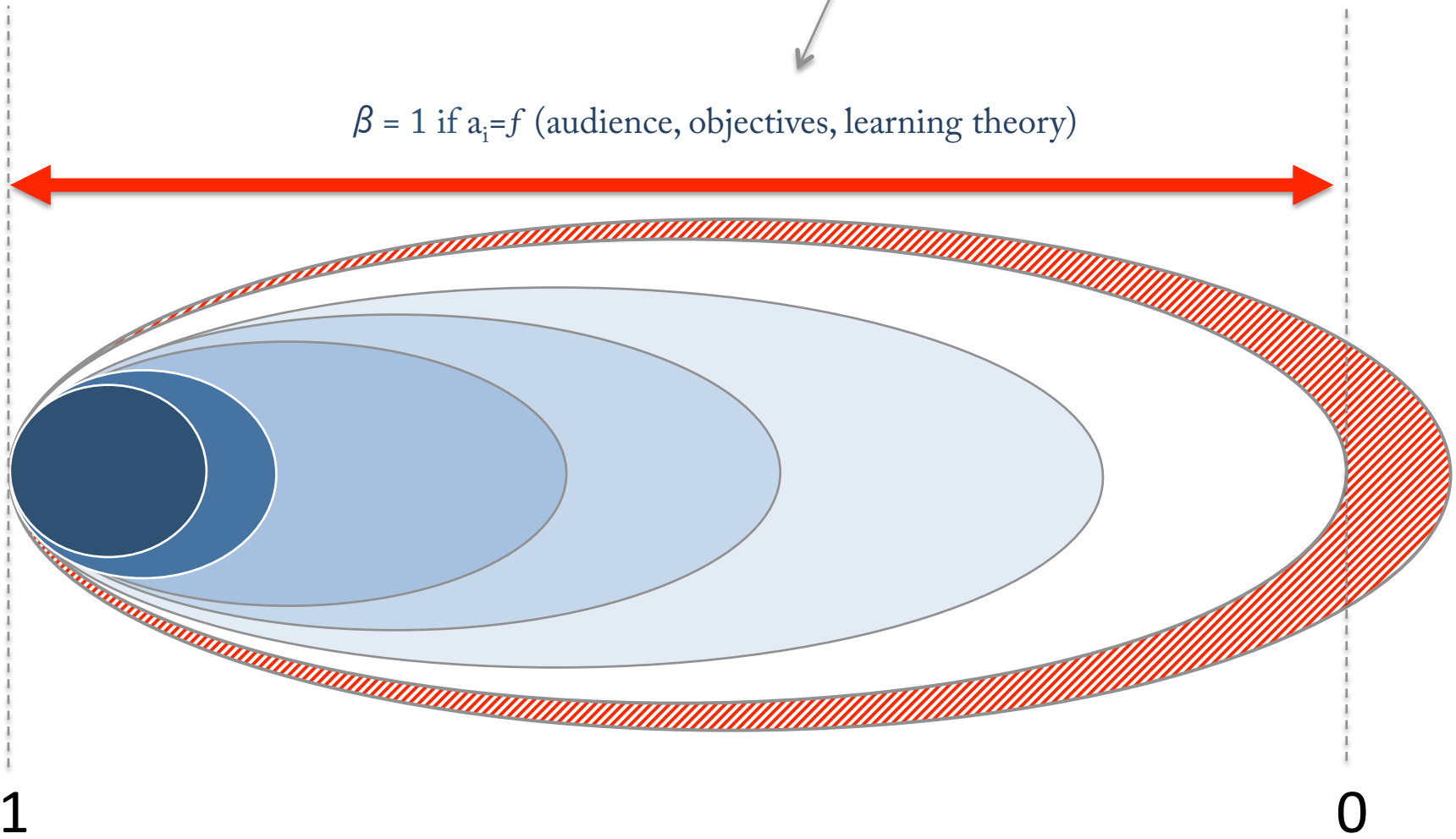


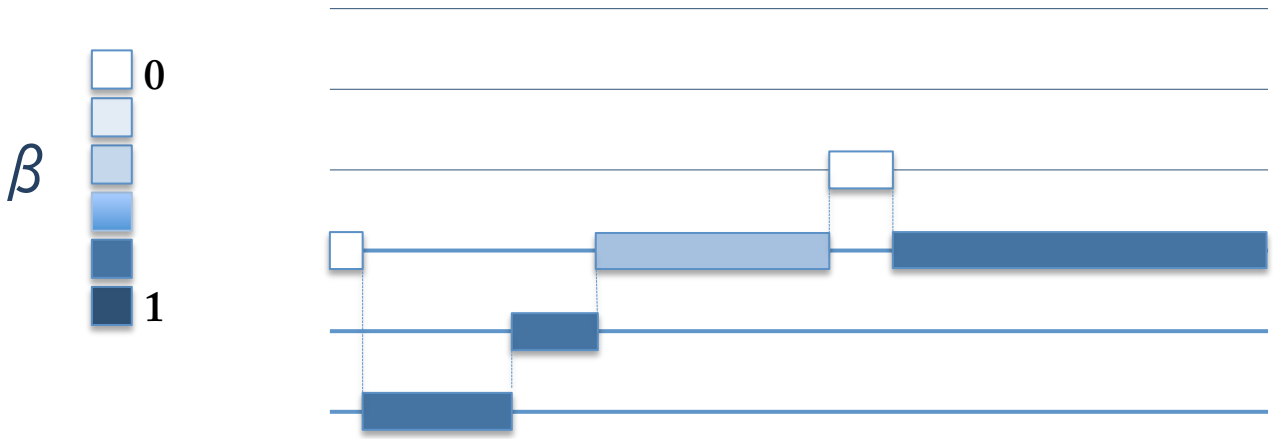
Sick / drop-out
Network failure
Eureka !
Fire
Crane

Extraneous events
(unavoidable)

[Step 2] Kernel activities are designed from learning theories while orchestration also covers other activities, less directly related to instructional design.

'βloominess'

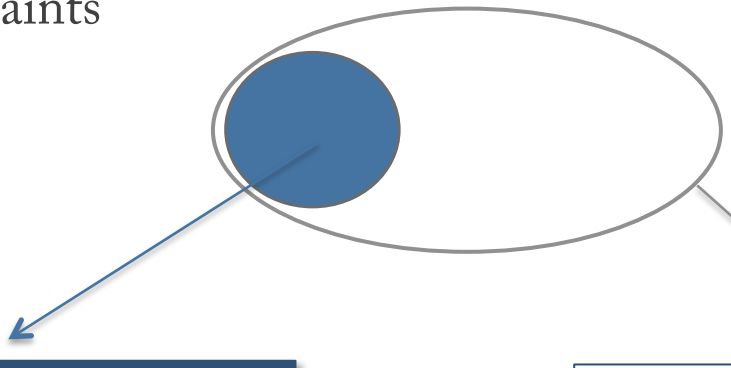




$a_i : (\pi, t, \beta,$ *input, output*, tools, resources, instructions, …*$)$

IMS-LD

[Step 3] The activity graph must satisfy intrinsic as well as multiple extrinsic constraints



Intrinsic constraints

- Students' profiles
- Domain epistemology
- How people learn
- Curriculum relevance

Extrinsic constraints

- Time budget (t)
- Time segmentation
- Resources
- Control
- Space
- Costs
- Producing grades
- leaving traces
- Safety
- Teacher's energy
- Teacher's self-image
- School culture
- ….

Extrinsic constraints

- Time budget (t)
- Time segmentation
- Control
- Resources
- Space
- Costs
- Producing grades
- Leaving traces
- Safety
- Teacher's energy
- Teacher's self-image
- School culture
- ….

Groups Progression

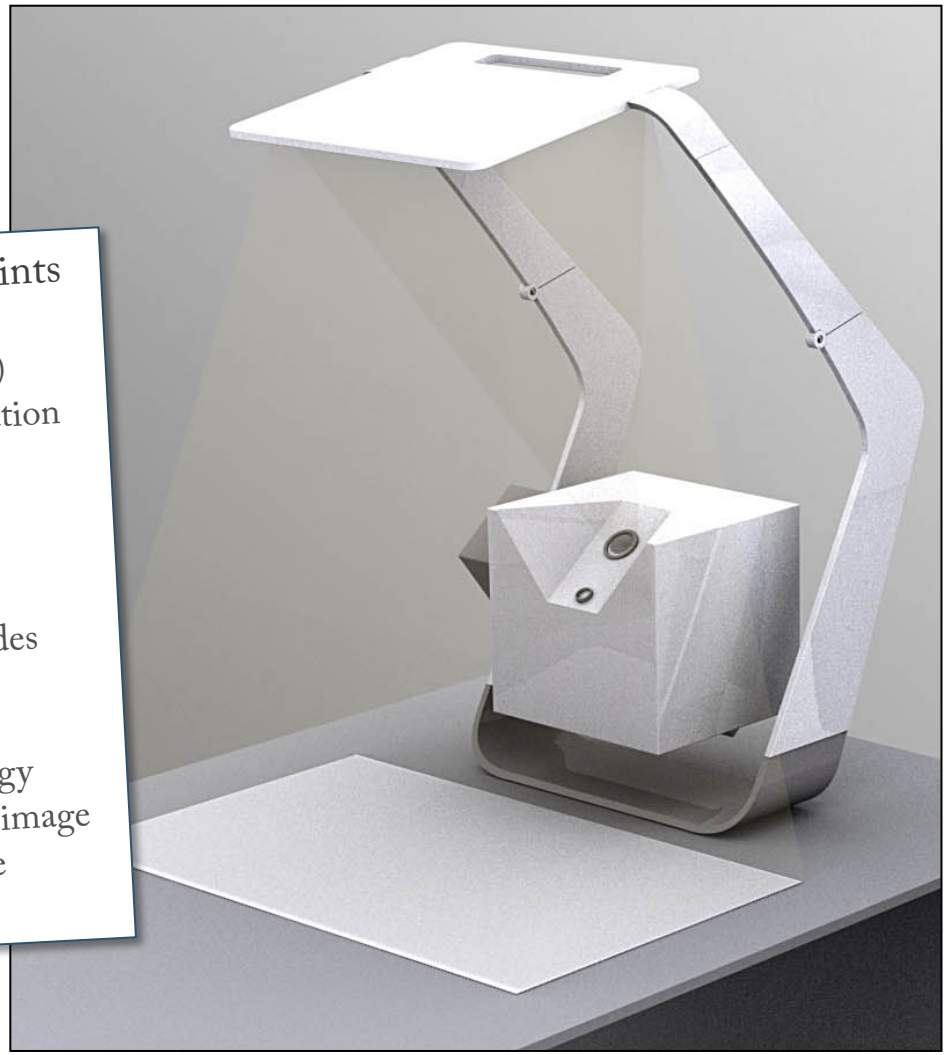
Students answers:

Name	Questions	~Words per questions
Armin [redacted]	(4/4)	22
Frank [redacted]	(4/4)	24
Bengt [redacted]	(4/4)	0
Pierre [redacted]	(4/4)	11

ByPass

Extrinsic constraints

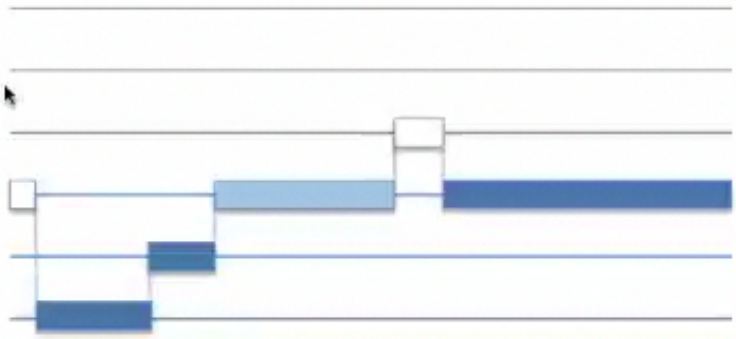
- Time budget (t)
- Time segmentation
- Control
- Resources
- Space
- Costs
- Producing grades
- Leaving traces
- Safety
- Teacher's energy
- Teacher's self-image
- School culture
- ….



D' Esposito & Gaillard

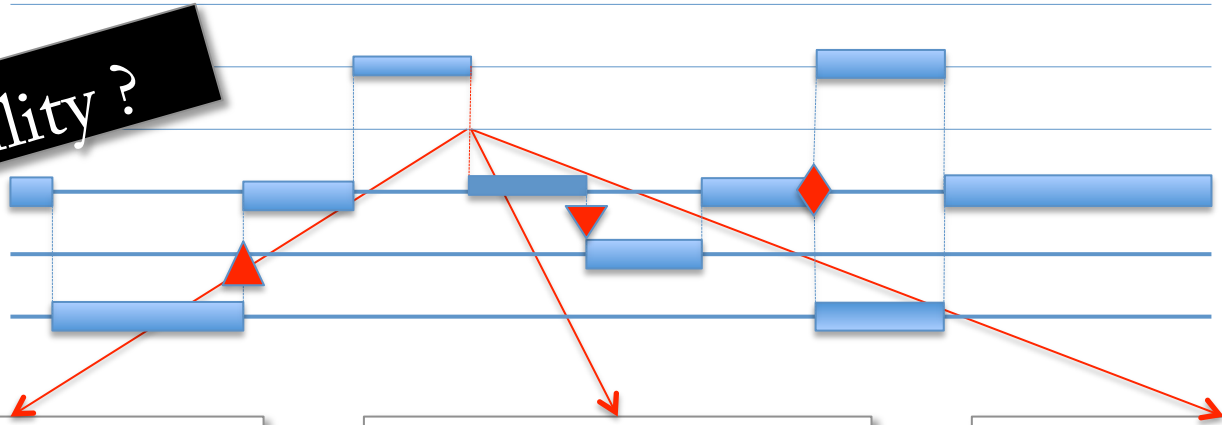
Y. Guibinelli

[Step 4] The activity graph must be permanently adapted to learners' behavior as well as to extrinsic constraints and events.



SodaConstructor

Flexibility ?



Fiber = R (a_i ➔ a_j)

Strength = 1- p (a_j | ¬ a_i)

Elasticity = f (t_i t_j)

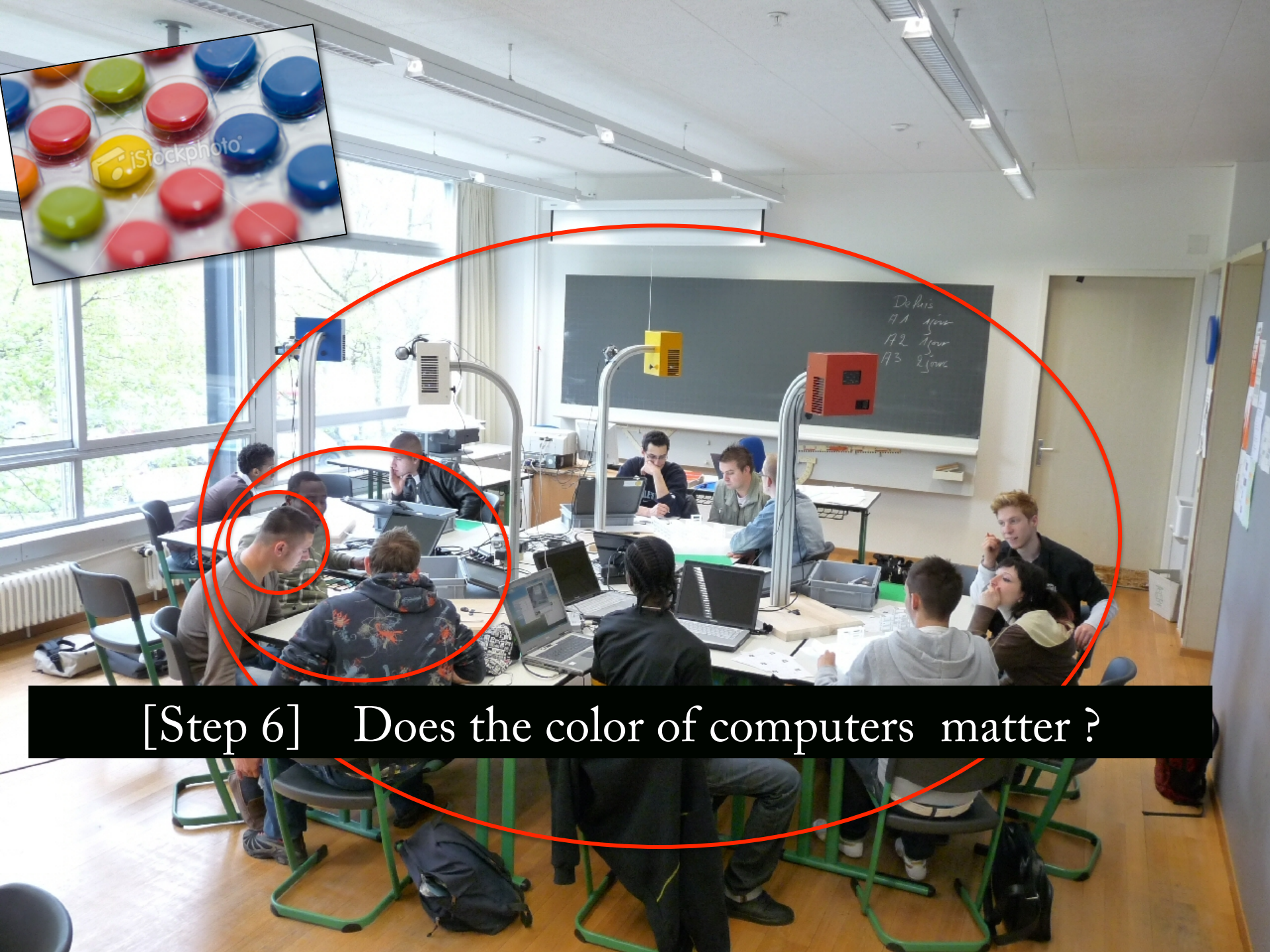
time decay

Pre-requisite	students acquire in a_i skills they need for a_j
Advance organizer	a_i pre-activates cognitive structures for a_j
Didactic contract	a_i presents teacher's expectations about a_j
Motivation	a_i motivates learners for a_j
Logistics	a_i sets up the environment for a_j
Dataflow	input (a_j) = f(output (a_i))

Operators input (a_{i+1}) = f(output (a_i))

Aggregation	e.g. collect data for debriefing
Distribution	e.g. JIGSAW set up
Group formation	e.g. form heterogenous pairs
Group rotation	e.g reciprocal teaching
Feedback	input for a_{i+1} is teacher's FB on a_i
Decision	e.g. level groups

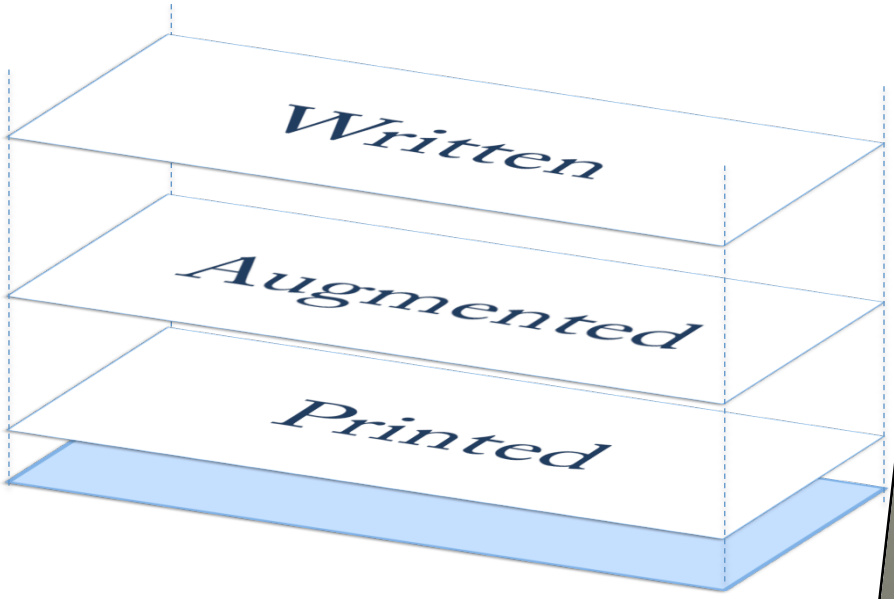
[Step 5 / HCI] A ‘flexible workflow’ is a paradox that can be addressed by physical ‘handles’ on digital structures (cf. step 7).

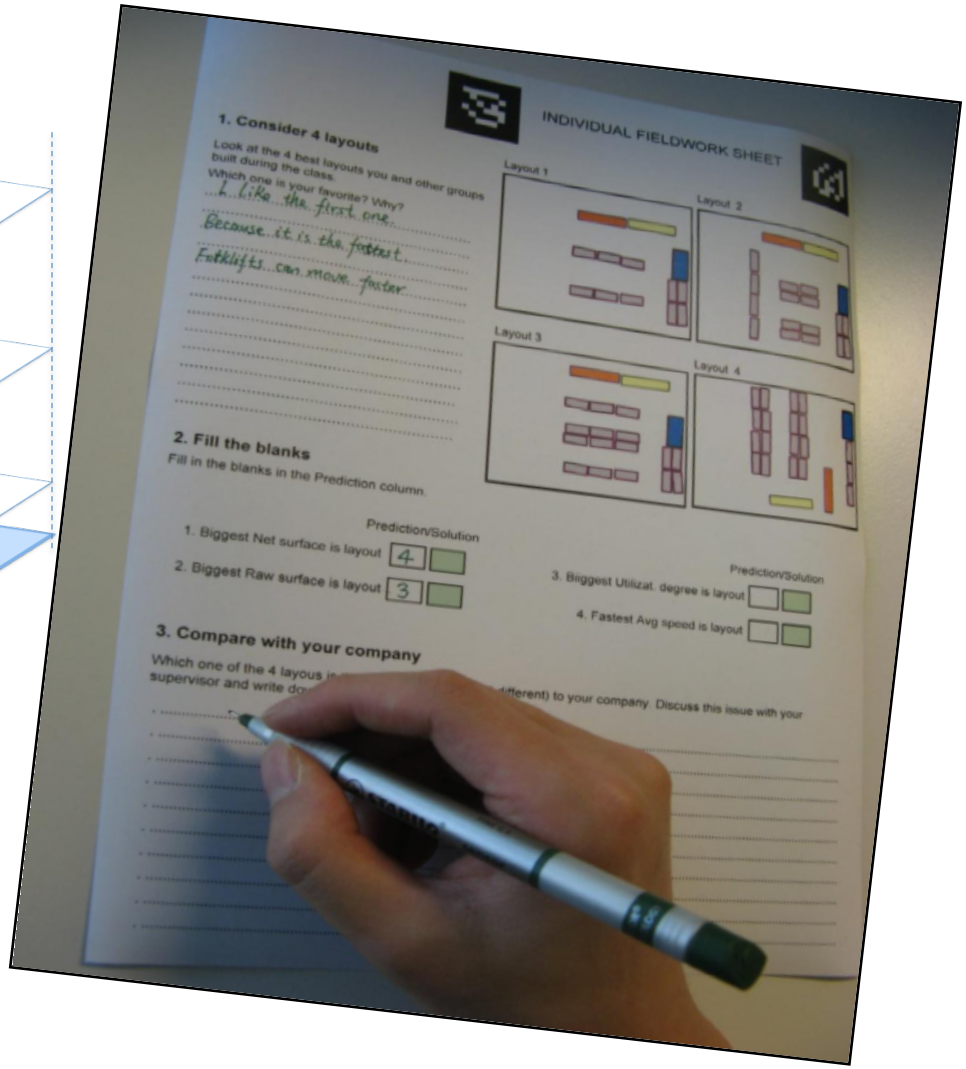

[Step 6] Does the color of computers matter ?

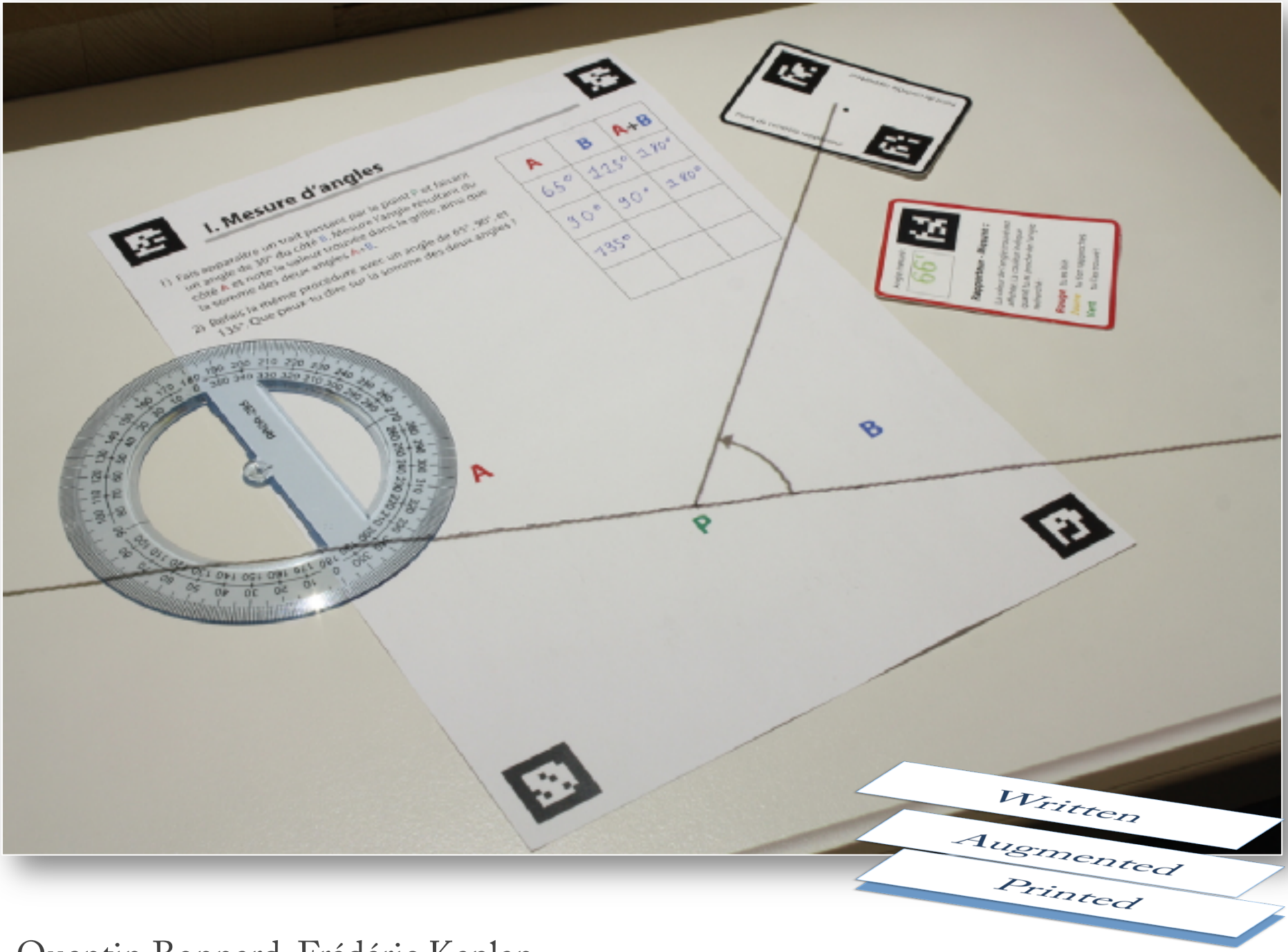
[Step 6] Orchestration is usability when the user is the classroom.

	User	Constraints
Circle 3	Classroom	*Discipline, time, energy, reporting…*
Hutchins	Cockpit	
Circle 2	Group	*Interdependence, WYSIWIS,…*
Circle 1	Individual	*Cognitive load, pre-requisites,...*

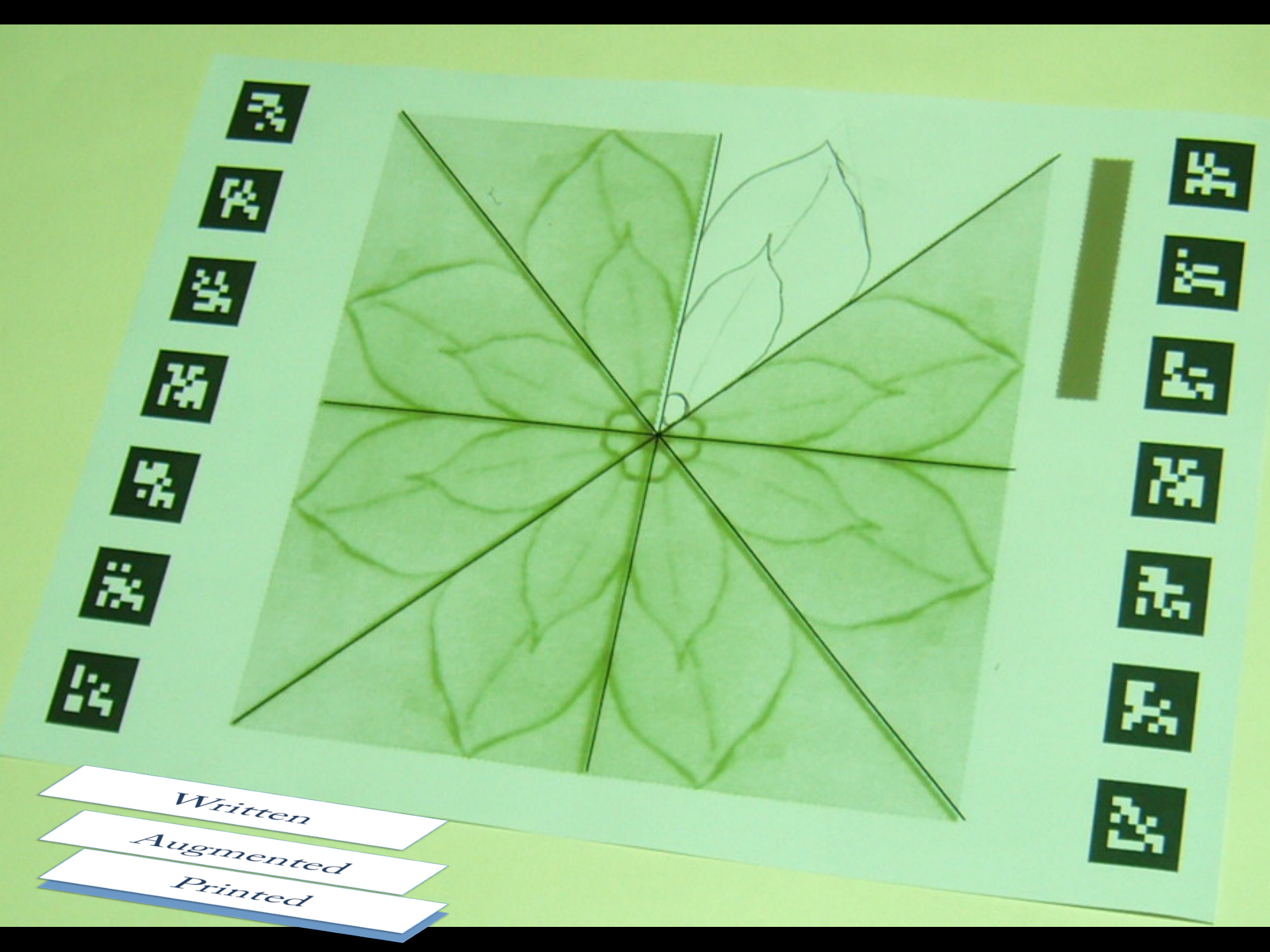
[Step 7] The graph expands on information layers: *ag* = π x t x l



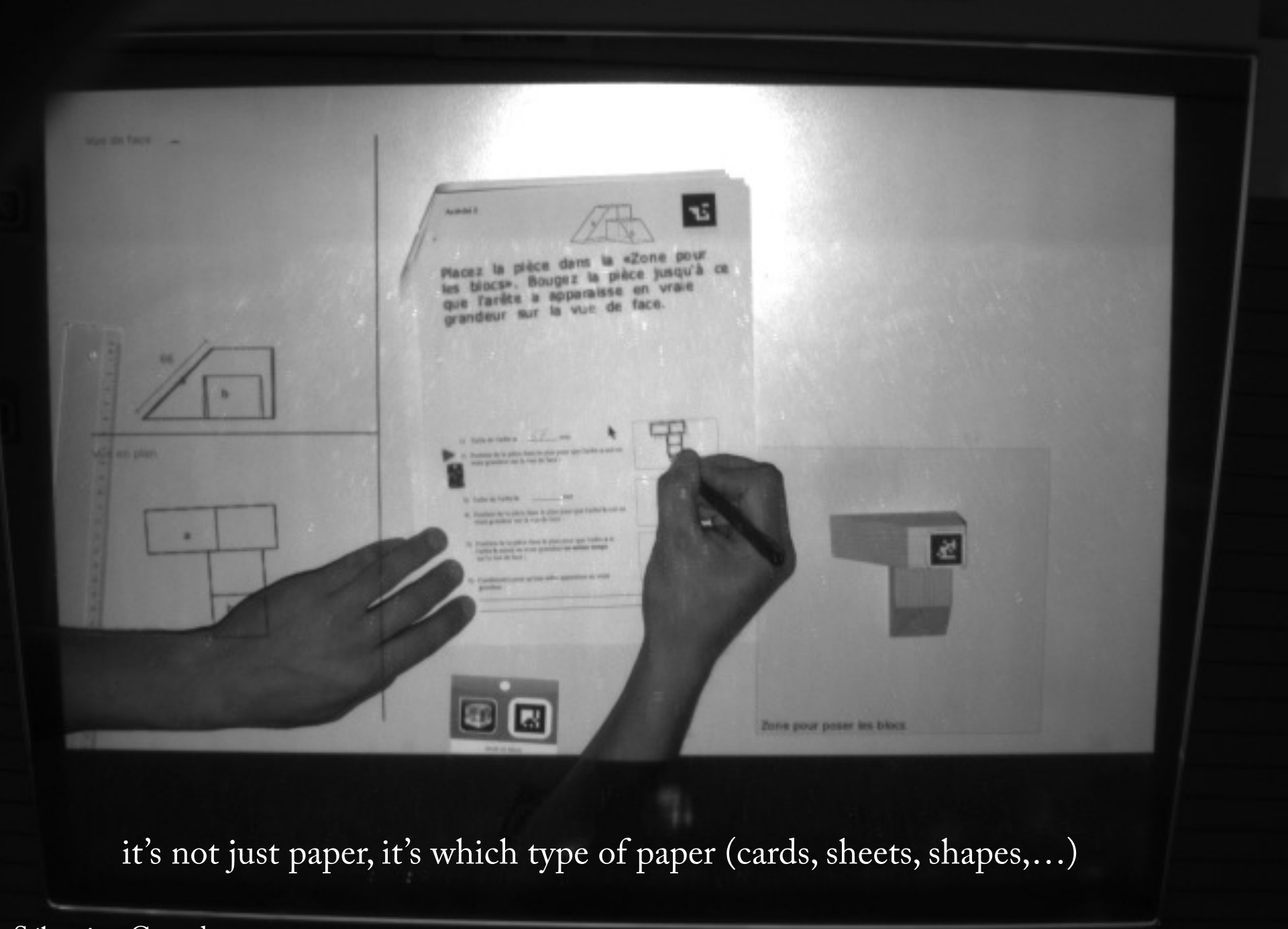




Quentin Bonnard, Frédéric Kaplan


Written
Augmented
Printed

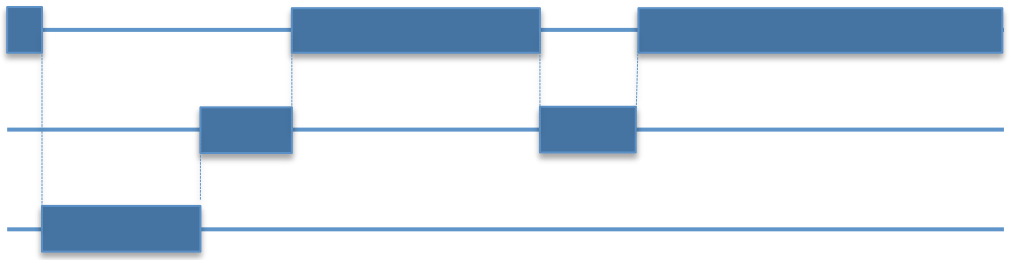
Augmented reality environment for the training of carpenters

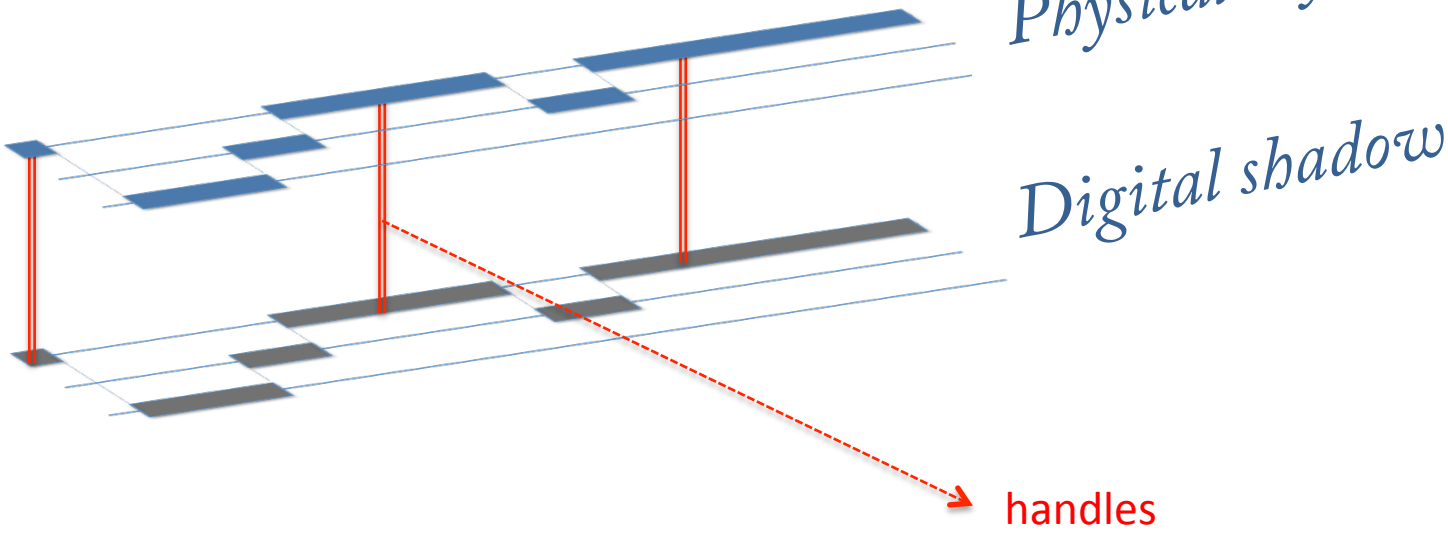


it's not just paper, it's which type of paper (cards, sheets, shapes,…)

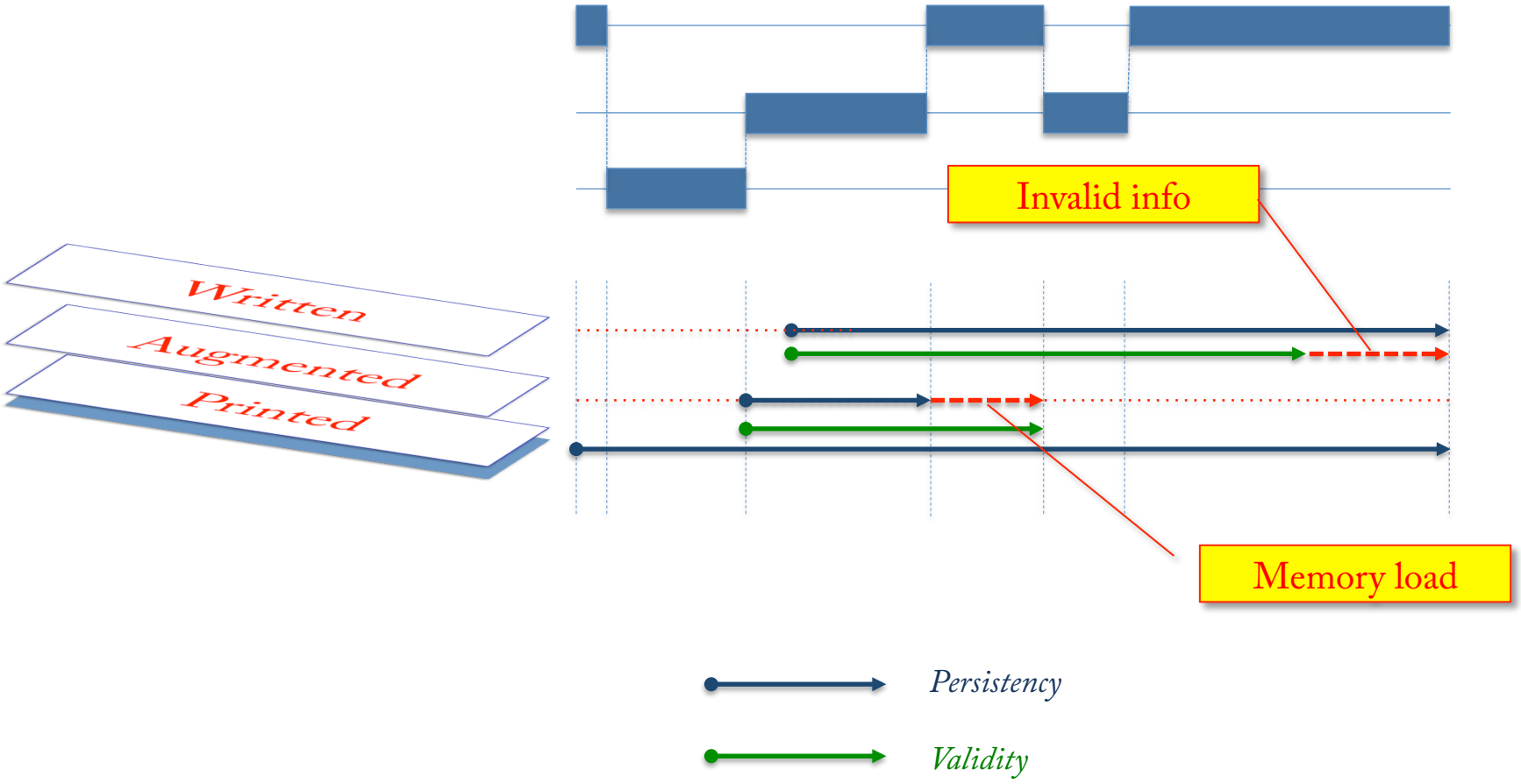
Sébastien Cuendet

[Step 7] An activity graph has 2 layers, physical & digital, which are connected by 'handles'.





[Step 8] Information layers differ in terms of information persistency.



[Step 9] By making visible what would otherwise be invisible, buffers increase persistency of information.

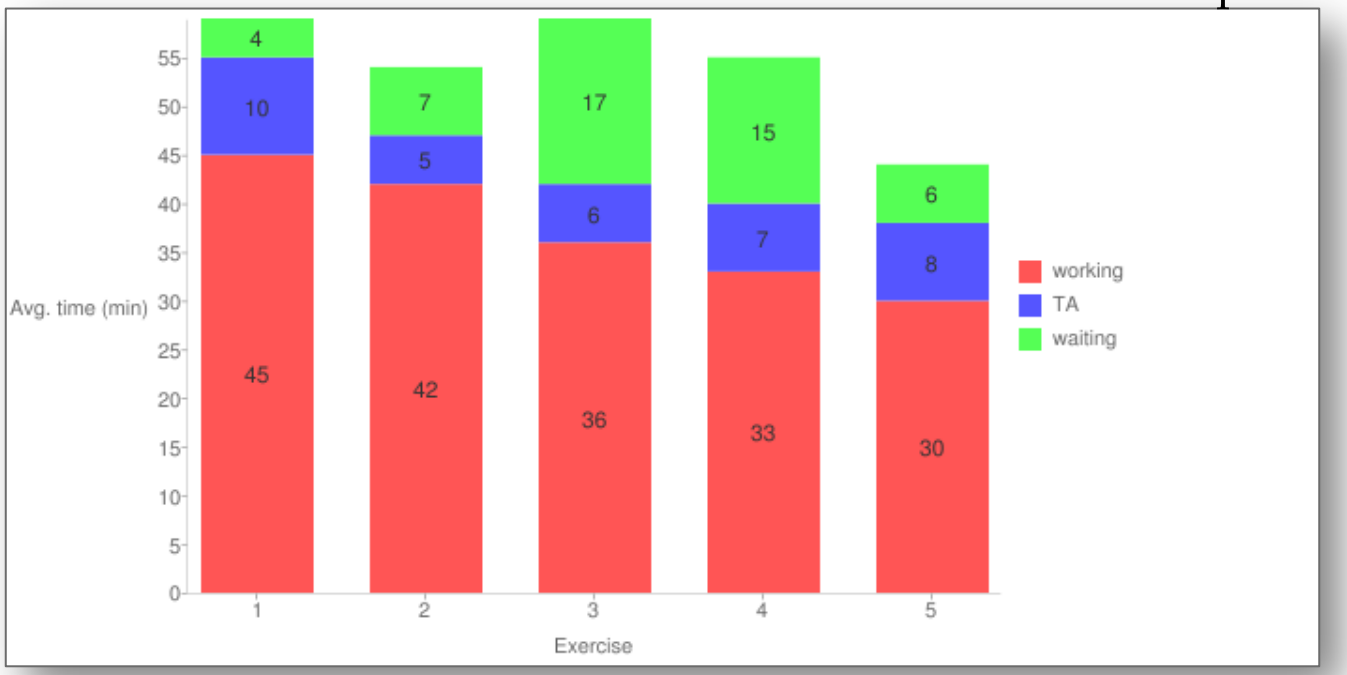
Physics 101: Exercises Session

Problems are delicious

"While Waiting Productivity" LOSS : 62% ➔ 6%

H. Alavi, Olivier Guédat

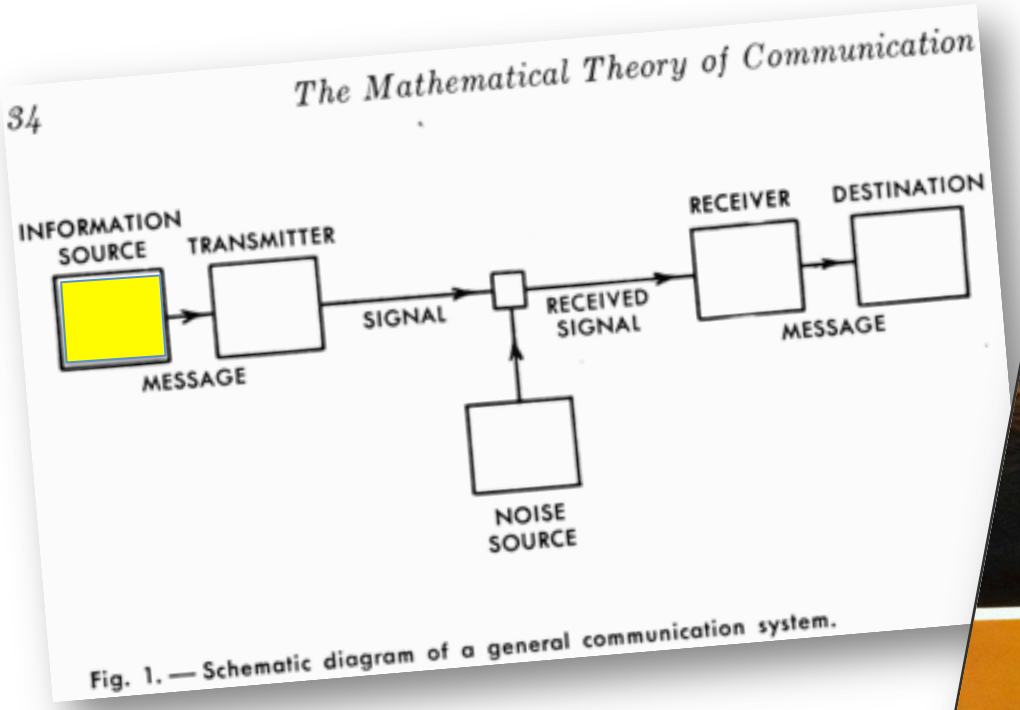
Teacher's cockpit



Action buffer

Reflection buffer

[Step 10] Orchestration requires managing massive flows of information.



[Step 10] Orchestration requires managing massive flows of information.

As it differs from information theory

An emitter is any object or actor in the classroom that display information.

A signal exists if a receiver perceives it

The beat = 1 Hz

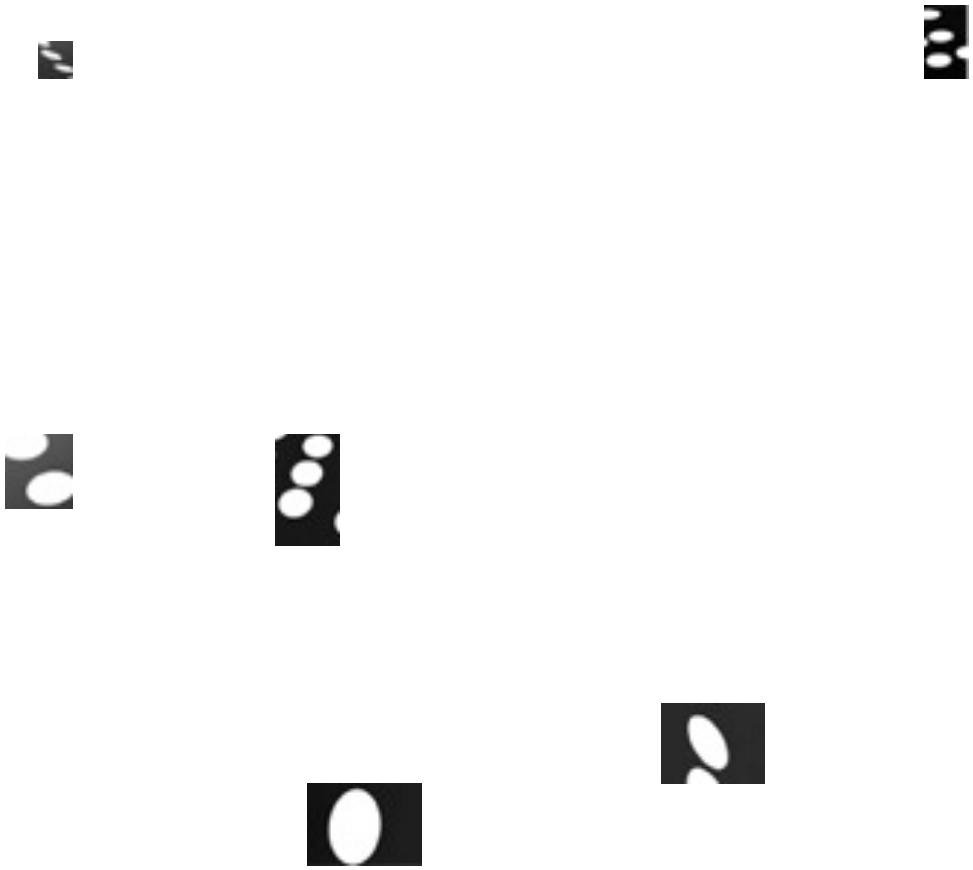
The channels are audio, vision, touch and wires.

The bandwidth is determined by the receiver's capacity (= teacher's cognitive load).

22 X 50 X 3000 < 10/3

By Daniel Schwartz

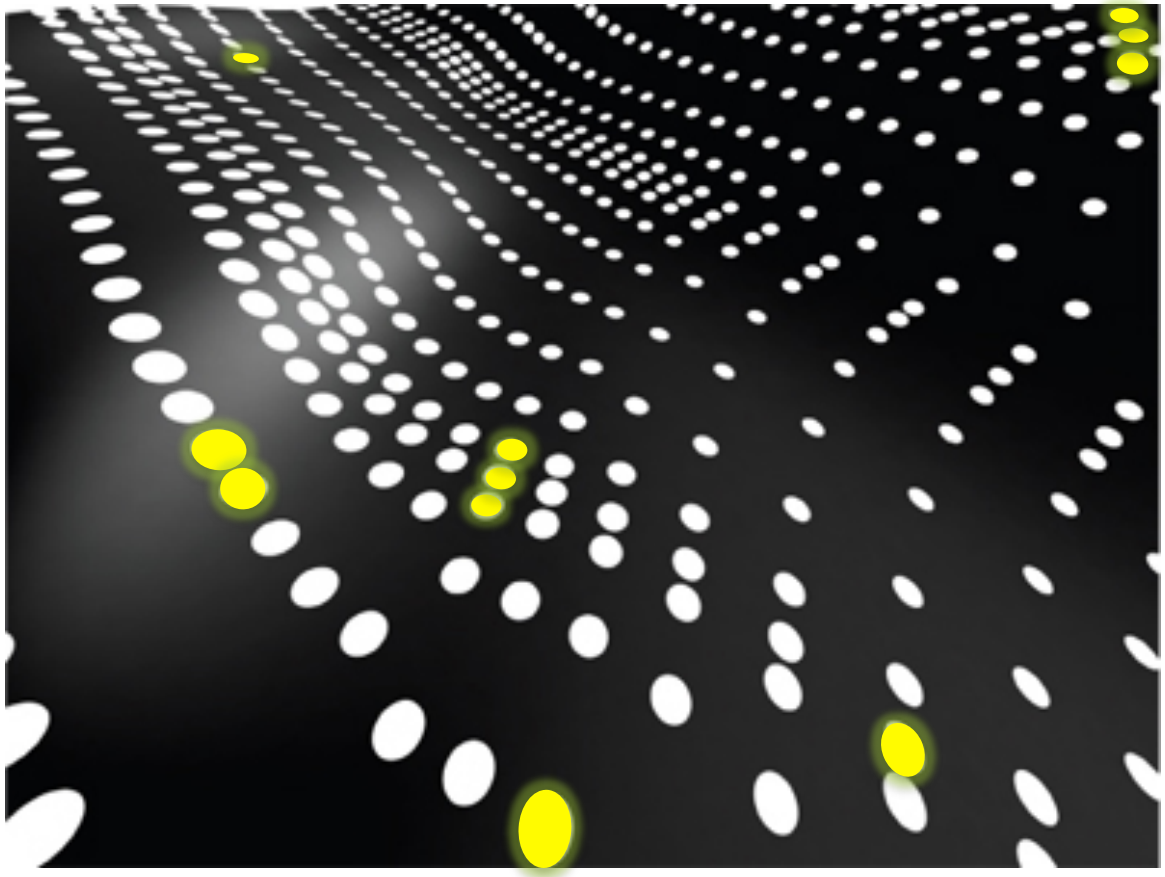
Cognitive Load Theory



Hard to grasp all this discrete information – need to use slow verbal encoding to handle working memory demands.

By Daniel Schwartz

"revelateur"



Same information as before, but now placed in its appropriate spatial context. Rapidly "graspable" without verbal encoding.

[Step 11] The classroom geometry ‘chunks’ for the teacher *(to be developed)*

[Step 12] Modeling a classroom as an information system (to be developed)

$ag^0 = f((C,S,T,X), \text{learning-theory})$ $\quad f = \textit{instruction design}$

$ag^t = f'(ag^{t-1}, C^{t-1}(S), T, X) \mid H(S,C^t) < H(S,C^{t-1})$ $\quad f' = \textit{orchestration}$

Orchestration the real-time management of multi-plane multi-layer activity graphs that maximize constraints satisfaction and minimize entropy

$ag = (V,E)$

$$V=\{a_i : (\pi, t, \beta, \textit{instruction, ressources,}\ldots) \wedge \sum_{i=1}^{|V|} t(a_i) = T\}$$

$$E=\{(a_i\ a_j): (\textit{fiber, operator, strength, elasticity}) \mid j > i,\}$$

$$H(C^t(S)) = \sum_{i=1}^{|S|} \sum_{j=1}^{10} (H(s_i, c_j) * (t - \textit{persistency}(c_j, l))) \mid c_j \in \{\textit{activity,attention, understanding,..}\}$$

Lantern
(A. Alavi)

WiTeach
(Z. Crivelli)

Design for Orchestration

1. Control
2. Visibility
3. Flexibility
4. Physicality
5. Minimalism
6. Do not target heroes

Summary

1. Graph
2. Bloominess
3. Constraints
4. Flexibility
5. Paradox
6. 3rd circle
7. Layers
8. Persistency
9. Buffers
10. Flows
11. Revelateur
12. Modeling

Education

Orchestration does not replace learning theories. It is a necessary but not sufficient condition for scaling up.

HCI

There is a need for HCI³ in education.

Information theory

Yes, we can.

Orchestration ?

Piaget, Vygotsky & Al Capone

Natacha Ongeloofelijk, Guillaume Zufferey, Patrick Jerman, M.-A. Nüssli, Quentin Bonnard, Hamed Alavi, Sebastien Cuendet Andrea Mazzei, Khaled Bachour, Olivier Guedat, Flaviu Roman, Frédéric Kaplanj, Julia Fink

Daniel Schwartz, Miguel Nussbaum, Frank Fischer, Yannis Dimitriadis, Pierre Tchounikine.

STELLAR NoE, Swiss Leading House for VET technologies, Swiss National Science Foundation