Chapter 7:

From collaborative learning to classroom orchestration

EPFL

How do people learn ?

- by exploration, trial and error
- by incremental mastery
- by verbal elaboration

Constructivism

mastery learning

socio-constructivism

If you were a school teacher, would you ask students to work in teams? Pick what you might decide and why. *

- Yes, it might force them to deepen the contents of my lecture
- Yes, even if they won't necessarily learn more, they might at least learn to work together
- No, they can learn to work in teams in many activities outside school
- No, teamwork takes too much time; I have to move faster in the curriculum

If you would decide anyway to make teams, which size of the teams would you choose? *

- Teams of 3, because the third can kind of arbitrate the disagreements between the two other ones, so the team would work better
- Teams of 2, because with larger teams, there is often one person that does not contribute much, which is unfair for the two other ones
- Teams of 5, so that I can detect which students take leadership
- Teams of 10, because that's often the size of the teams they will join later on in the workplace

Let's say that you finally decide to make teams of 2, what would be the best team composition? *

- Two students with different viewpoints so that they produce multiple solutions
- Two students with a different backgrounds, so that they get used to handle diversity
- Two students with the same level, otherwise the better students will waste time with the weaker one
- Two students with different levels, so that one develops the skills of helping other students

If during their teamwork, three students start to argue loudly what would you do? *

- Ask them to elaborate a list of pros and cons and connect it to what was taught in the last lecture
- Discuss with them to see if some opinions are scientifically incorrect
- Nothing, I will ask them to less loud then I will check who wins the argumentation
- Nothing, it may force them to deepen their understanding of the task

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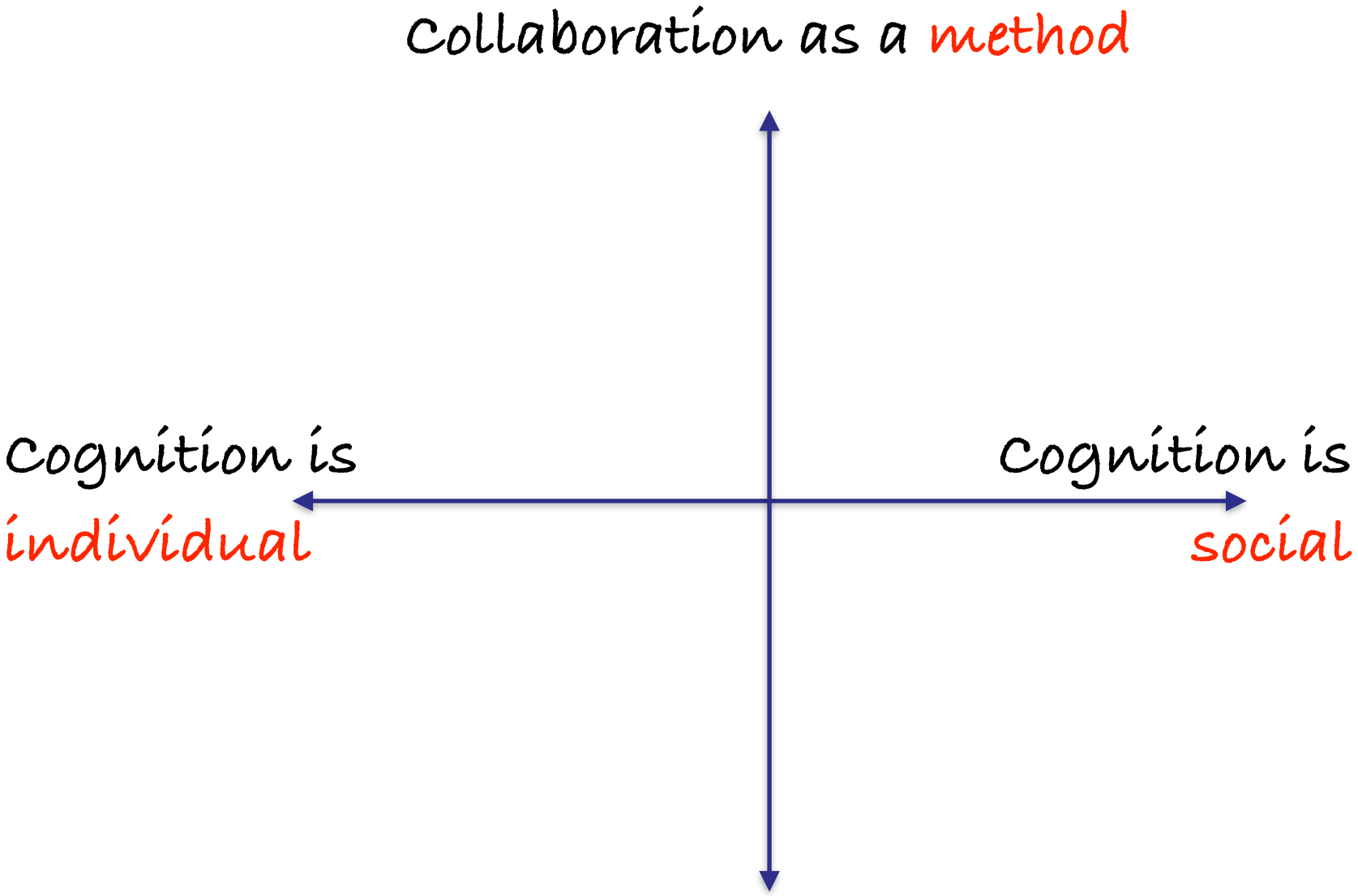
Collaboration as a method
Cognition is individual
Cognition is social
Collaboration as a skill

If you were a school teacher, would you ask students to work in teams? Pick what you might decide and why.

- [2, -2] 'Yes, it might force them to deepen the contents of my lecture'
- [2, -2] 'Yes, even if they won't necessarily learn more, they might at least learn to work together '
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- [-2, 2] 'No, teamwork takes too much time; I have to move faster in the curriculum.'

If you would decide anyway to make teams, which size of the teams would you choose?

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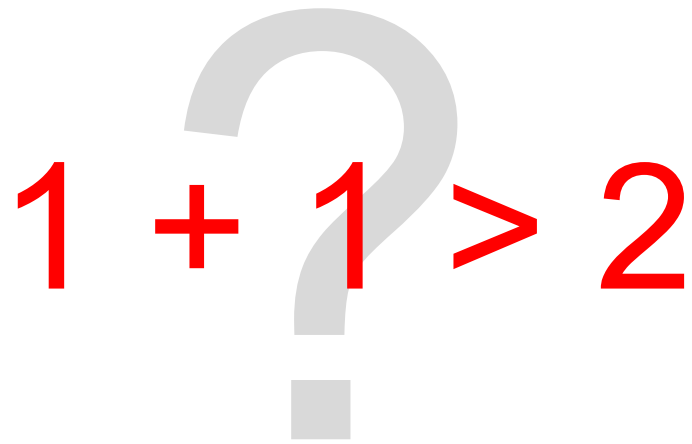
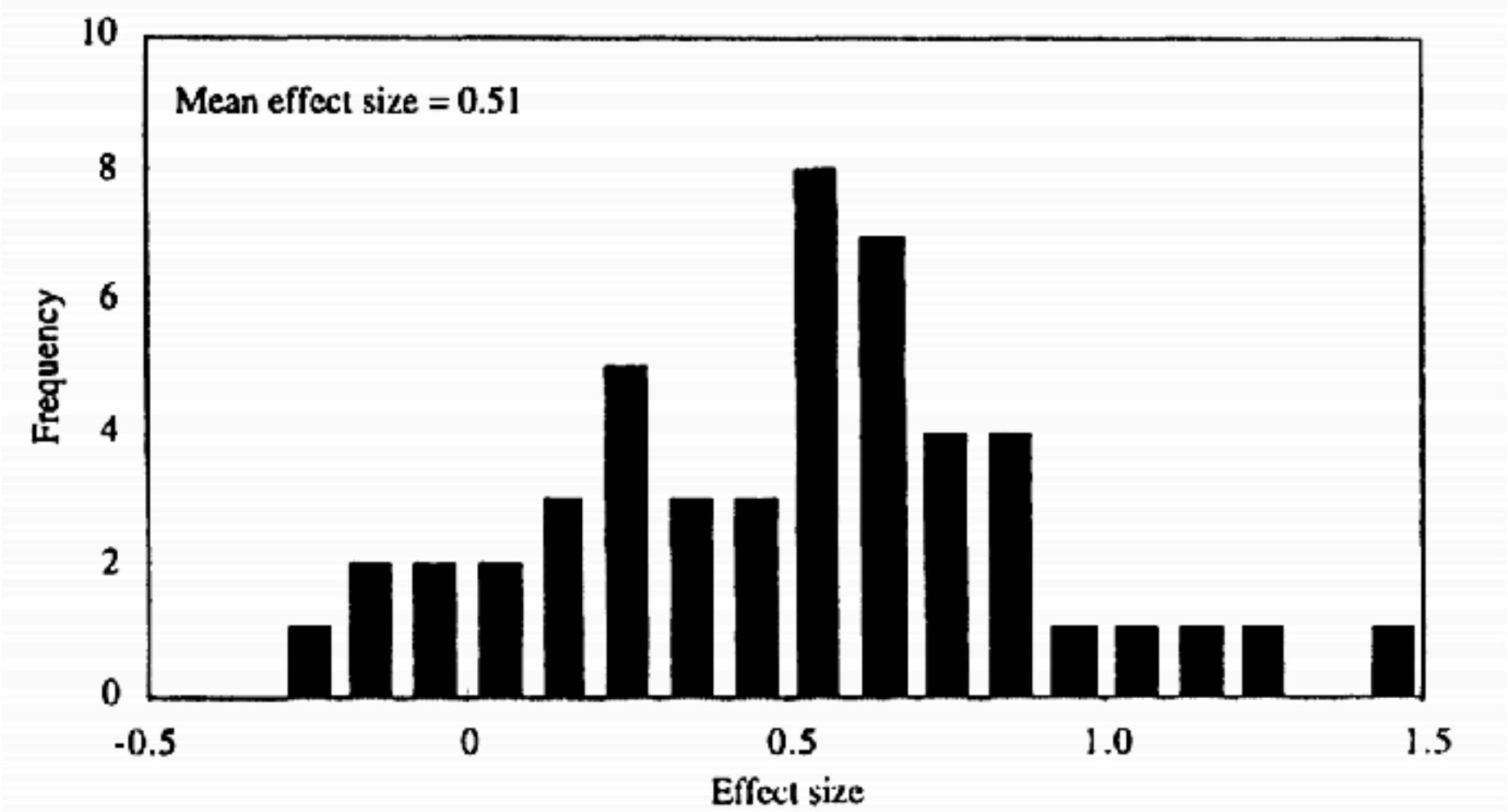


Is learning in teams
more effective
than learning alone ?

Research Phase 1
Is Collaborative Learning Effective ?

	Learning Gains		
Meta-analyses: collaborative versus individual	>	=	<
Slavin, 1983.	**26**	14	1
Johnson & Johnson, 1989	**829**	645	109

Research Phase 1
Is Collaborative Learning Effective ?



Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of educational research*, *69*(1), 21-51.

Kyndt, E., Raes, E., Lismont, B., Timmers, F., Cascallar, E., & Dochy, F. (2013). A meta-analysis of the effects of face-to-face cooperative learning. Do recent studies falsify or verify earlier findings?. *Educational research review*, *10*, 133-149.

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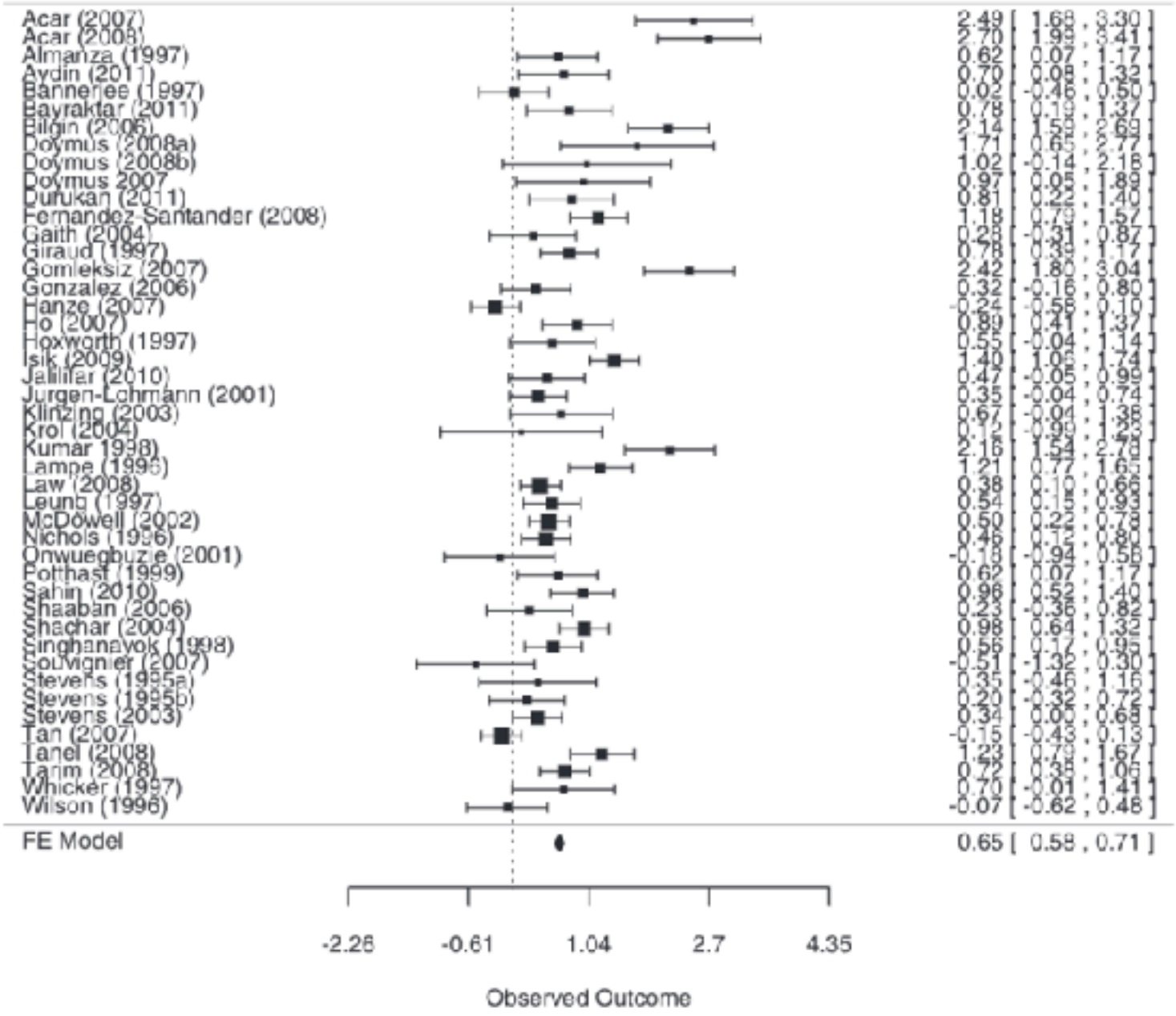


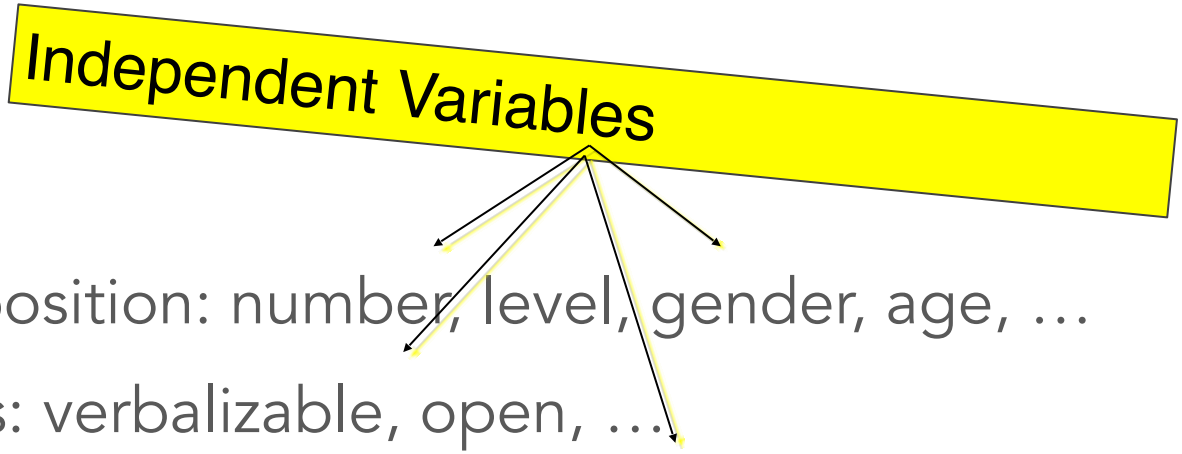
Fig. 1. Forest plot with weighted effect sizes for all studies of the meta-analysis.

Research Phase 1
Is Collaborative Learning Effective ?

A **decision maker** could conclude that the probability that team learning is effective is high enough to use it.

A **learning scientist** would conclude that team learning is not effective per se, but depends on the conditions… see next slide

Research Phase 2
When is collaborative learning effective ?

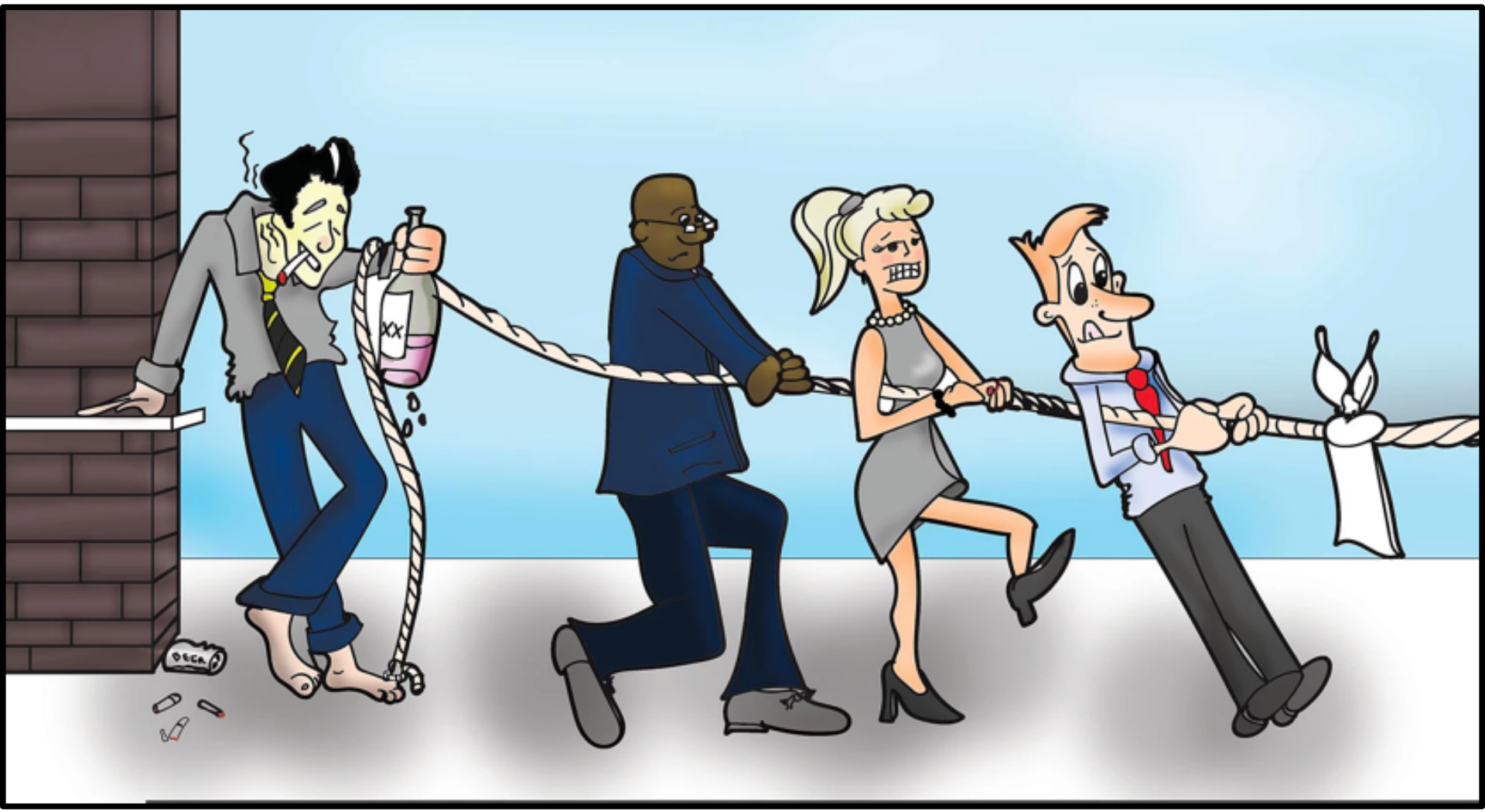


Factors:

- Group composition: number, level, gender, age, …
- Task features: verbalizable, open, …
- Medium: face-to-face, synchro/not, text/audio/video,…
- Context: school/work

The effects of collaborative depends upon so many variables (plus their interaction effects) that it is impossible to predict that a given teamwork in a specific context will be effective

Pitfalls in Teamwork



‘social loafing’, ’free rider effect’

Pitfalls in Teamwork

- Free-rider / Social Loafing: some teams members let the others do the work
- …

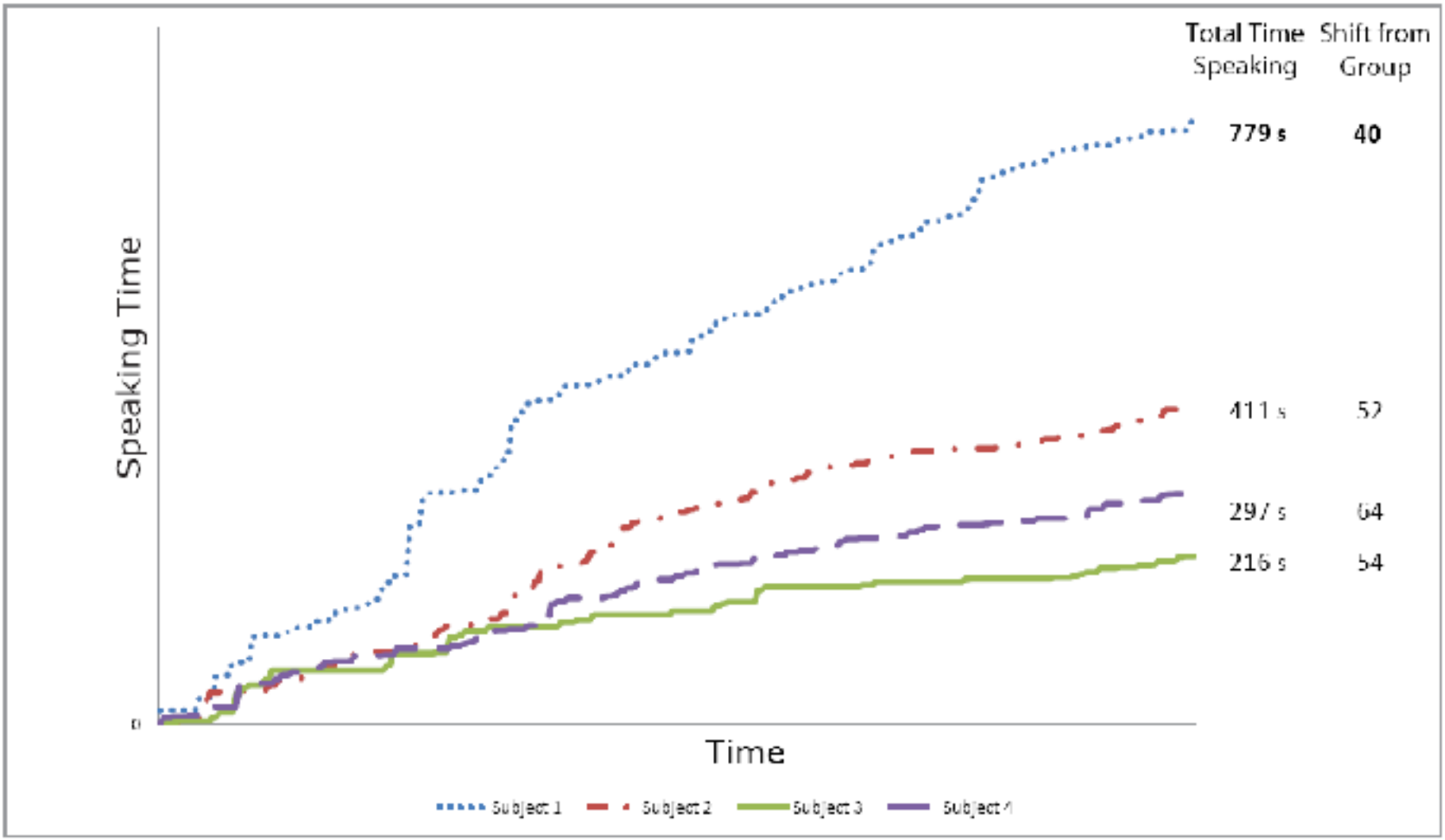
Meeting at the White House Cabinet Room
during the Cuban Missile Crisis on October 29, 1962.

GroupThink

https://www.youtube.com/watch?v=glUUmsBb_58

Pitfalls in Teamwork

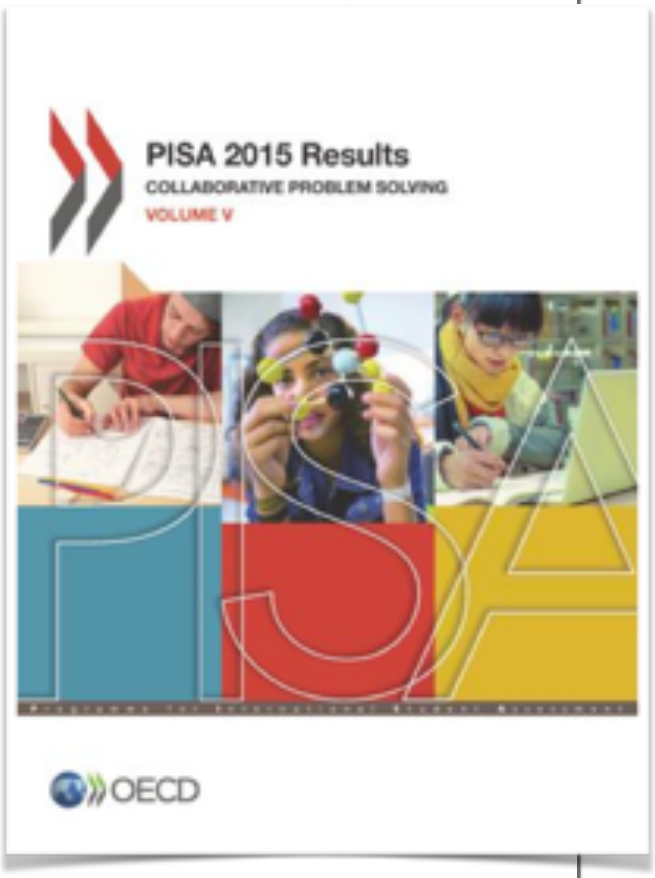
- Free-rider / Social Loafing: some teams members let the others do the work
- ‘GroupThink’: as soon as they agree, learners return the solution to the teacher without checking if it is the optimal solution In education, as soon as they agree, learners return the solution to the teacher without checking if it is the best one
- In education, consensus to satisfy the teacher
- ….

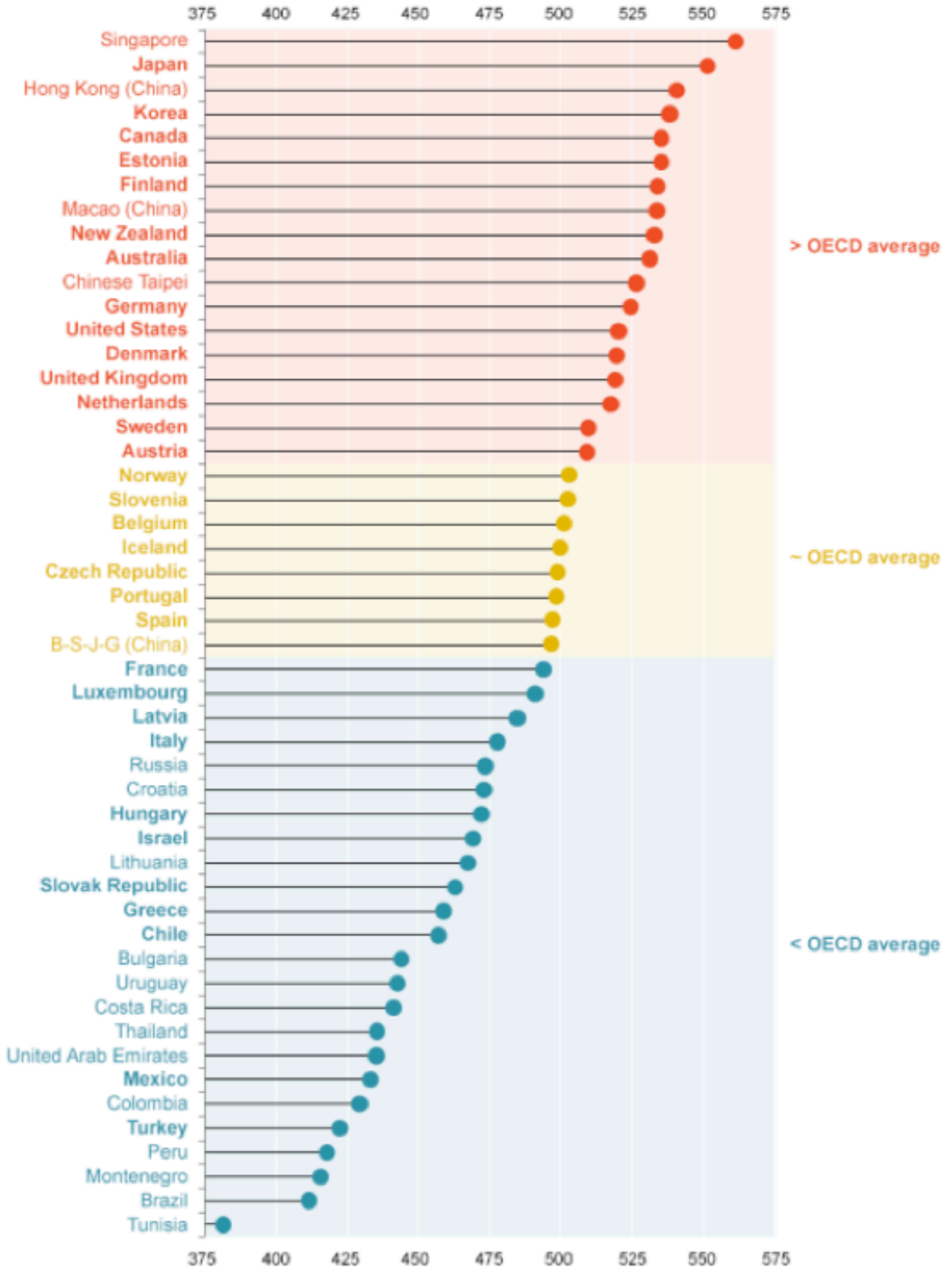


Domination / Disengagement

Pitfalls in Teamwork

- Free-rider / Social Loafing: some teams members let the others do the work
- 'GroupThink': as soon as they agree, learners return the solution to the teacher without checking if it is the optimal solution In education, as soon as they agree, learners return the solution to the teacher without checking if it is the best one
- In education, consensus to satisfy the teacher
- Domination: some team members dominate verbal interactions; contributions from some members are rejected or not taken into consideration
- ~~Misunderstandings~~
- Emotional (vs epistemic) conflict: « your suggestion is so stupid ! »
- Lack of alignment on goals or commitment
- Lack of « collaboration skills » (one of the 'transversal skills ')


PISA 2015 Results
COLLABORATIVE PROBLEM SOLVING
VOLUME V
OECD


375
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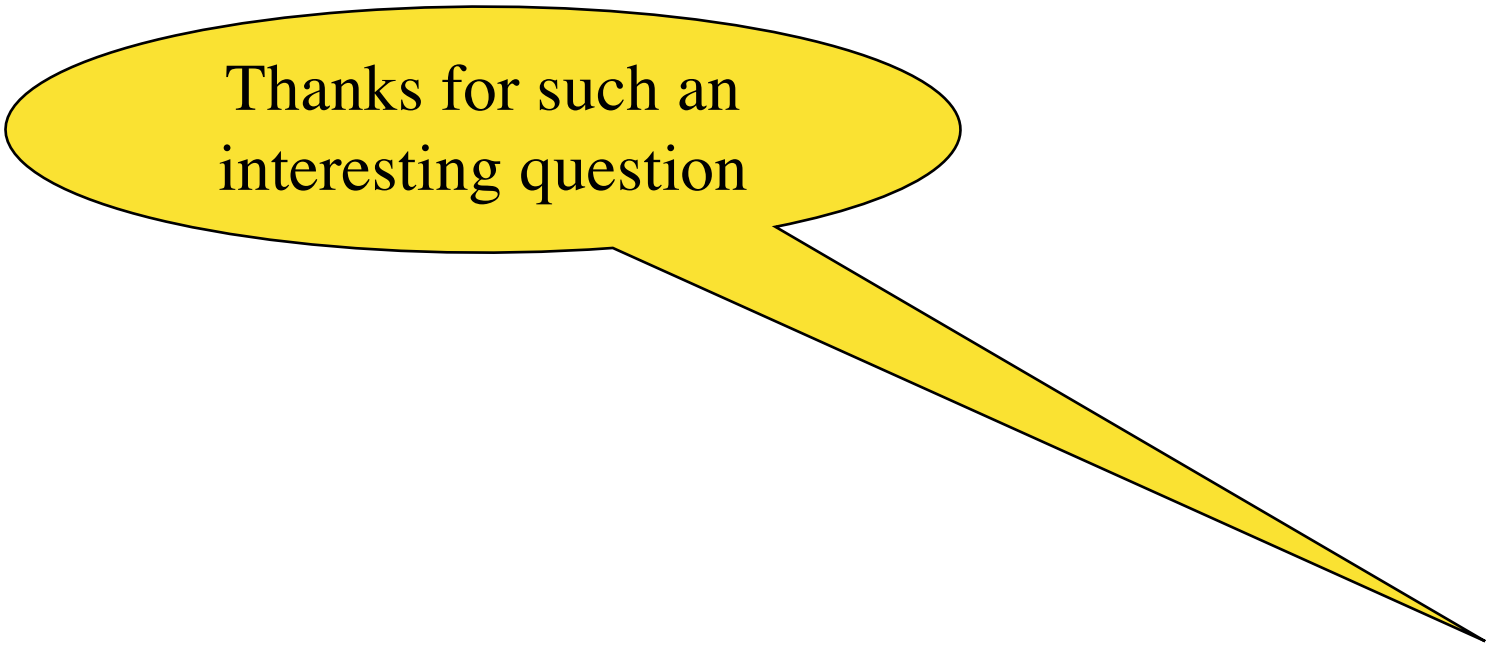
Singapore
Japan
Hong Kong (China)
Korea
Canada
Estonia
Finland
Macao (China)
New Zealand
Australia
Chinese Taipei
Germany
United States
Denmark
United Kingdom
Netherlands
Sweden
Austria
Norway
Slovenia
Belgium
Iceland
Czech Republic
Portugal
Spain
B-S-J-G (China)
France
Luxembourg
Latvia
Italy
Russia
Croatia
Hungary
Israel
Lithuania
Slovak Republic
Greece
Chile
Bulgaria
Uruguay
Costa Rica
Thailand
United Arab Emirates
Mexico
Colombia
Turkey
Peru
Montenegro
Brazil
Tunisia
> OECD average
~ OECD average
< OECD average

Apprendre à collaborer ?



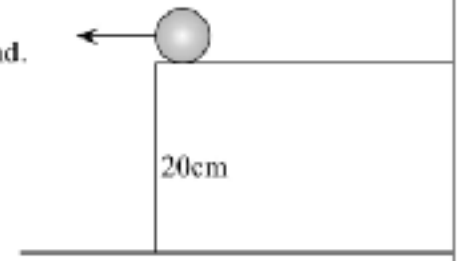
Research Phase 3

Which interactions make collaborative learning effective ?

1. Elaborated explanations

The (self-)explanation effect

A ball with mass 10kg on the desk is shooting at initial velocity of 10m/s. Calculate the velocity of the ball when it hits the ground.



Solution

When the ball leave from the desk, the ball is forced by weight force only. The object will keep constant velocity motion in X direction and constant acceleration motion in Y direction.

1) flight time t

$$h = \frac{1}{2} \times g \times t^2 \longrightarrow t = \sqrt{\frac{2h}{g}} = 2s$$

2) velocity in X direction

$$v_x = v_{0x} = 10m/s$$

3) velocity in Y direction

$$v_y = v_{0y} + g \times t = 0 + 10 \times 2 = 20(m/s)$$

4) total velocity

$$v = \sqrt{v_x^2 + v_y^2} = 10\sqrt{5}m/s$$

Explaining aloud a worked out problem

https://www.researchgate.net/figure/Worked-example-problem-as-adequate-scaffolding-to-the-original-unsolved-problems_fig13_313617511

Moderator	k	ĝ(SE)	$CI_{ĝ}$	$Q_b(df_b)$
Type of Self-Explanation				1.11(2)
Prompted	31	.39(.08)	.24 to .54	
Spontaneous	6	.50(.18)	.15 to .85	
Instructional	5	.24(.17)	-.11 to .60	
Instructional Format				0.21(2)
Worked Example	19	.40(.01)	.20 to .58	
Conventional	10	.33(.14)	.05 to .61	
Text	11	.40(.13)	.16 to .65	
Type of Population				1.80(2)
Post-Secondary	26	.38(.08)	.22 to .54	
Secondary	7	.54(.15)	.24 to .84	
Primary	9	.26(.15)	-.03 to .55	
Element Interactivity				0.04(1)
High	39	.38(.07)	.25 to .51	
Low	3	.43(.24)	-.04 to .91	
Field of Study				0.31(3)
Mathematics	22	.36(.09)	.18 to .54	
Engineering/technical	6	.42(.17)	.09 to .75	
Science	9	.45(.15)	.16 to .73	
Other	5	.37(.19)	.00 to .74	
Pacing of Learning				0.00(1)
Limited	8	.51(.13)	.26 to .76	
Self-Paced	25	.50(.08)	.35 to .65	
Feedback				0.03(1)
Yes	9	.37(.16)	.09 to .64	
No	33	.39(.07)	.25 to .54	

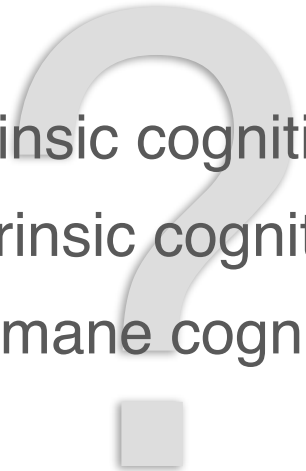
Note. k = number of effect sizes; $ĝ$ = Hedges' effect size; SE = standard error; $CI_{ĝ}$ = 95% confidence interval around the effect size; Q_b = variability between the categories of moderators; df = degrees of freedom.

The (self-)explanation effect

Hedge's Effect size

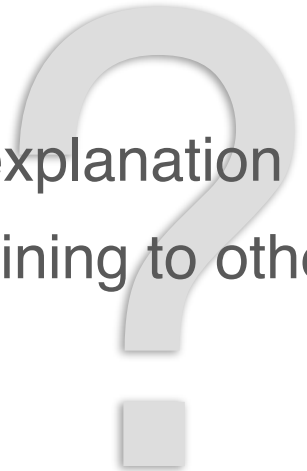
https://www.academia.edu/8601818/A_Meta_Analysis_of_the_Self_Explanation_Effect

The (self-)explanation increases



A. the intrinsic cognitive load
B. the extrinsic cognitive load
C. the germane cognitive load

Is germane cognitive load higher



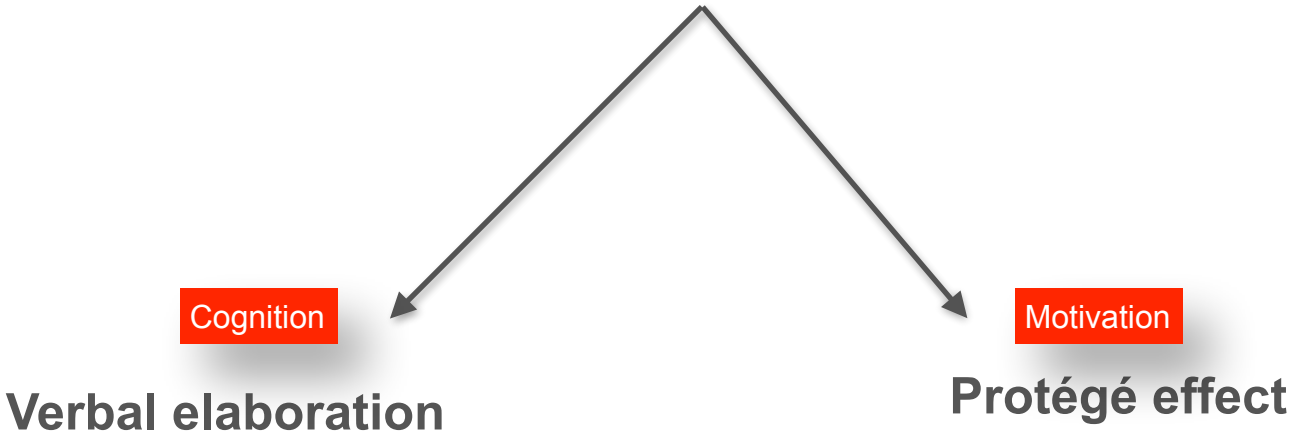
A. self-explanation
B. explaining to other

Mutual modelling

Learning by teaching

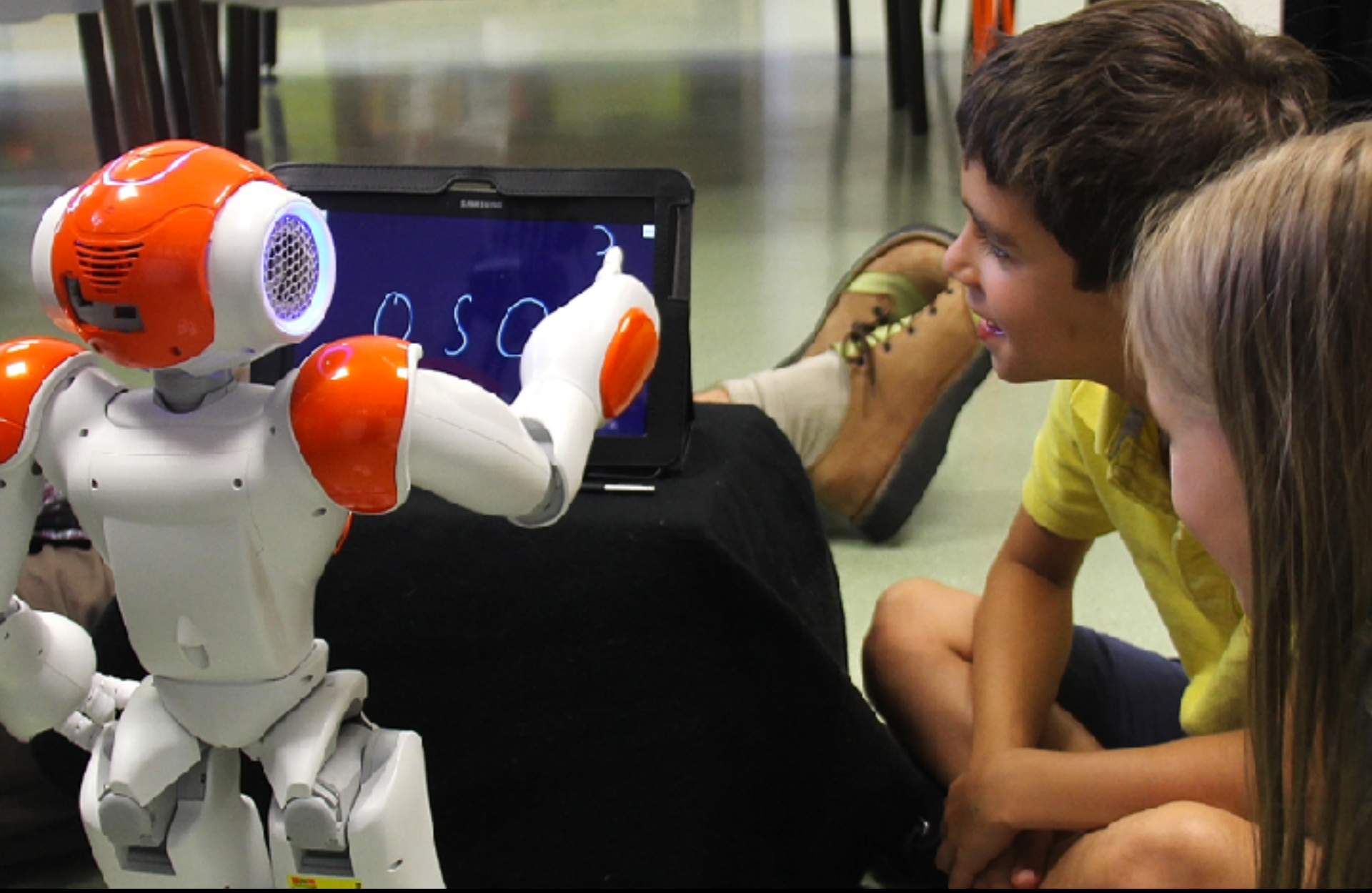
https://digest.bps.org.uk/2018/05/04/learning-by-teaching-others-is-extremely-effective-a-new-study-tested-a-key-reason-why/

Learning by teaching / tutoring



students make greater effort to learn for their TAs than they do for themselves

https://aaalab.stanford.edu/assets/papers/2009/Protege_Effect_Teachable_Agents.pdf



The cowriter project

Remediation of handwriting difficulties

- Testing the system with the same child for 9 months.
- One session per week, followed by a therapist.
- At regular intervals, Raphael was asked to do a BHK test, which was rated by a professional.

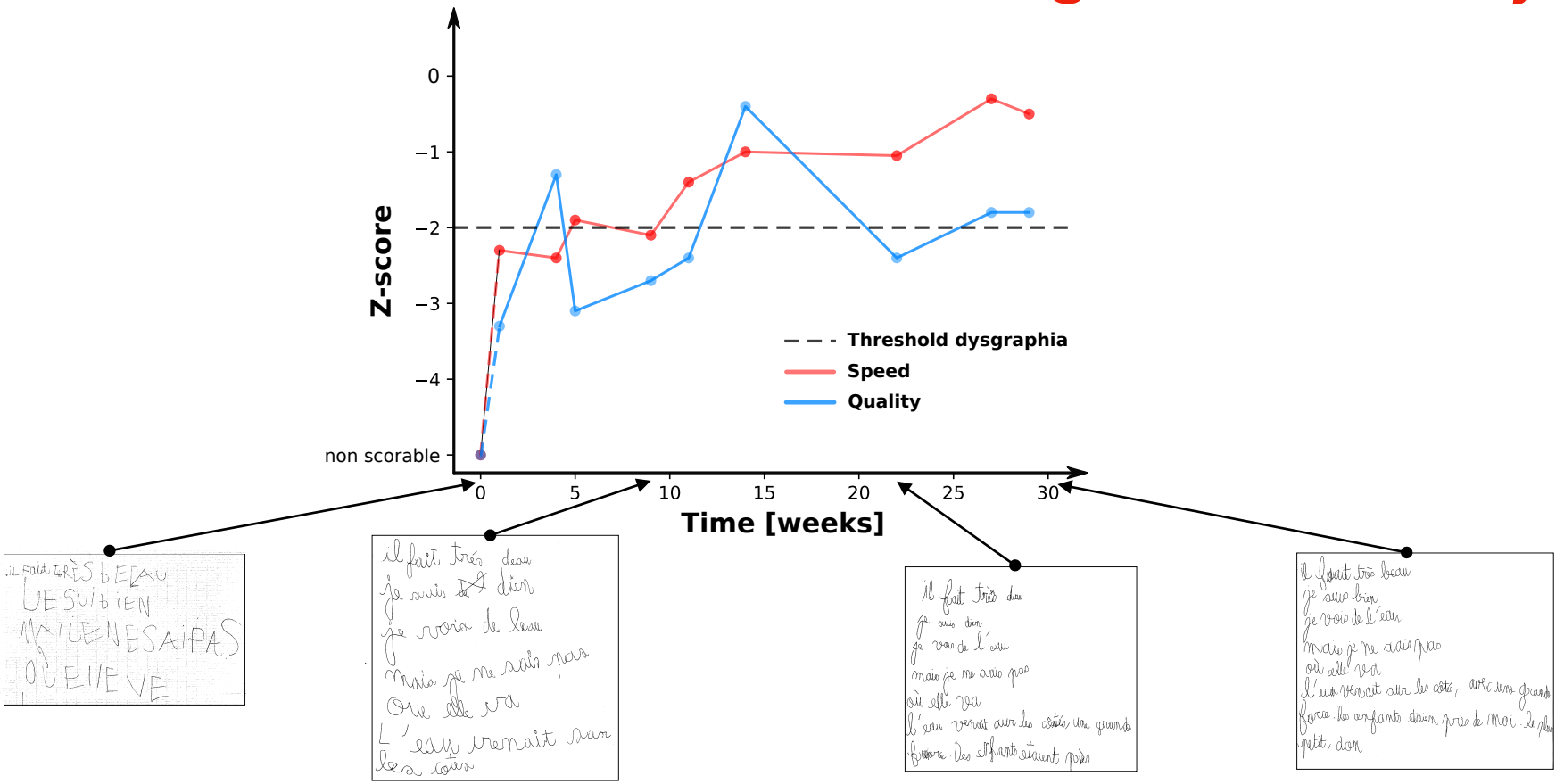
Acquisition of handwriting in children with and without dysgraphia: A computational approach

Thomas Gargot, Thibault Asselborn, Hugues Pellerin, Ingrid Zammouri, Salvatore M. Anzalone, Laurence Casteran, Wafa Johal, Pierre Dillenbourg, David Cohen, Caroline Jolly

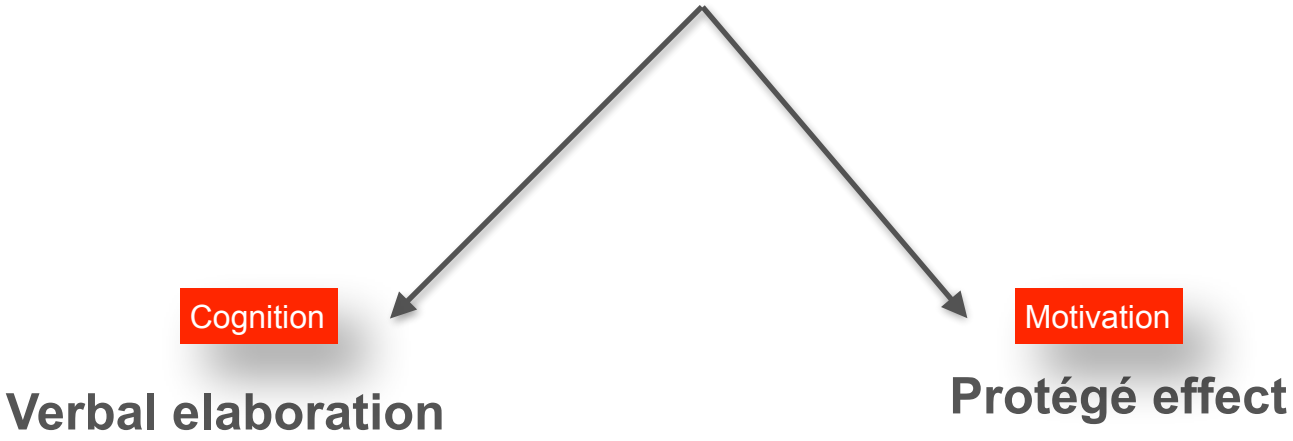
Published: September 11, 2020 • https://doi.org/10.1371/journal.pone.0237575

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0237575

Longitudinal study



Learning by teaching / tutoring



Does it increase:

A. intrinsic motivation
B. extrinsic motivation

Research Phase 3

Which interactions make collaborative learning effective ?

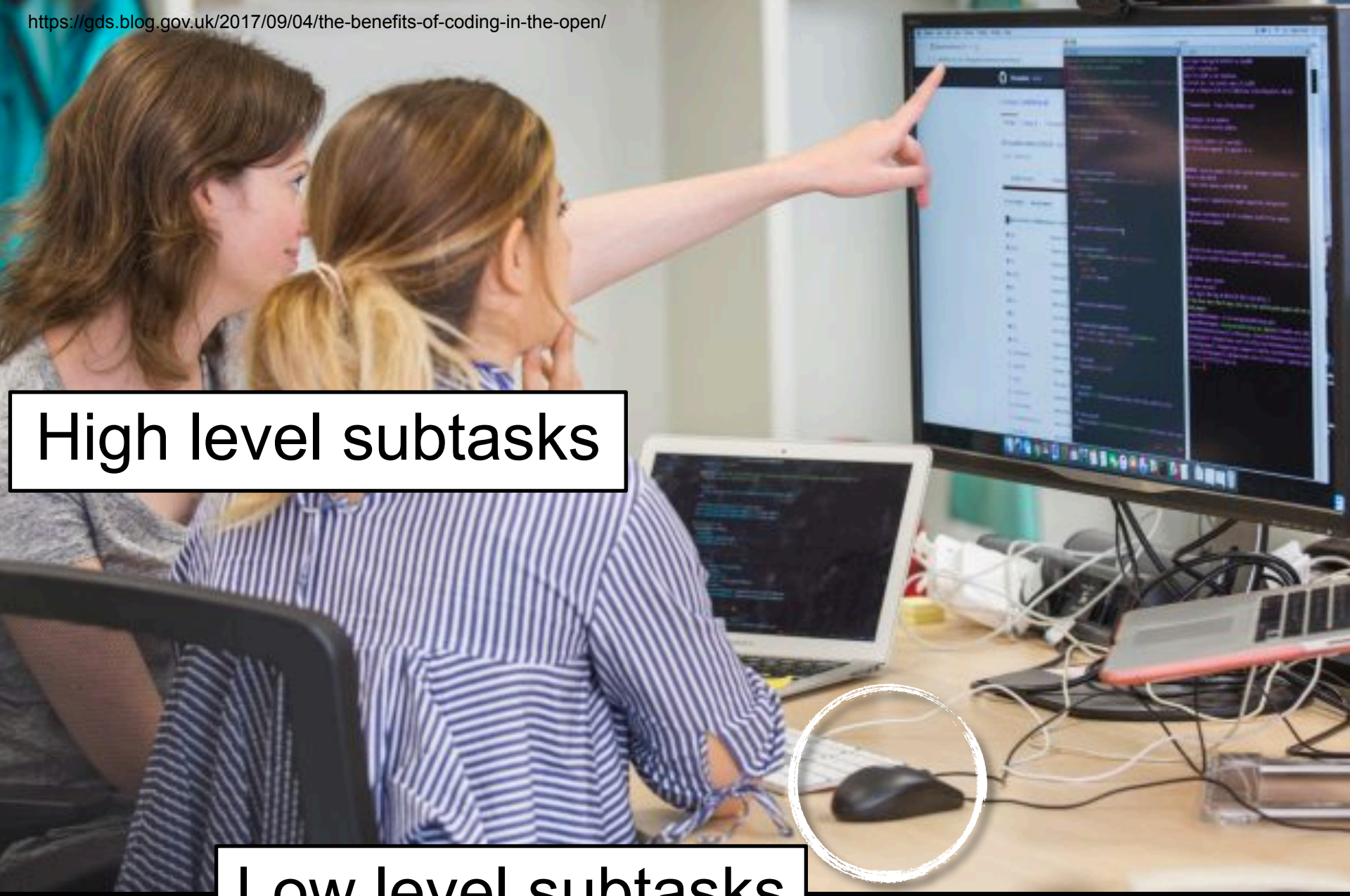
1. Elaborated explanations
2. Conflict resolution, Argumentation / Négociation

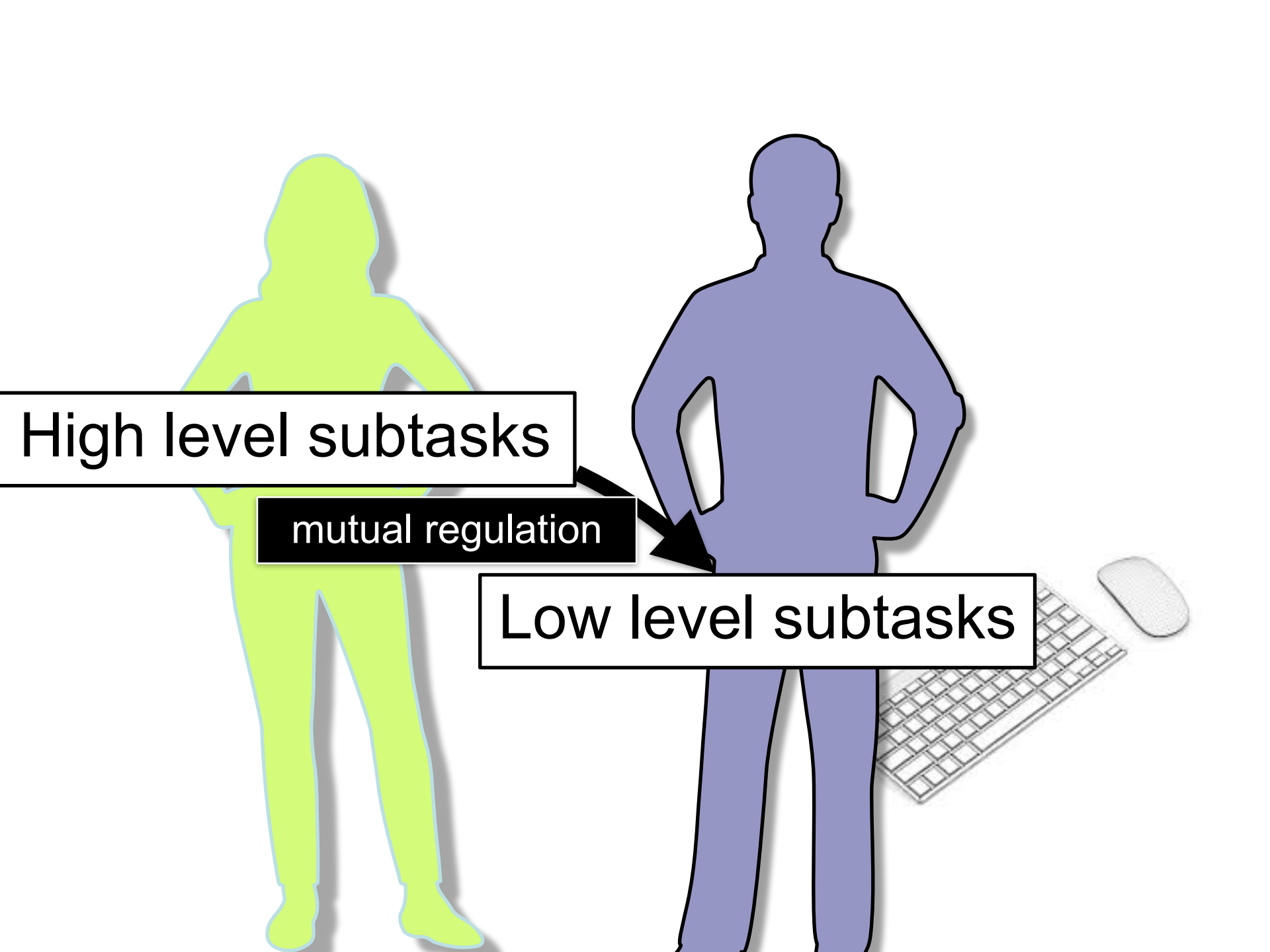
ArgueGraph

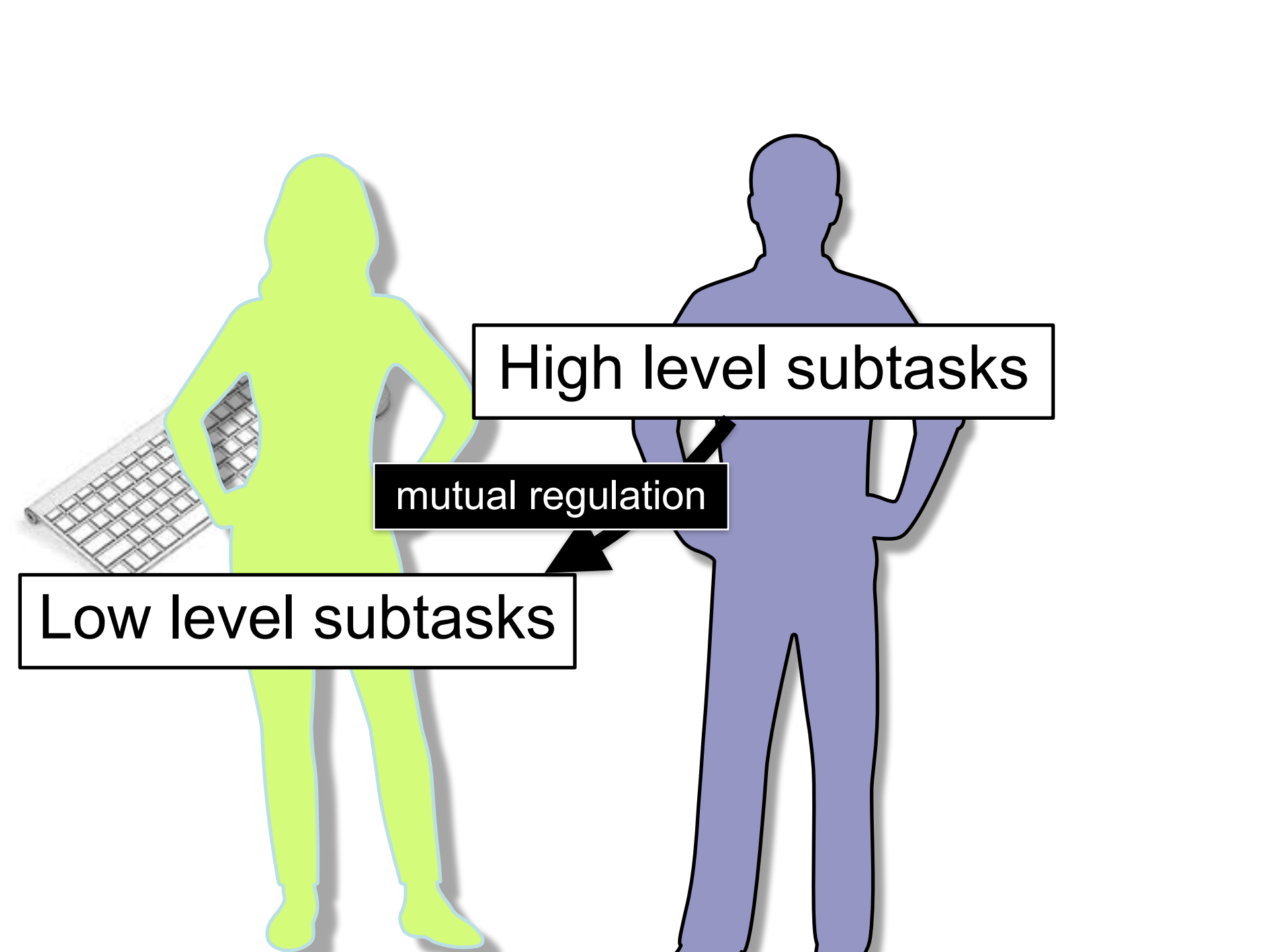
Research Phase 3

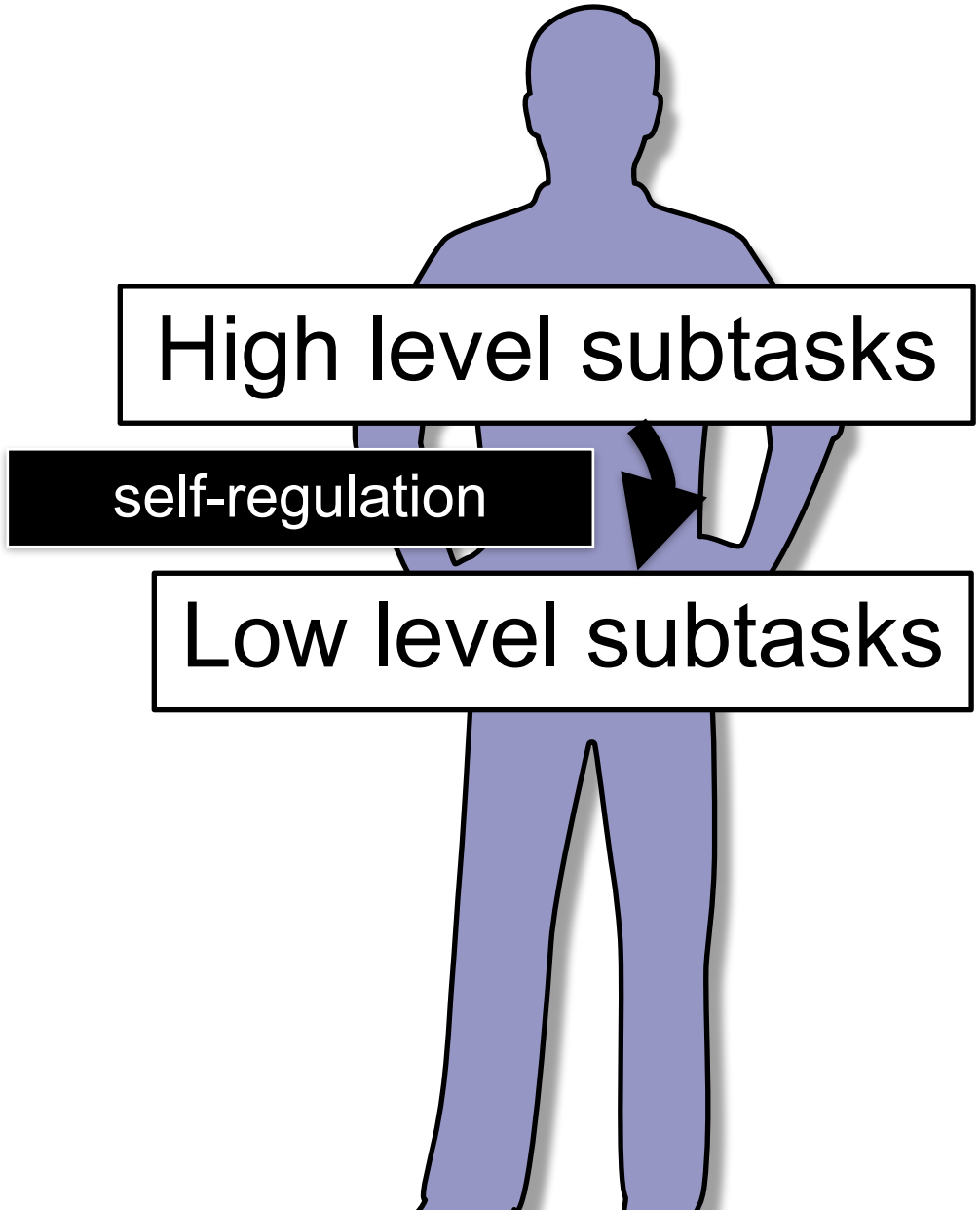
Which interactions make collaborative learning effective ?

1. Elaborated explanations
2. Conflict resolution, Argumentation / Négociation
3. Mutual Regulation


https://gds.blog.gov.uk/2017/09/04/the-benefits-of-coding-in-the-open/
High level subtasks
Low level subtasks


High level subtasks
mutual regulation
Low level subtasks


High level subtasks
mutual regulation
Low level subtasks


High level subtasks
self-regulation
Low level subtasks

Collaboration ≠ Cooperation

Emerging and instable division of labour

Fixed division of labour

Research Phase 1
Is Collaborative Learning Effective ?

A **decision maker** could conclude that the probability that team learning is effective is high enough to use it.

A **learning scientist** would conclude that team learning is not effective per se, but depends on the conditions… see next slide

Research Phase 2
When is collaborative learning effective ?

Factors:

- Group composition: number, level, gender, age, …
- Task features: verbalizable, open, …
- Medium: face-to-face, synchro/not, text/audio/video,…
- Context: school/work

The effects of collaborative depends upon so many variables (plus their interaction effects) that it is impossible to predict that a given teamwork in a specific context will be effective

Research Phase 3

Which interactions make collaborative learning effective ?

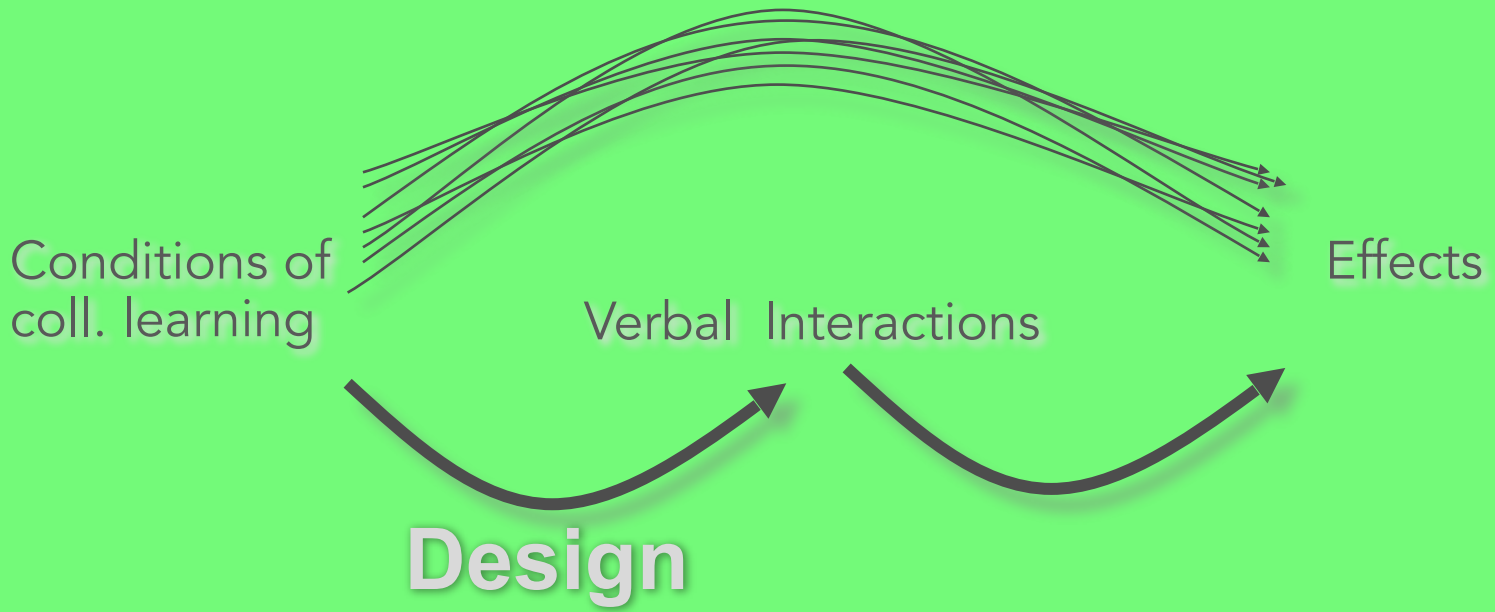
1. Elaborated explanations
2. Conflict resolution, Argumentation / Négociation
3. Mutual Regulation

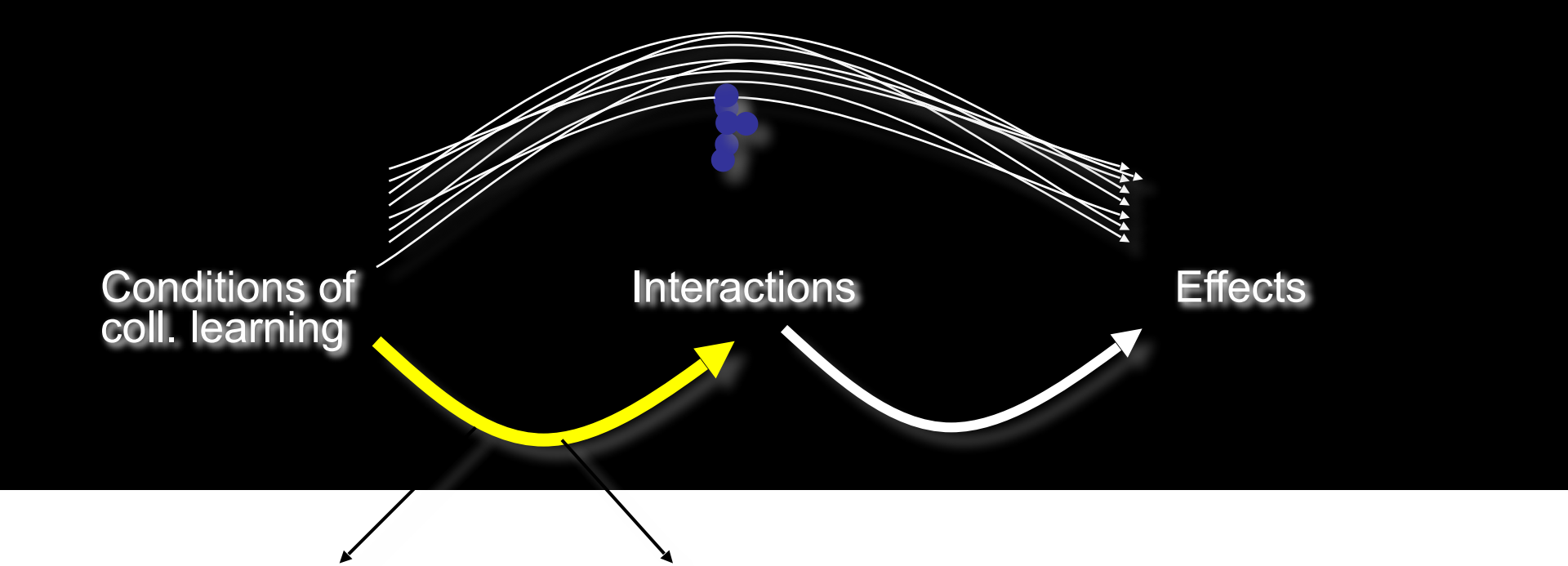
Collaborative learning occurs when team members engage into the ‘productive interactions’ listed above.

These interactions are summarized as “the effort” that team members engaged to reach and maintain a shared understanding of the task.

Research Phase 4:

Which design increases the probability that teams produce rich verbal interactions (that make collaborative learning effective) ?





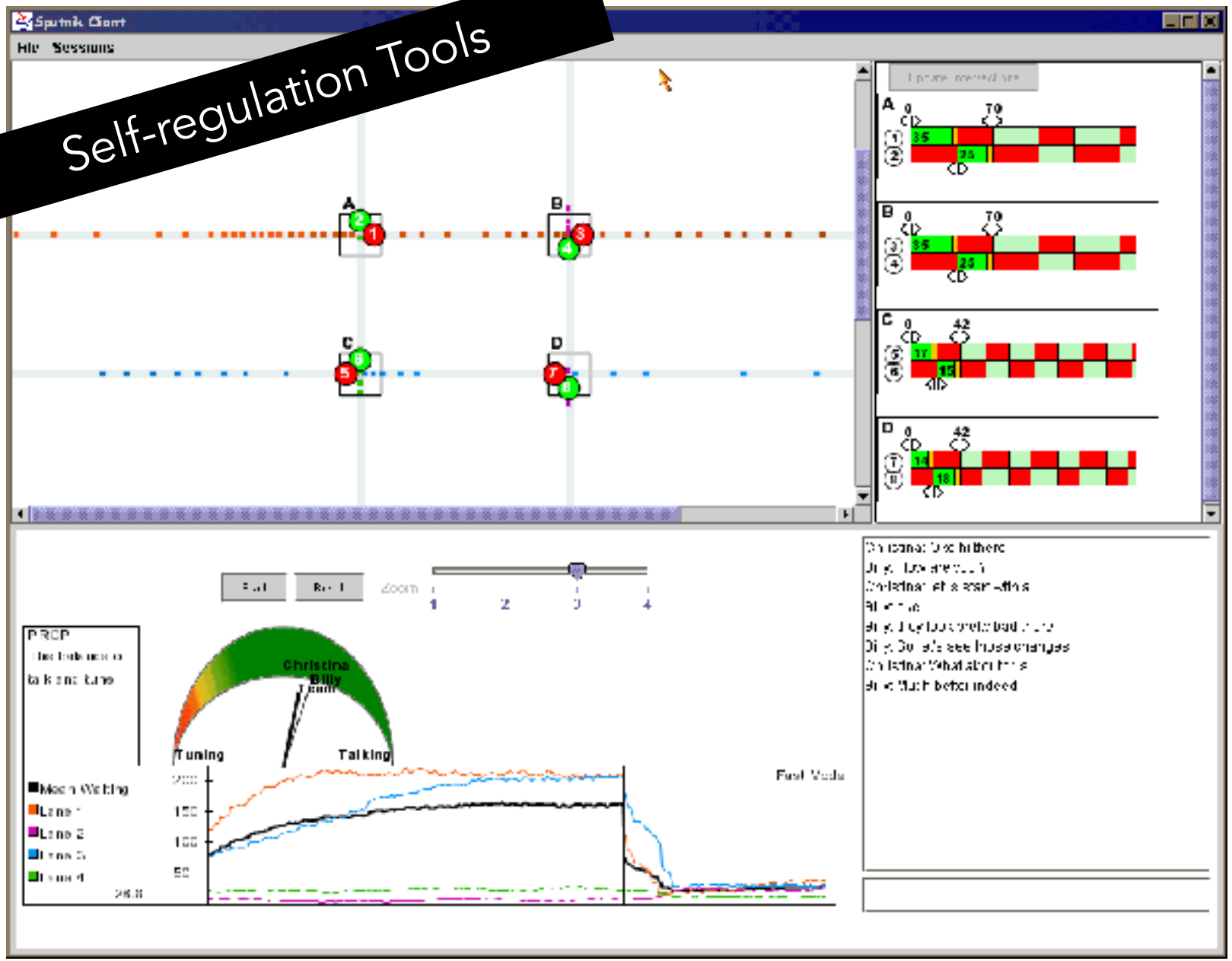
(proactive)

STRUCTURE

(reactive)

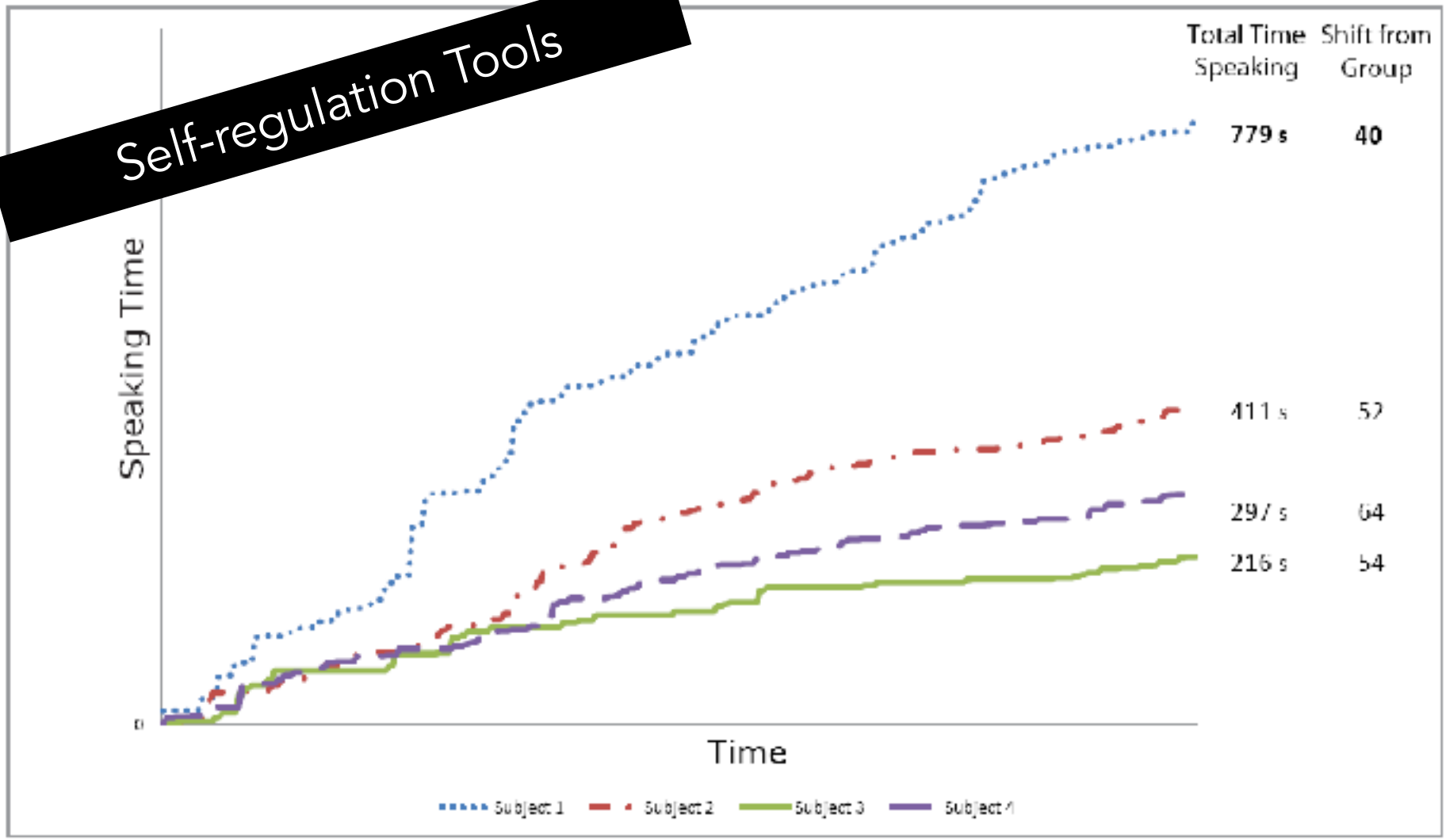
(self-) REGULATE

Self-regulation Tools



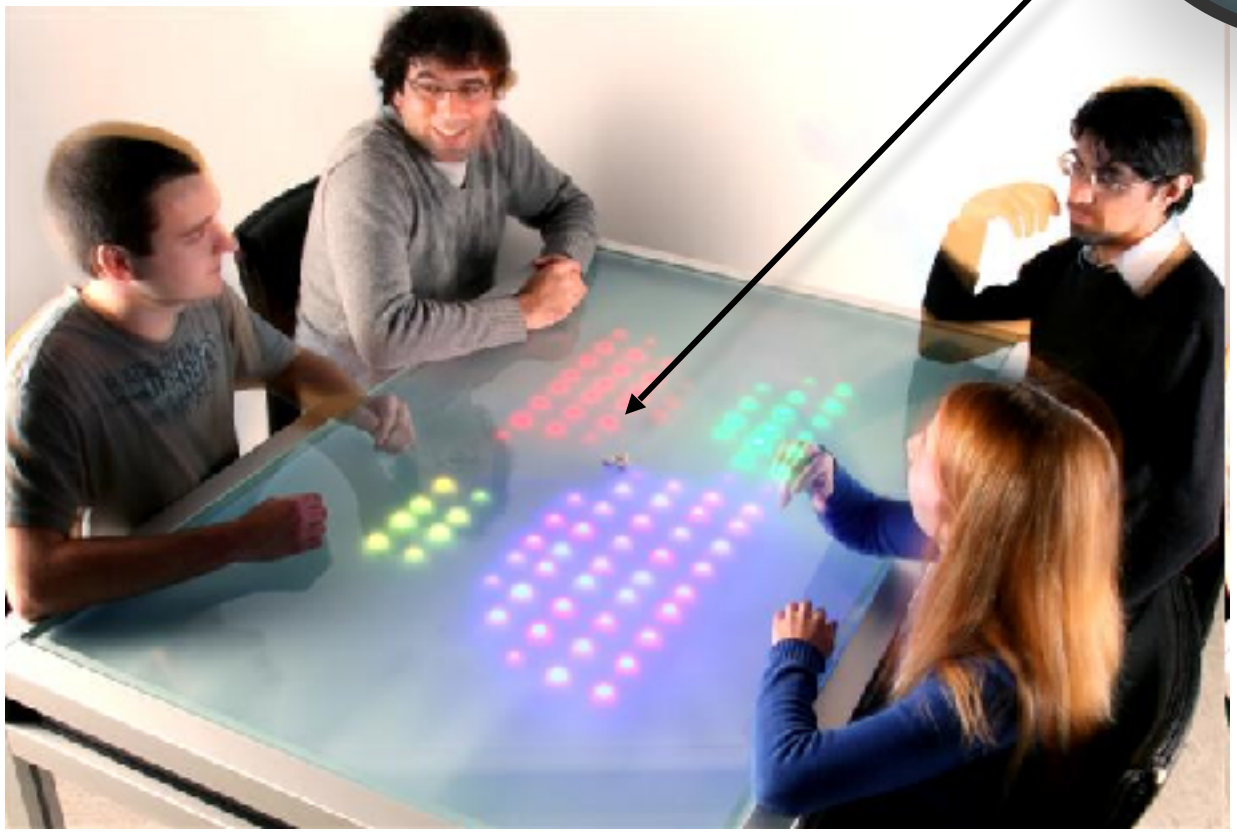
P. Jermann

Self-regulation Tools



Example of domination in teamwork

Self-regulation Tools

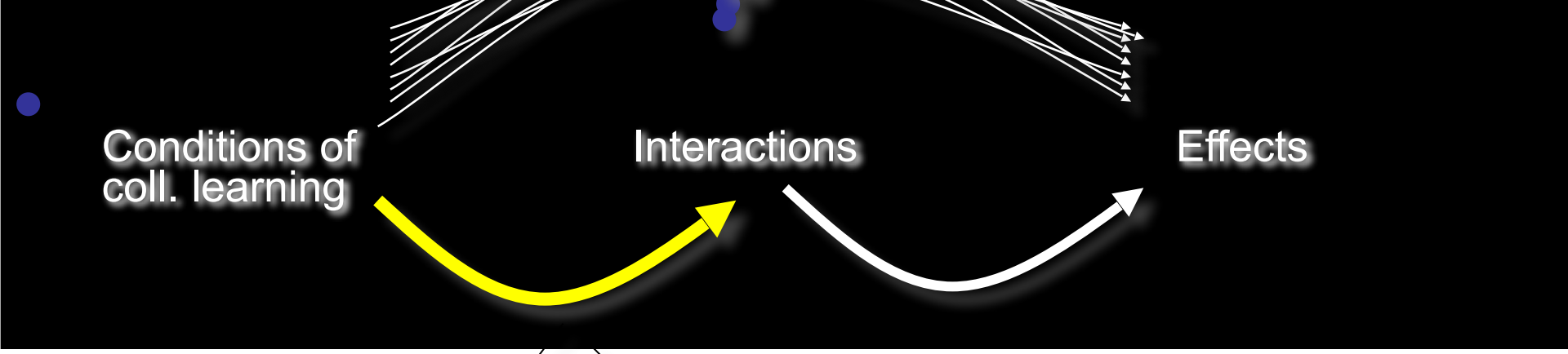


Reflect Table

•K. Bachour, F. Kaplan, W. Hokenmeier

Reflect

Self-regulation Tools

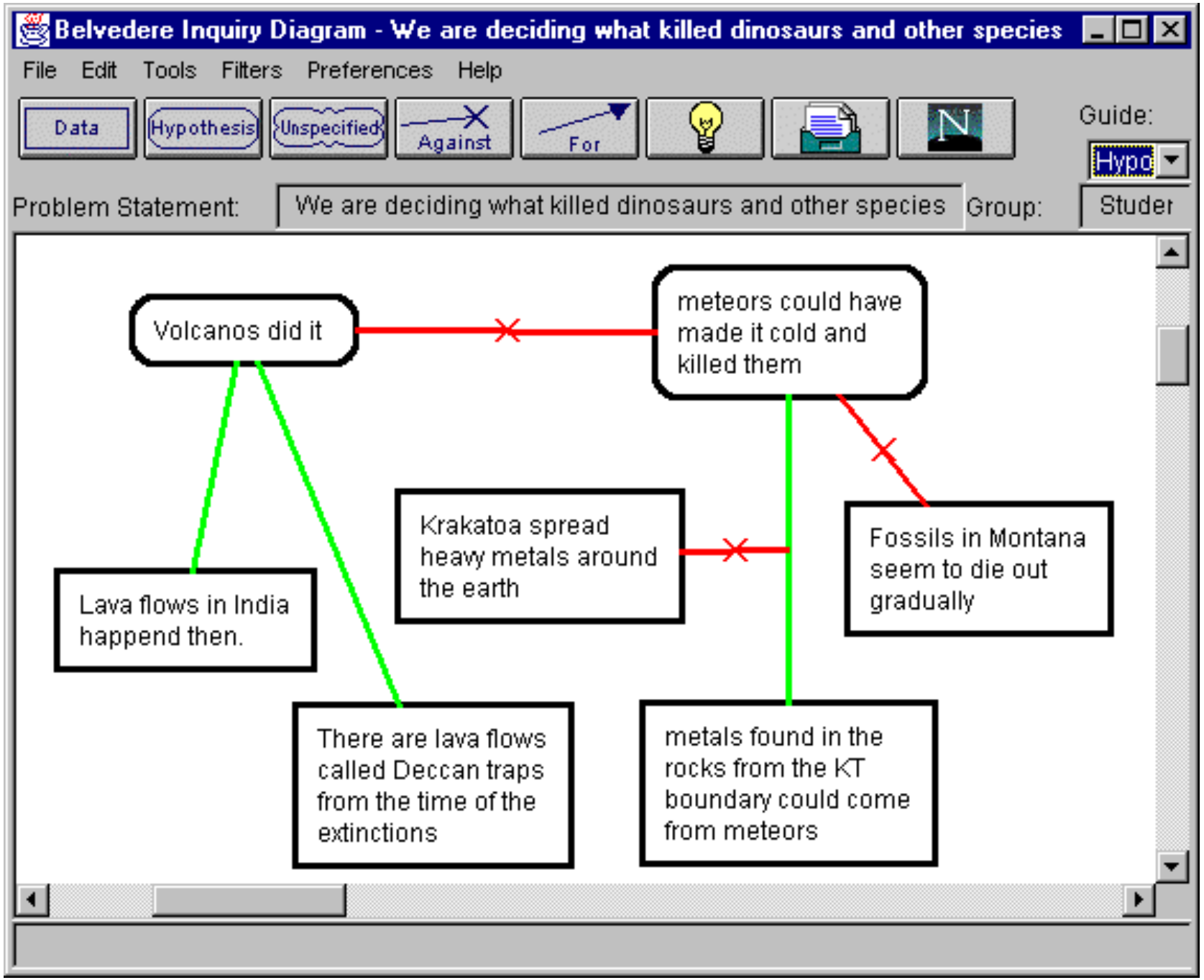


(reactive) REGULATE

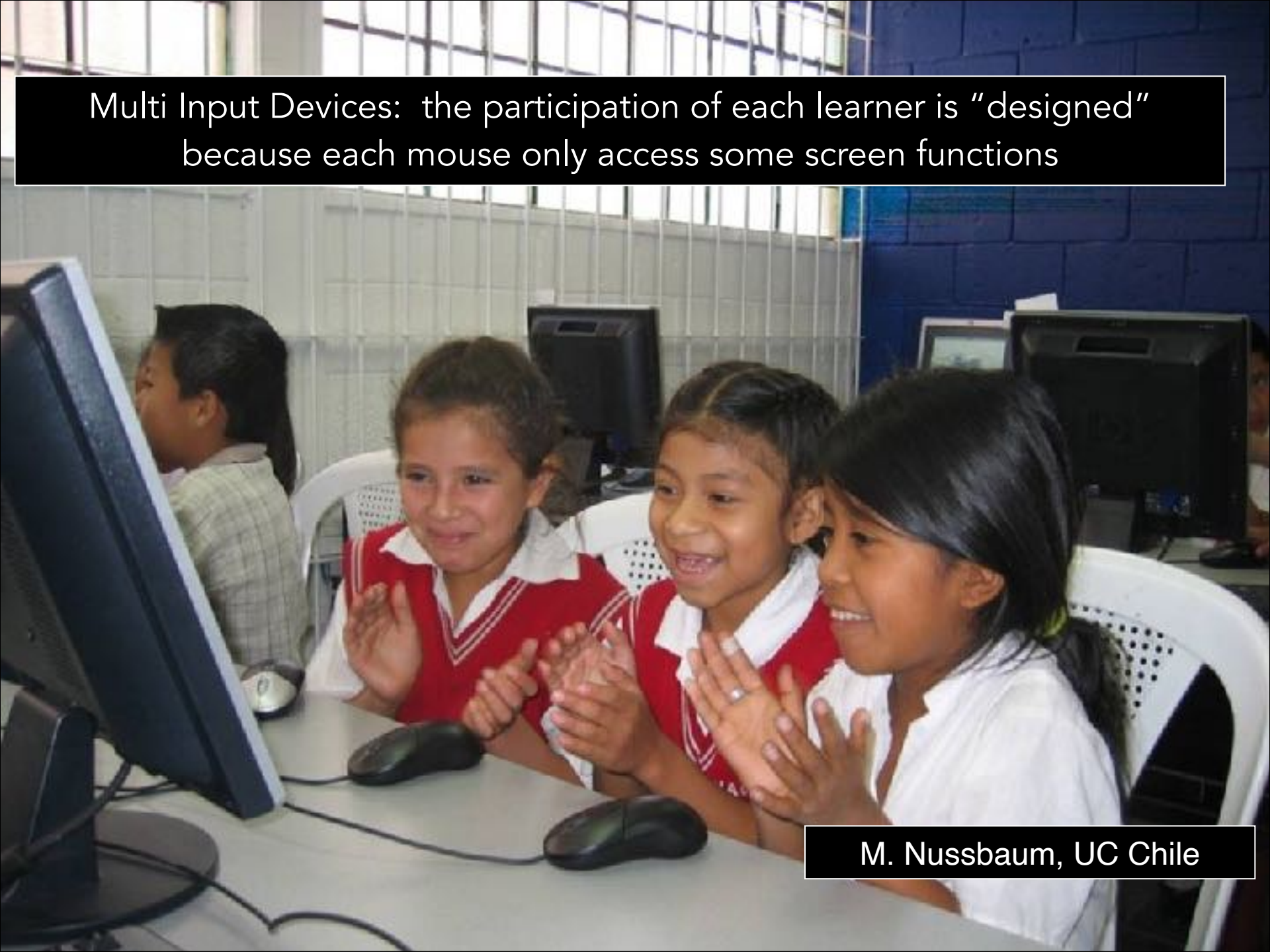
(proactive) STRUCTURE

SCRIPTS

Semi-Structured Interfaces

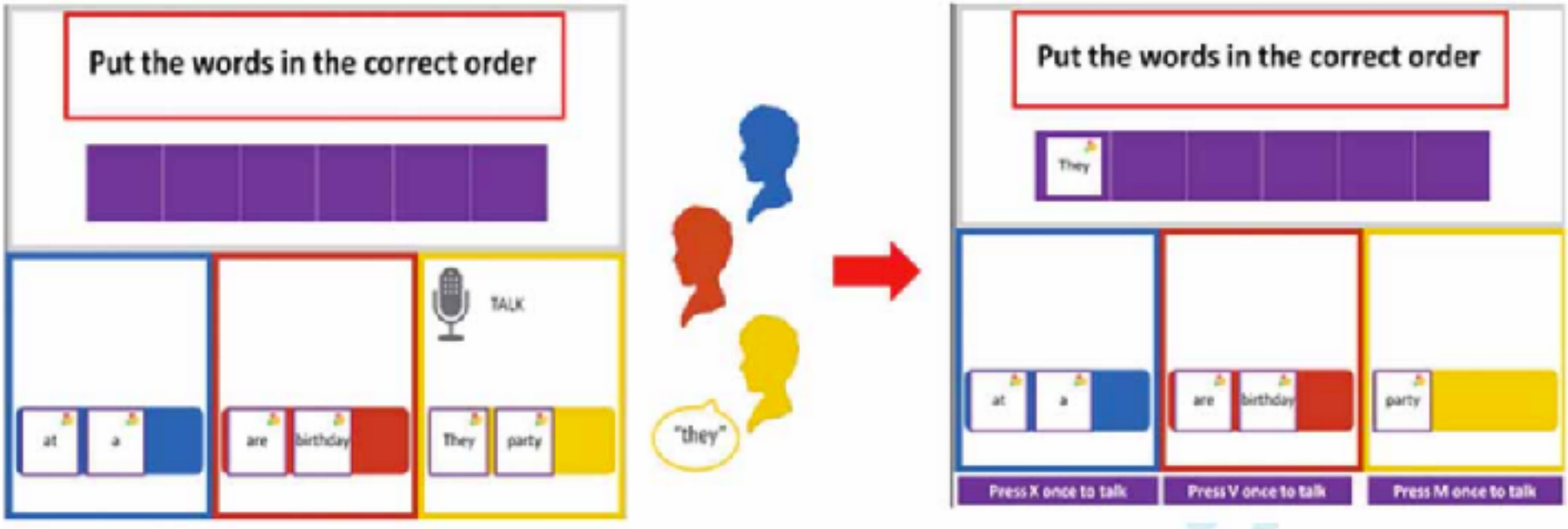


Belvedere (Suther et al.)


Multi Input Devices: the participation of each learner is "designed" because each mouse only access some screen functions
M. Nussbaum, UC Chile

Multi Input Devices:

the participation of each learner is “designed” because each mouse only access some screen functions



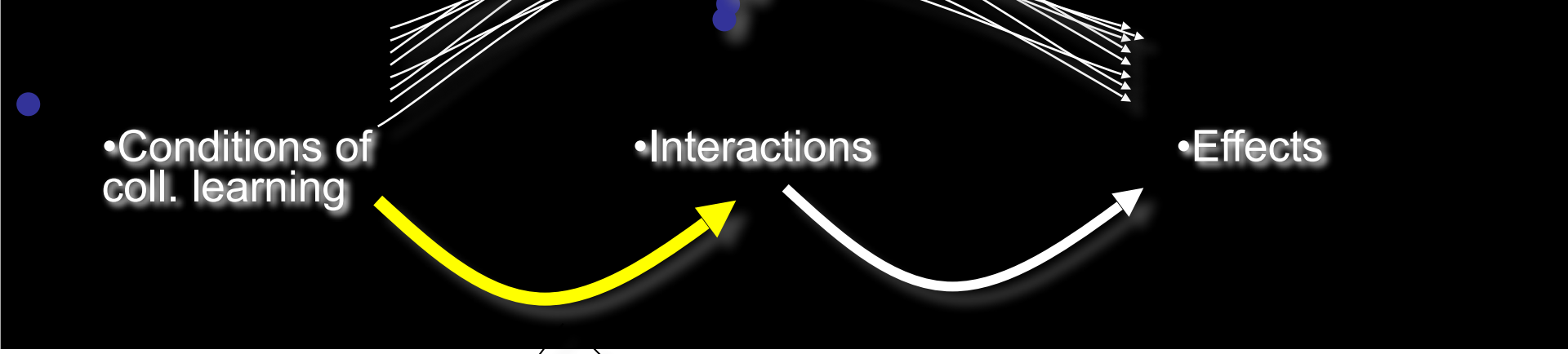
M. Nussbaum, UC Chile

"Computer-supported collaborative learning" (CSCL)

1990-2000: Technologies enable collaboration

2000-2010: Technologies shape collaboration (design)

2010-2020: Technologies that integrate collaboration



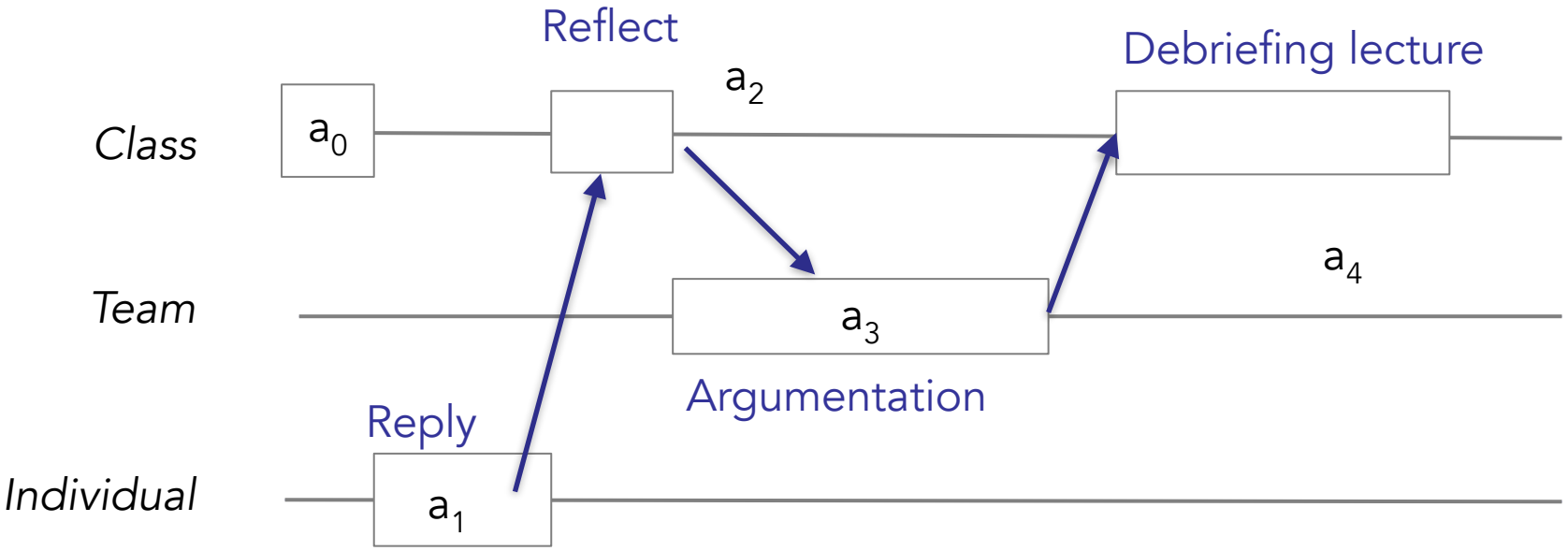
(reactive) REGULATE

(proactive) STRUCTURE

Semi-Structured Interfaces

Pedagogical scenario for increasing the probability that interactions X,Y,Z occur in teamwork.

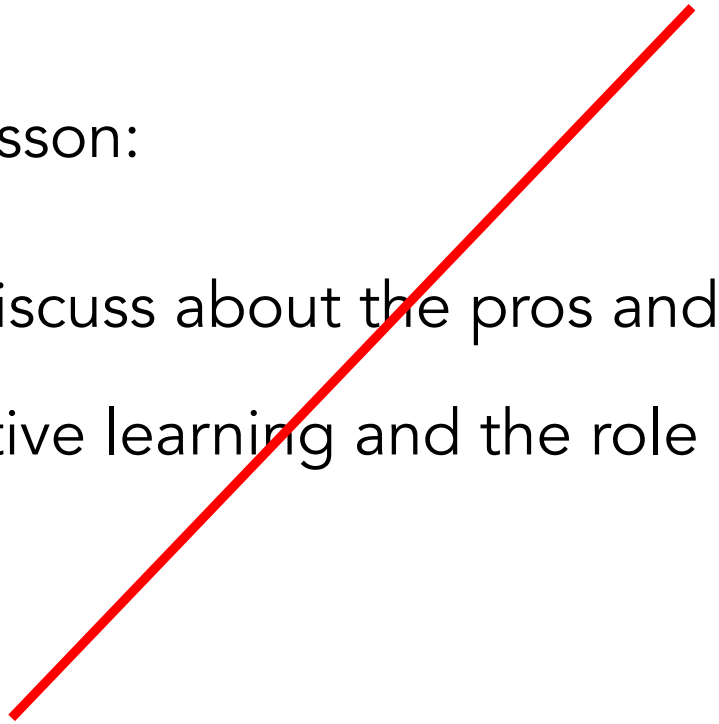
Orchestration Graph

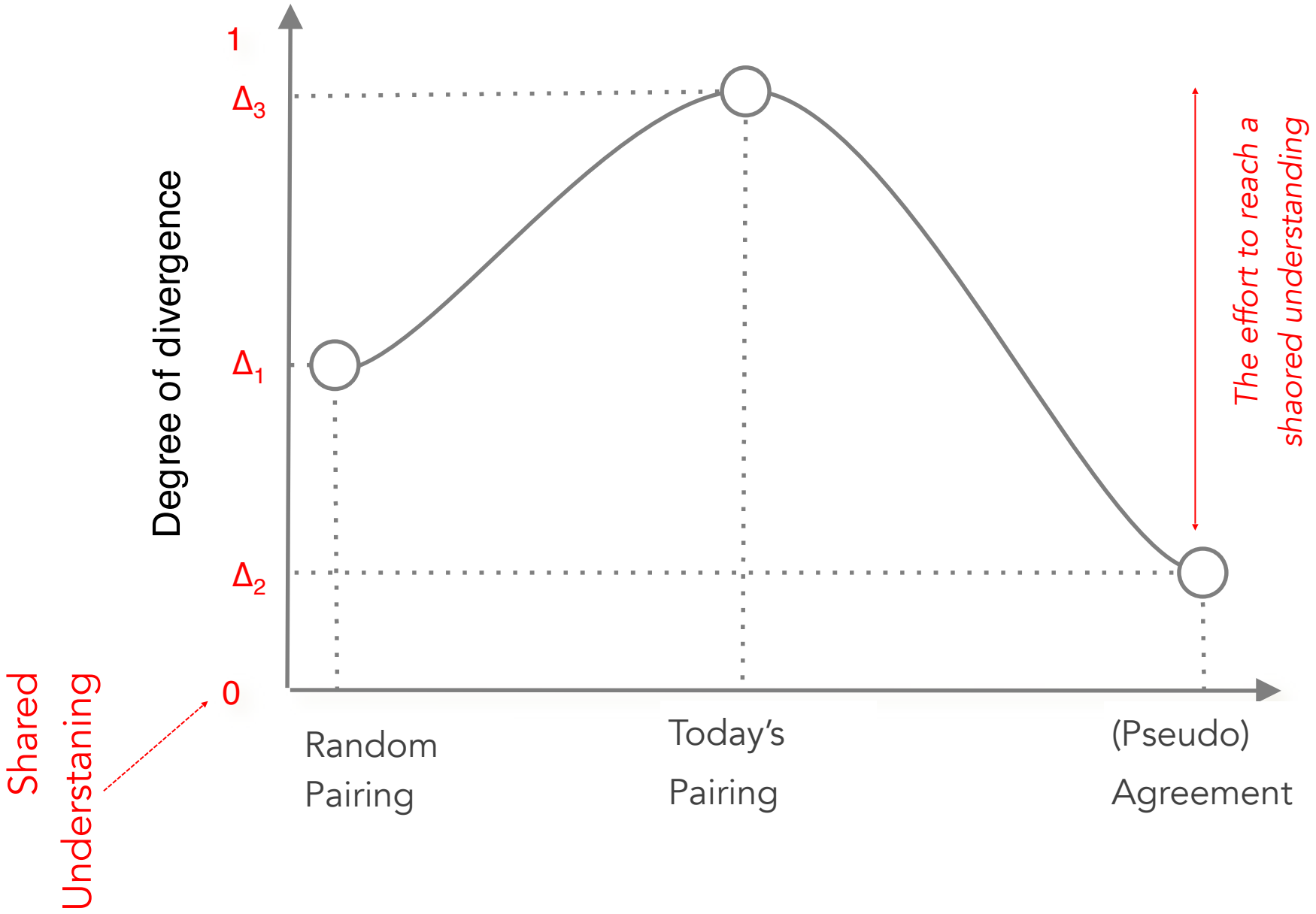


Collaborative learning is not a dogma

Today's lesson:

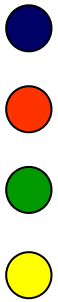
"Please discuss about the pros and cons of collaborative learning and the role of computers !"




1
Δ_3
Δ_1
Δ_2
0
Degree of divergence
Shared Understaning
Random Pairing
Today's Pairing
(Pseudo) Agreement
The effort to reach a shaored understanding

"Jigsaw"

- Task: How to prevent a large earthquake ?
- Roles:
  - Maire of San Francisco
  - Insurance agent
  - Security officer
  - Geologist

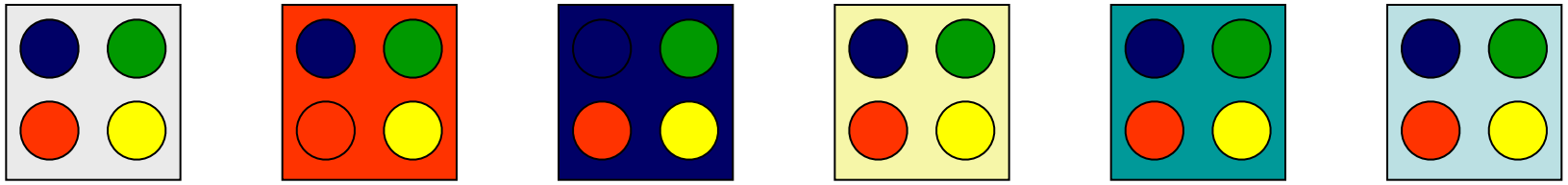


- Context: Previous experiments in Denver

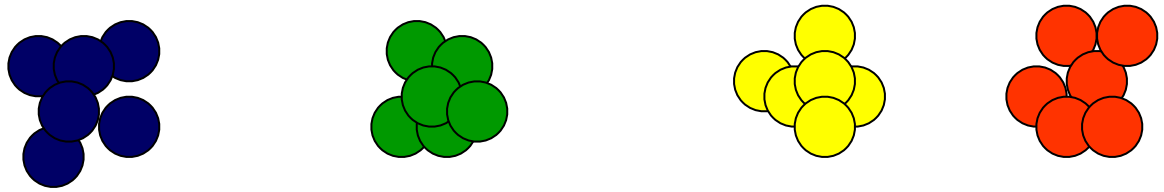
In the Jigsaw script, every team member receives a subset of the information necessary to solve the task. This task cannot be solved without the contribution of each individual.

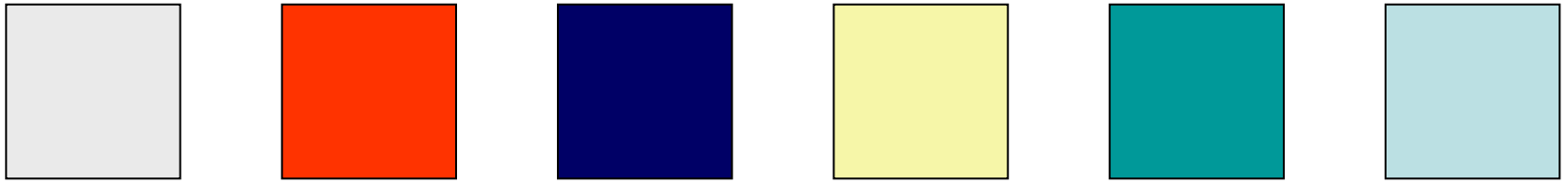
Jigsaw

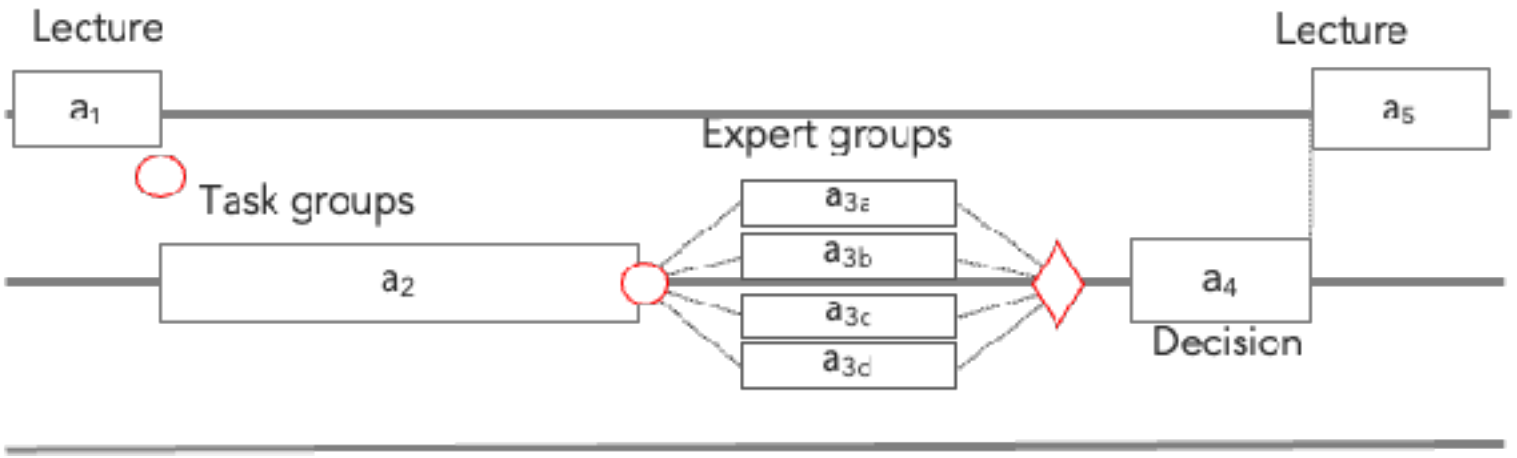
Phase “Groups”



Phase “Experts”

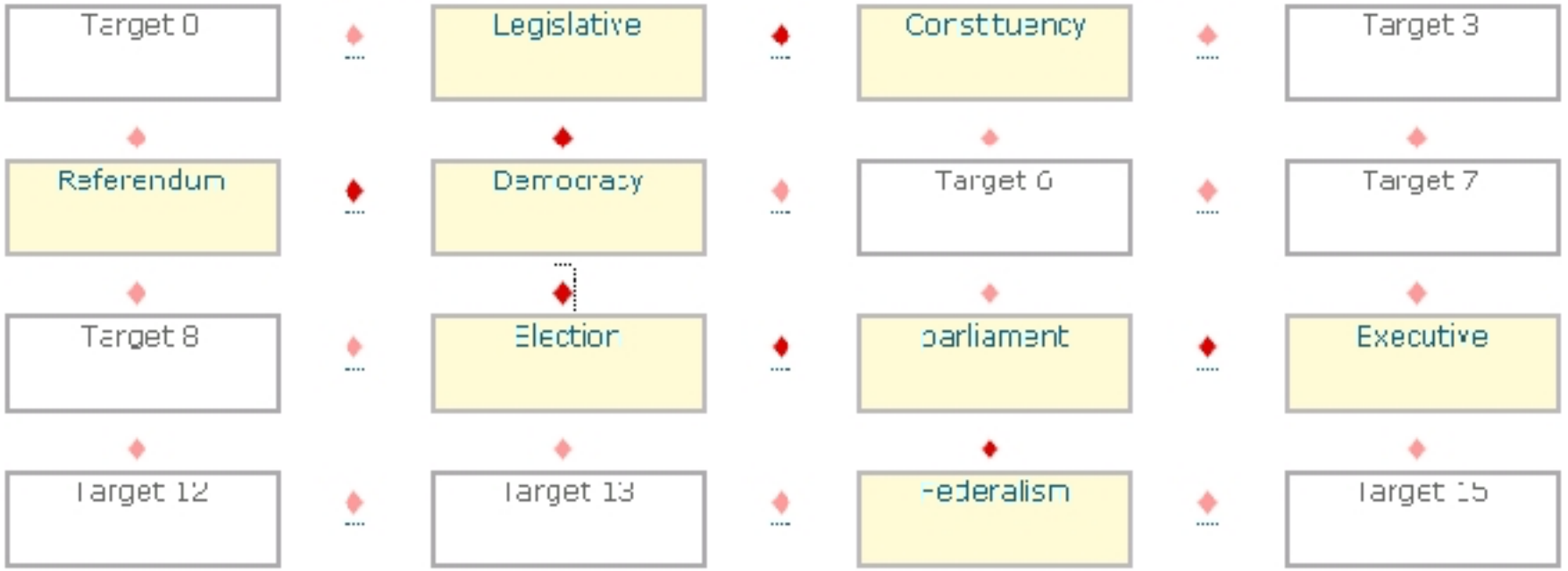





Lecture
Lecture
a1
a5
Expert groups
Task groups
a3a
a3b
a2
a4
a3c
a3d
Decision

Grid

Place the concepts below on this grid then click on the link between two concepts to define their similitude or difference with the help of your group members. You might change the concepts place to define other relations.

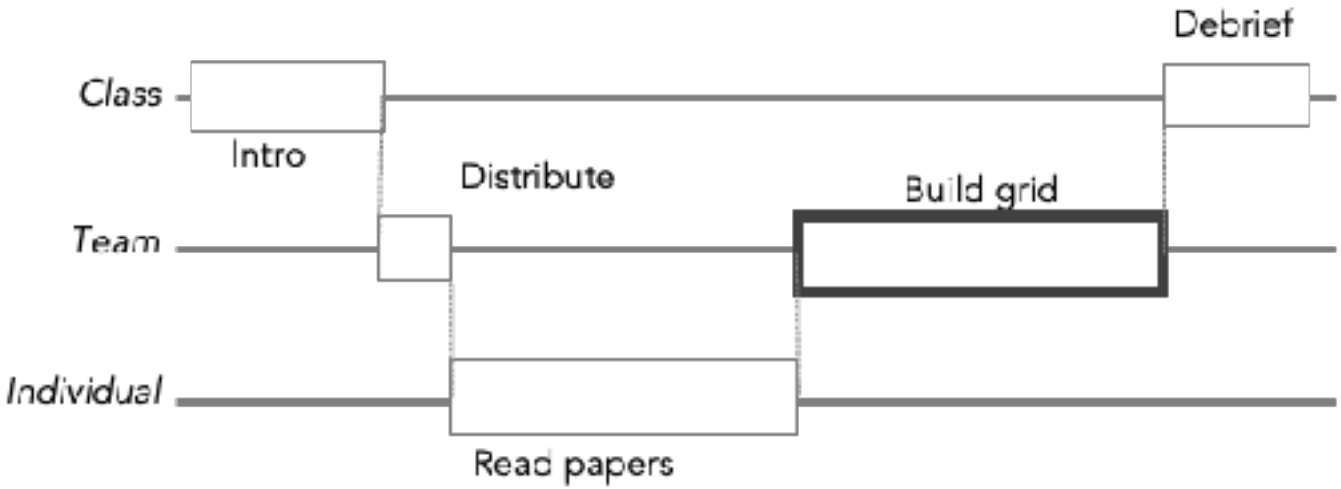


"Democracy" vs "Election"

Relationship: Similar

Comments: Democracy is a form of goverment in which it is recognized that ultimate authority belongs to the people, who have the right to participate in the decision-making process called elections, to appoint and dismiss their rulers.

Save | Reset


Debrief
Class
Intro
Distribute
Build grid
Team
Individual
Read papers

1. Collaborative learning occurs when team members engage into

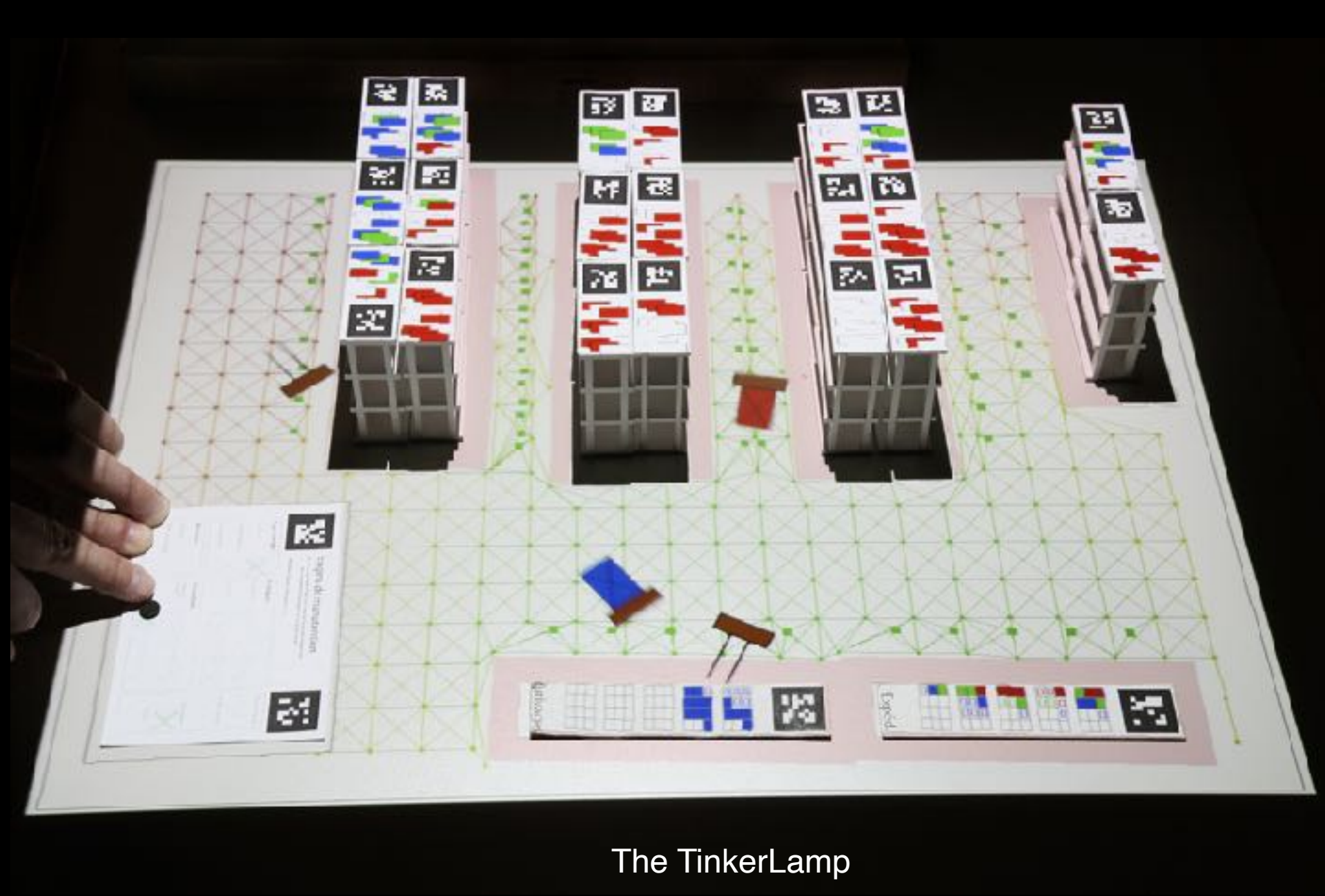
rich verbal interactions

These interactions are summarized as "the effort" that team members engaged to reach and maintain a shared understanding of the task.

2. Collaborative learning is not a religion. It benefits from being integrated into classroom scenarios that integrate individual, team and class wide activities.

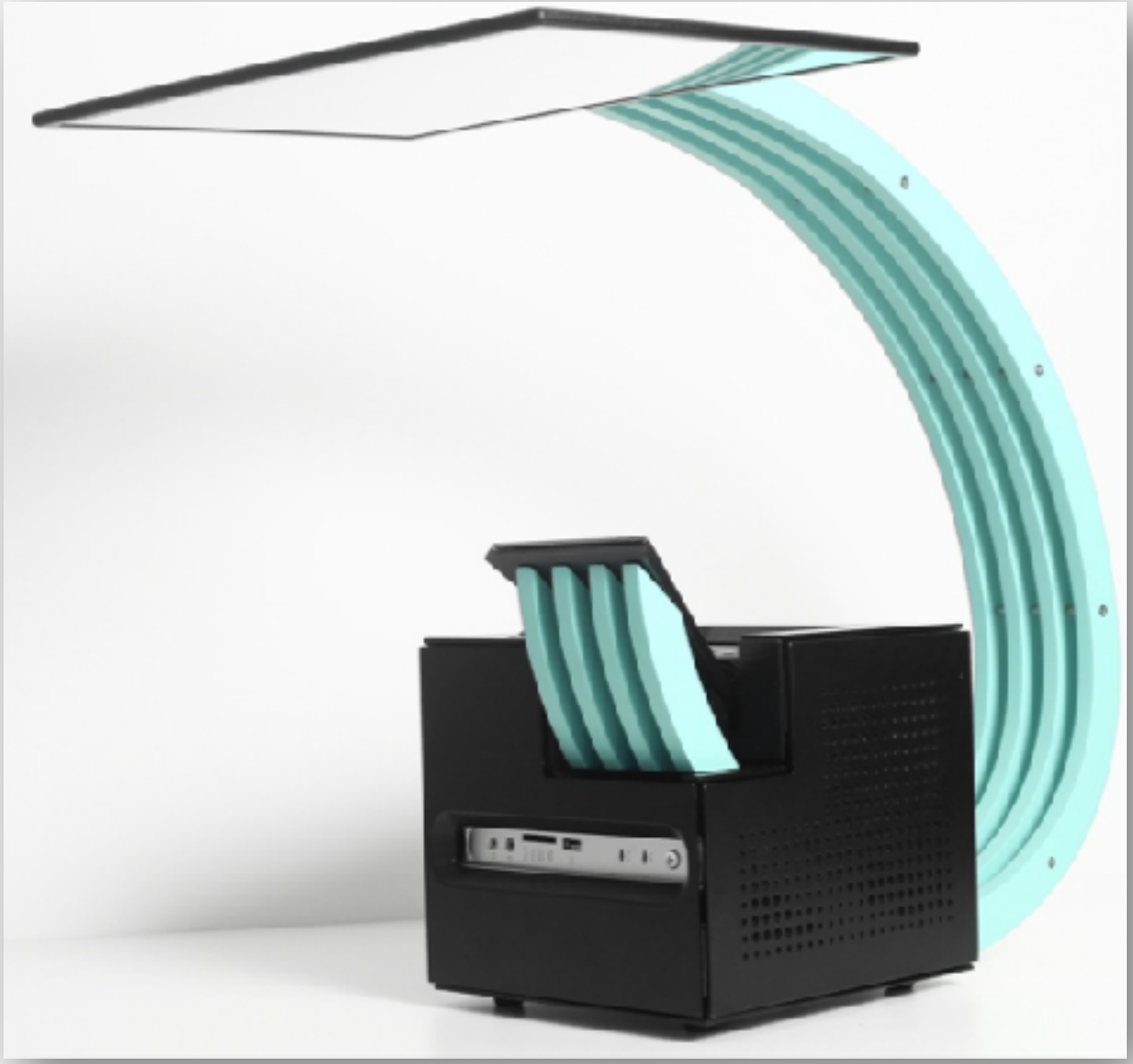
3. It takes talented teachers to orchestrate these scenarios

Apprentissage

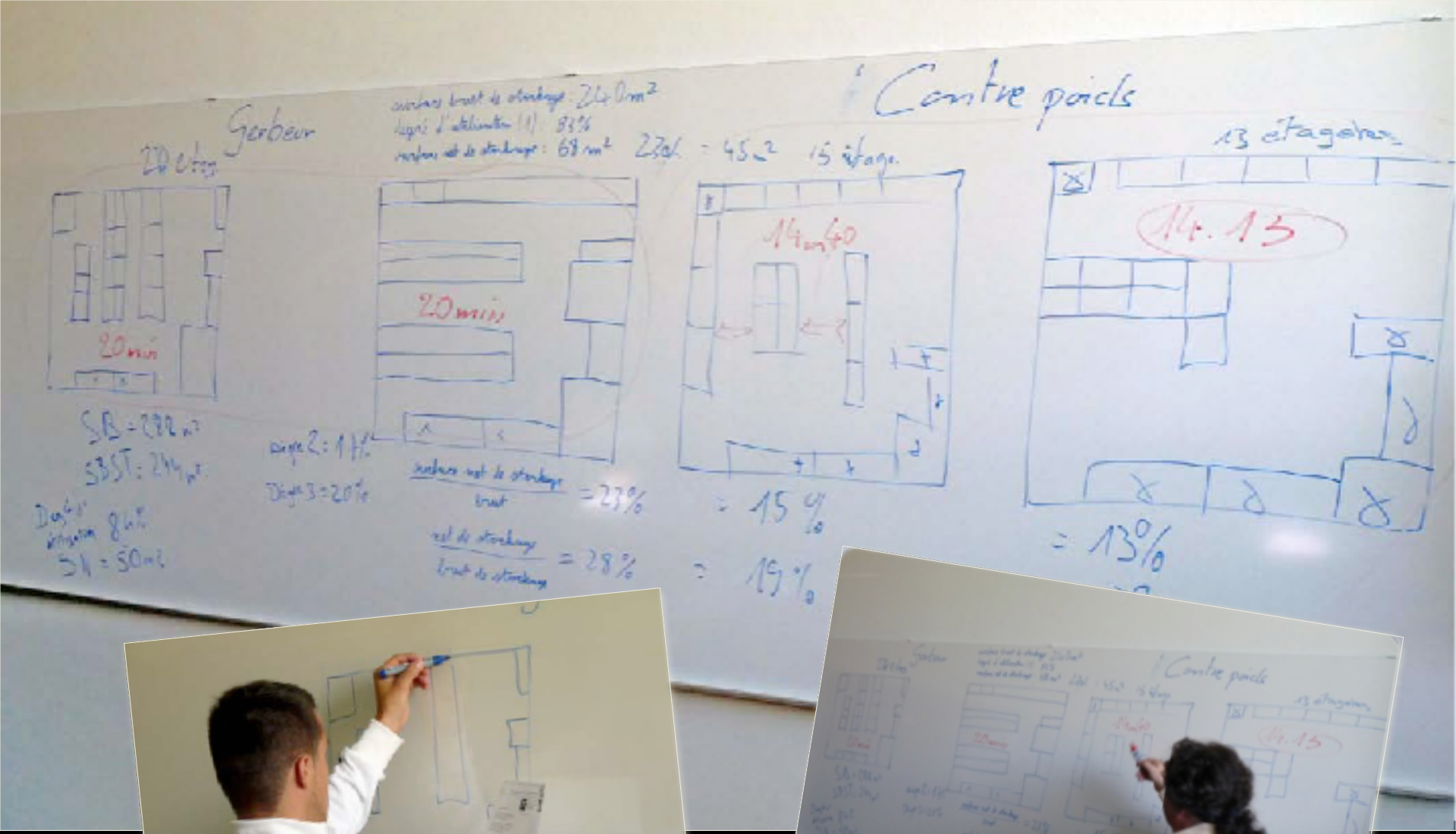


The TinkerLamp

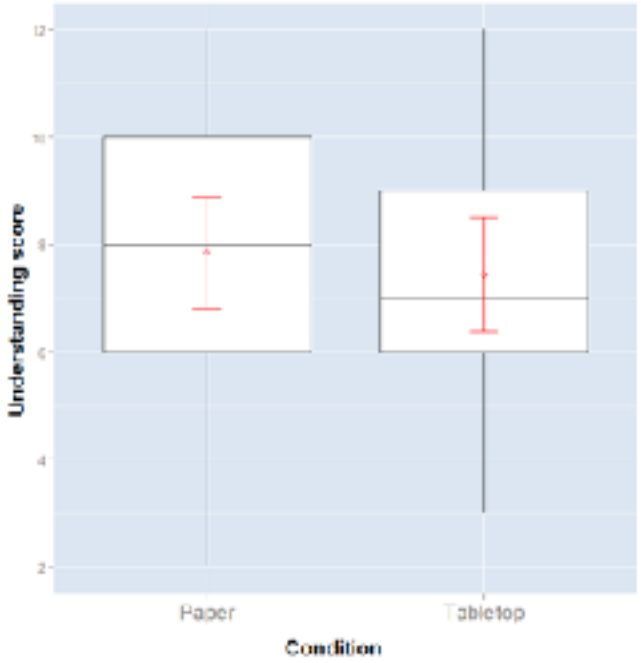
Guillaume Zufferey, Patrick Jermann




Simpliquity

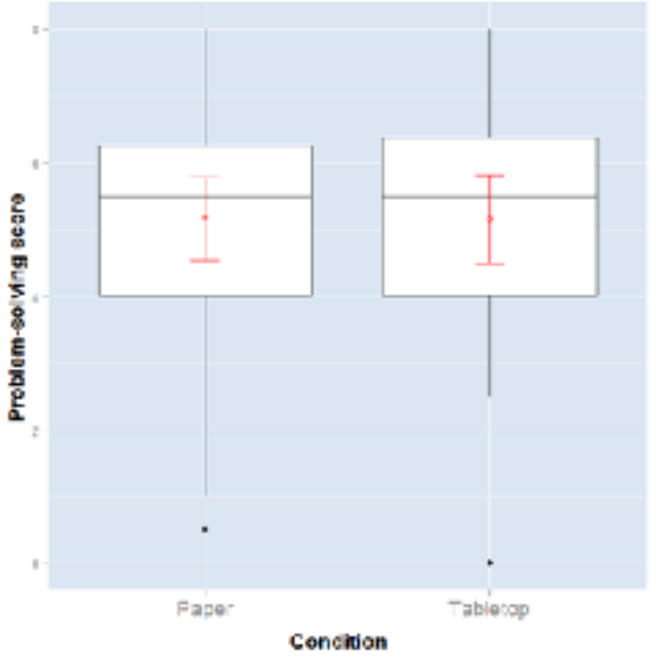

Gerbeur
Contre poids
20 min
20 min
14 m 40
13 étages
14.13
SB = 292 m²
SBST: 244 m²
Dégré 2: 11%
Dégré 3 = 20%
= 23%
= 28%
= 15 %
= 19 %
= 13%

No sign. effect in understanding



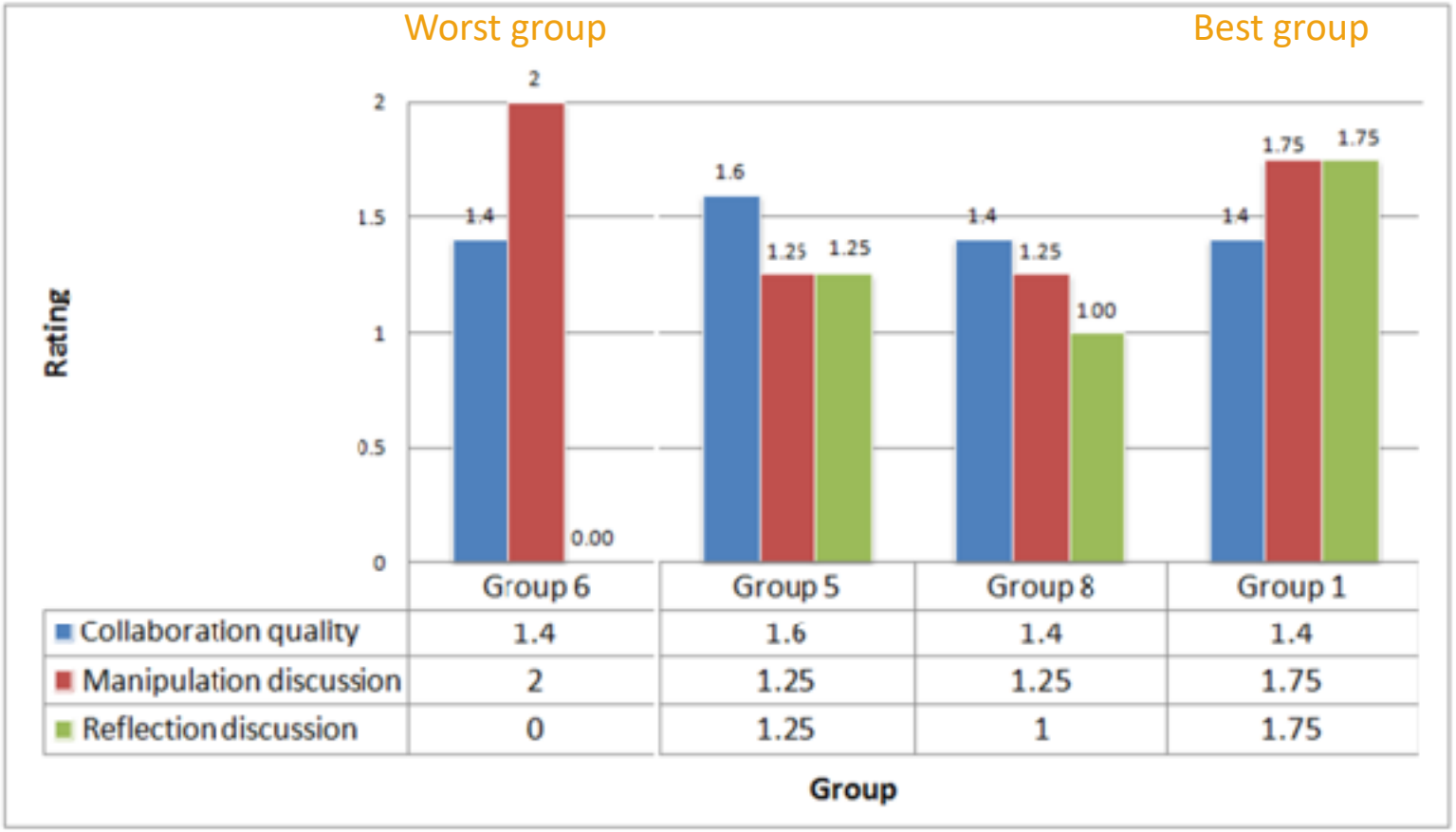
mean = 7.84 vs. mean = 7.43
F(1,14) = .25; p > .05

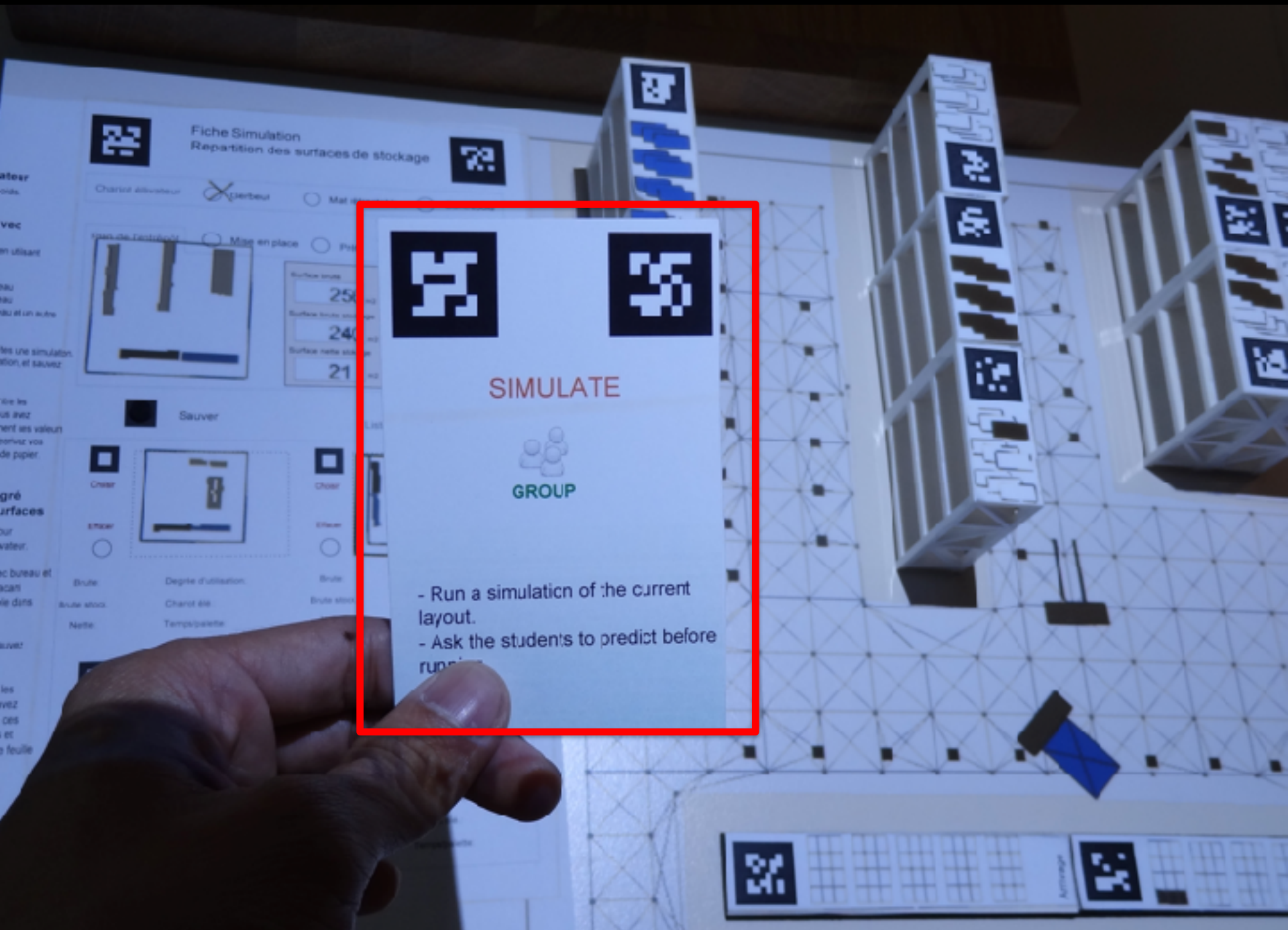
No sign. effect in problem-solving

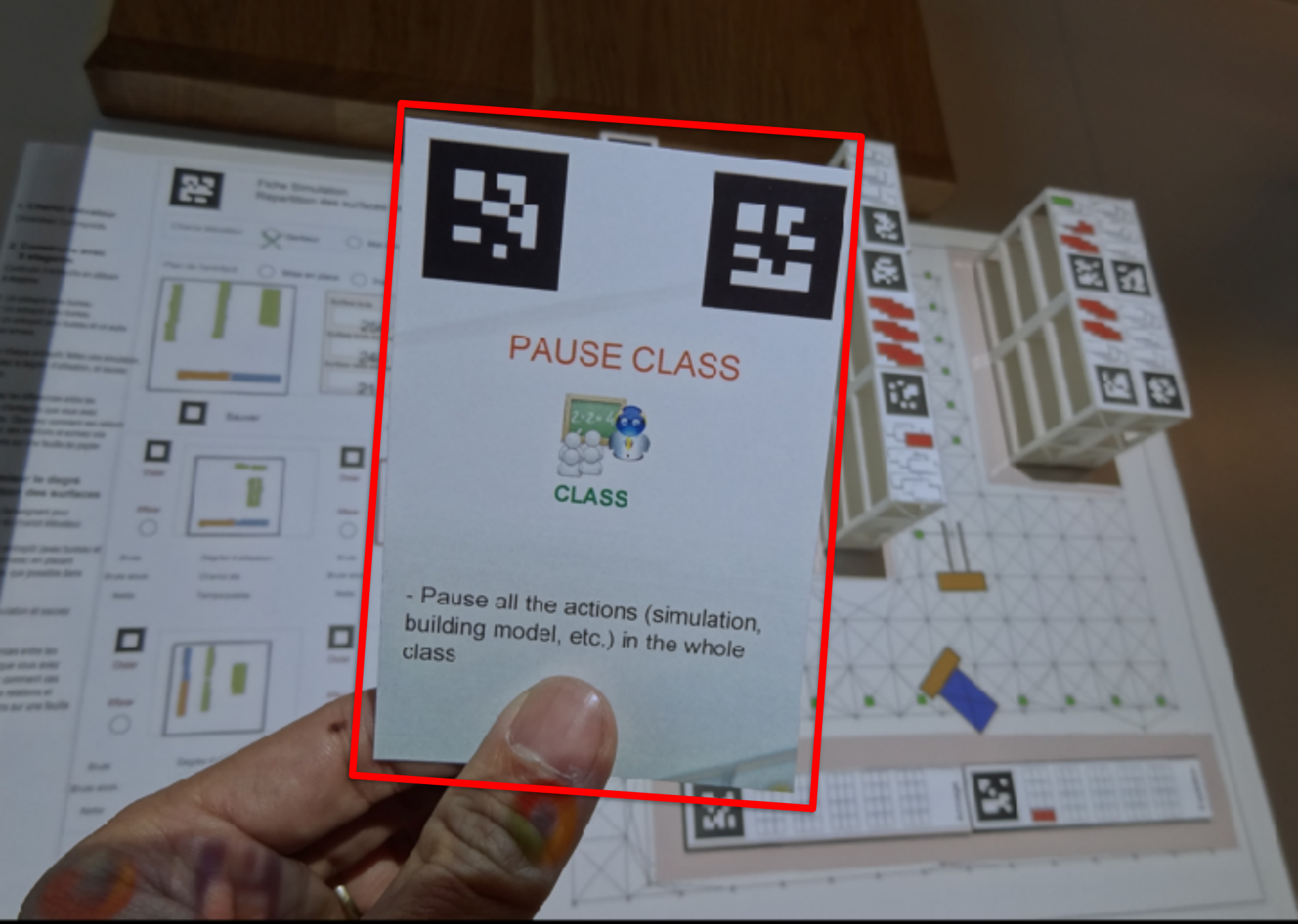


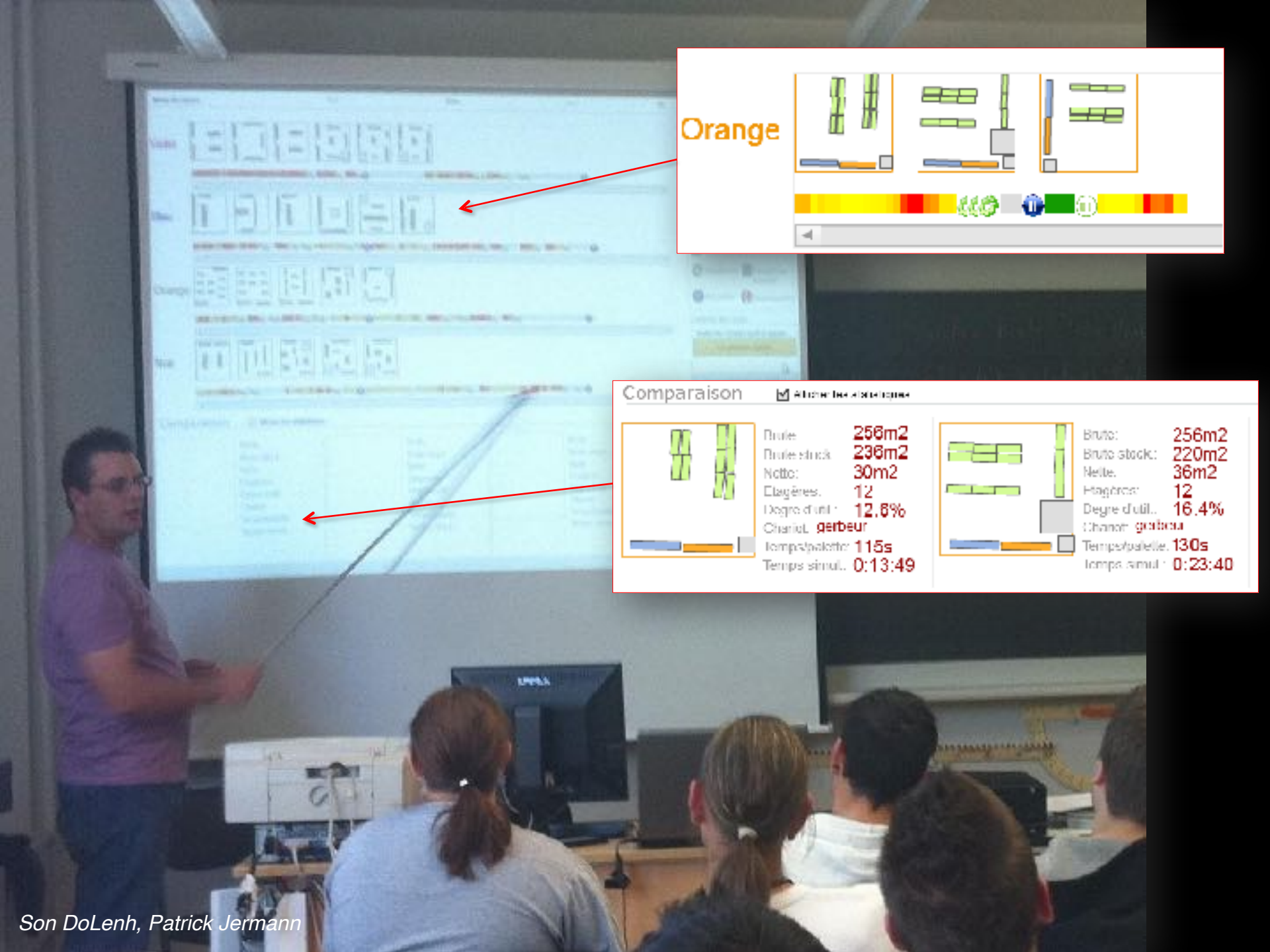
mean = 5.16 vs. mean = 5.15
F(1,14)=.06, p>.05

“Tentation de manipulation”




Fiche Simulation
Répartition des surfaces de stockage
Sauver
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

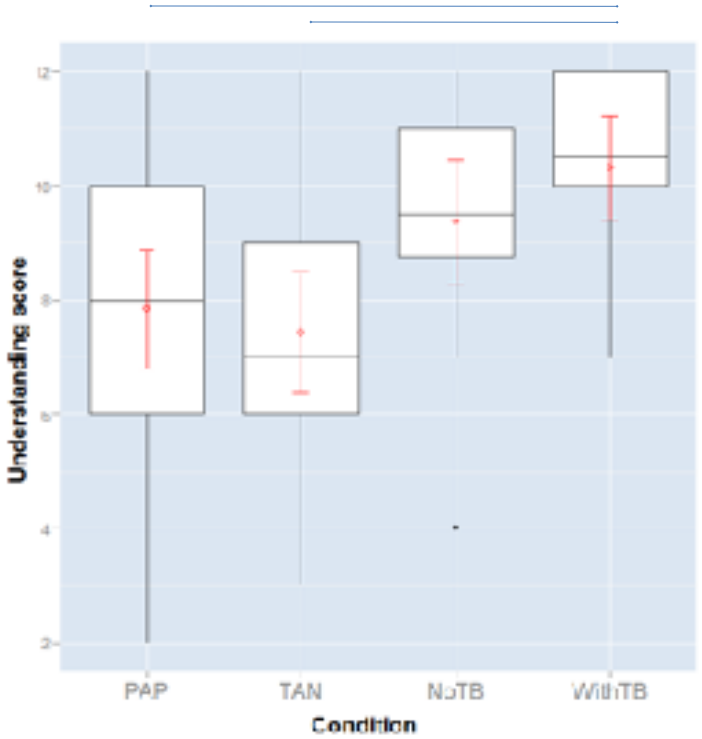


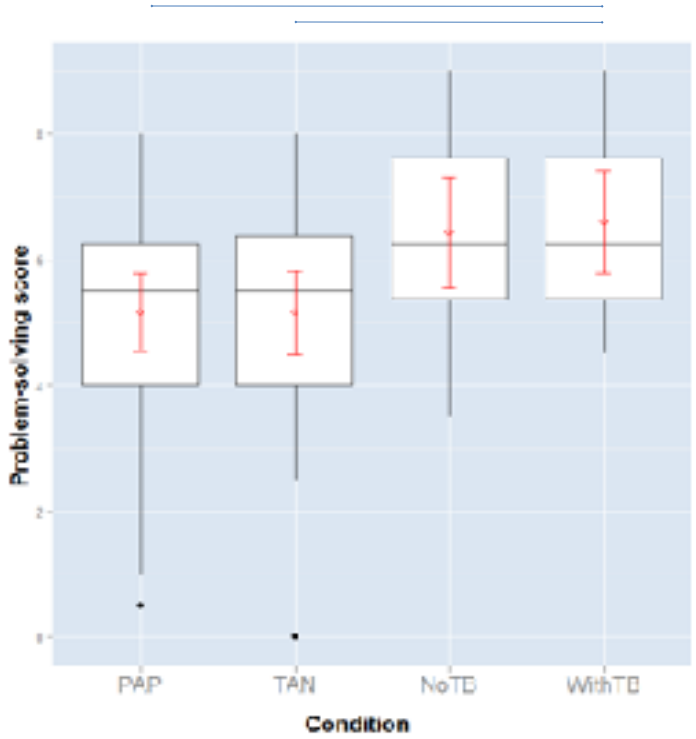
Son DoLenh, Patrick Jermann

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(2.05)	7.43(2.02)	9.39(2.63)	10.31(1.70)
Problem-solving score	5.16(1.70)	5.15(1.78)	6.44(1.65)	6.59(1.53)

Question

Please order a standard return 2nd class

Enter command

from Lausanne to Davos standard C2|re

Question

Please order a young return 2nd class ticket from Basel to Geneva without bike.

Your Ticket

City

From
Basel

To
Geneva

Basel | Davos | Fribourg
Geneva | Lausanne | Neuchâtel
Zurich

Travel
Return

Fare

Travel
One-way | Return

Fare
Standard | Young | Half-fare

Class

Bike

Class

Bike

Question

Please order a standard return 2nd class ti

From:
Fribourg

To:
Zurich

Travel:
Return

Fare:
Standard

Class:
2nd

Bike:
No

:24

Question

Please order a standard return 2nd class ticket from Basel to Zurich with a bike.

From
Basel

To
Zurich

Travel
One way
Return

Fare
Standard
Young
Half-fare

Class
1st
2nd

Bike
Yes
No

:24

HELP

BUY

Please select the interfaces and rank them with 1 being the best and 4 being the worst. Please justify your ranking.

If you rarely buy a train ticket rank the interfaces in the order that you would most prefer them.

Ryan's List

1. **Drag and Drop**
2. **Command**
3. **Form**
4. **Map**

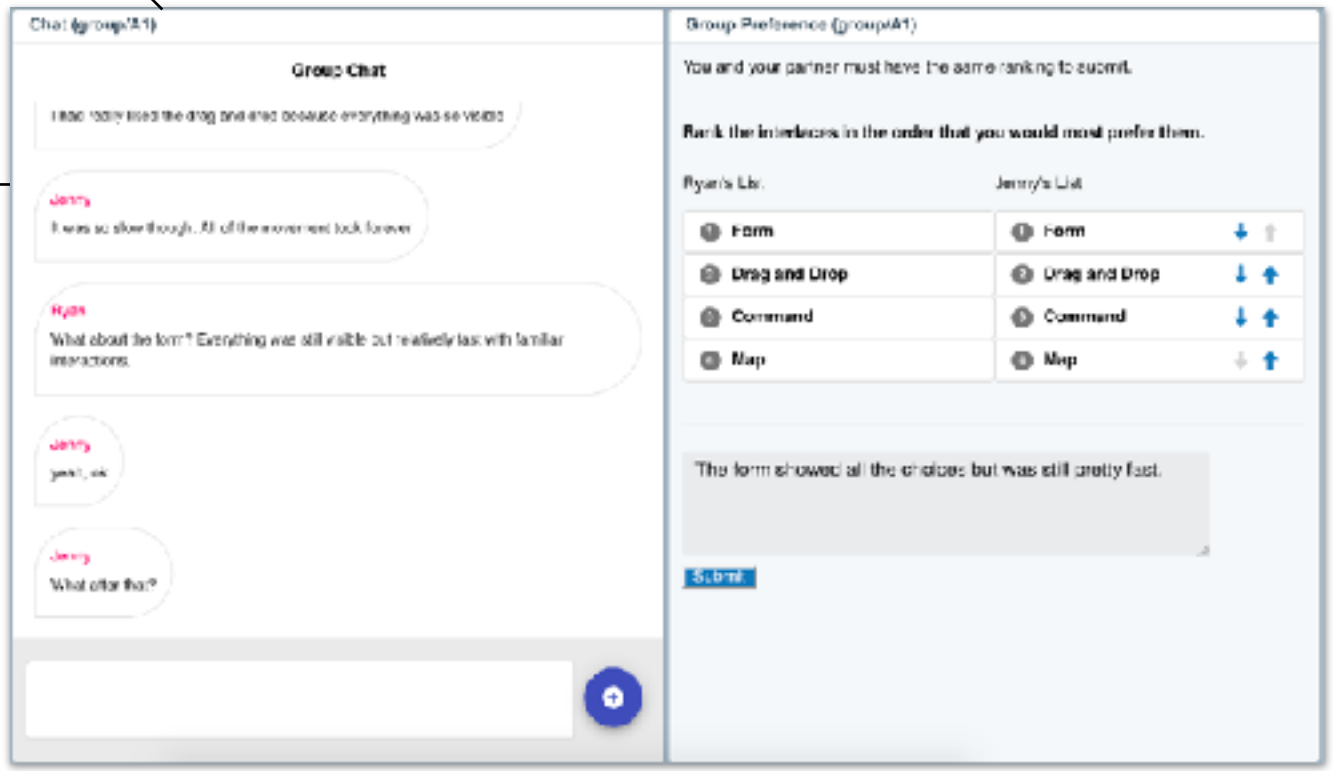
The drag and drop is easiest to see all of the options.

Submit

Class

Team

Solo



Socio-cognitive conflict

Class

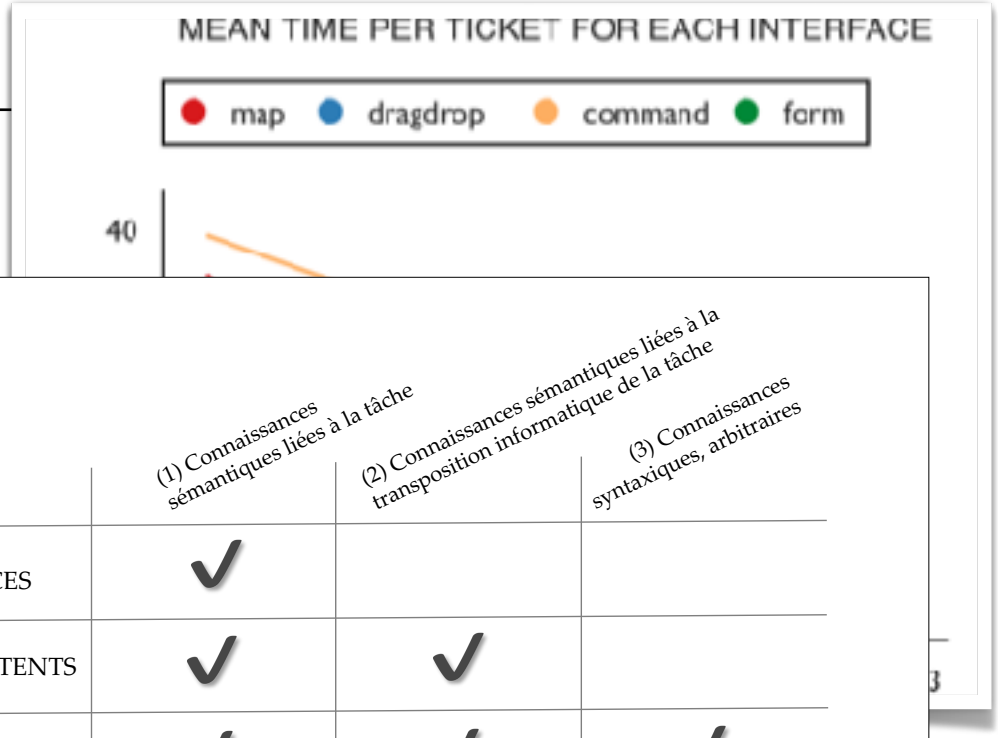
Team

Solo

Arguing with data

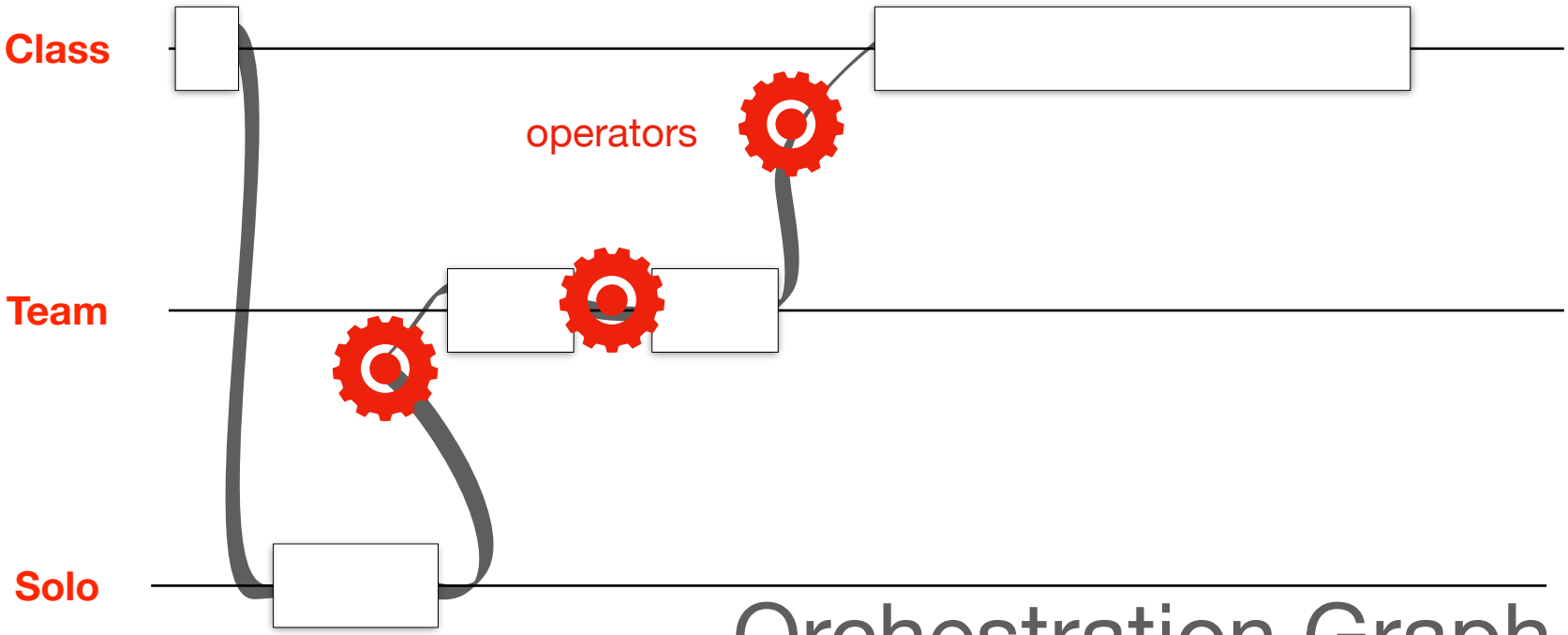
Class

Team

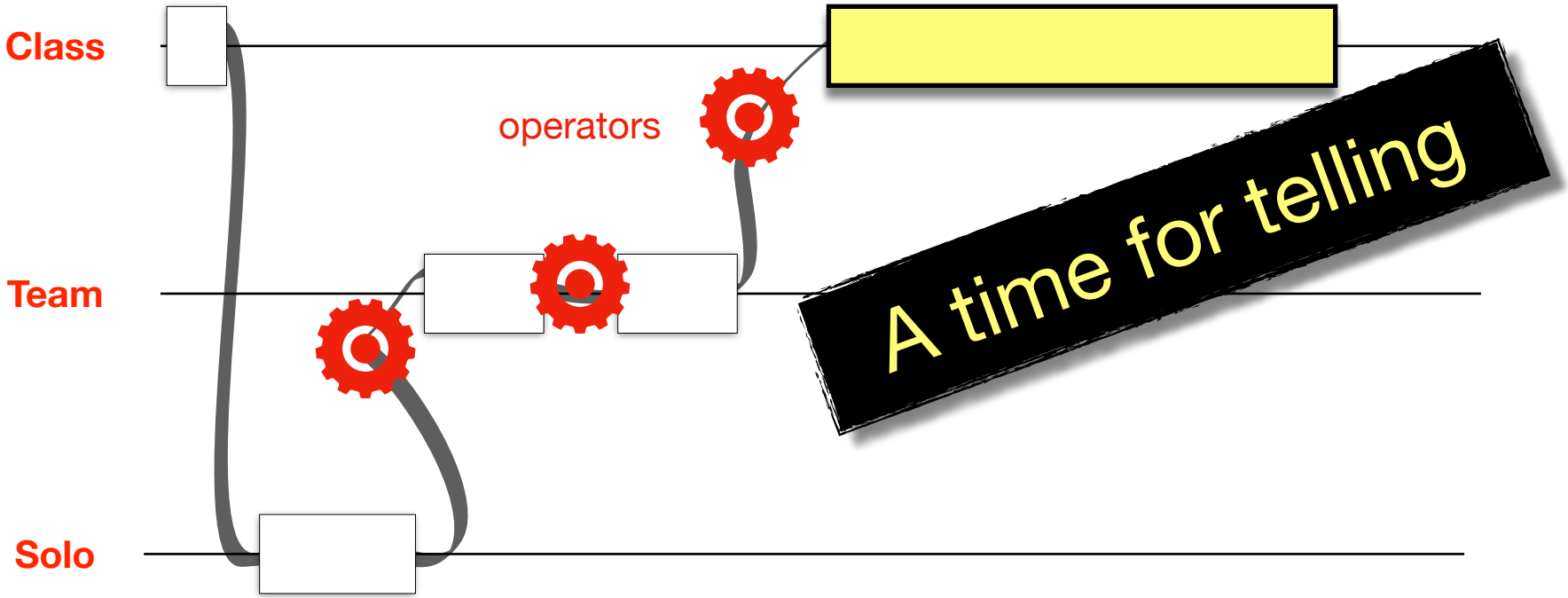


Solo

	(1) Connaissances sémantiques liées à la tâche	(2) Connaissances sémantiques liées à la transposition informatique de la tâche	(3) Connaissances syntaxiques, arbitraires
NOVICES	✓		
INTERMITTENTS	✓	✓	
EXPERTS	✓	✓	✓



Orchestration Graph


Class
operators
Team
Solo
A time for telling

Classroom Orchestration

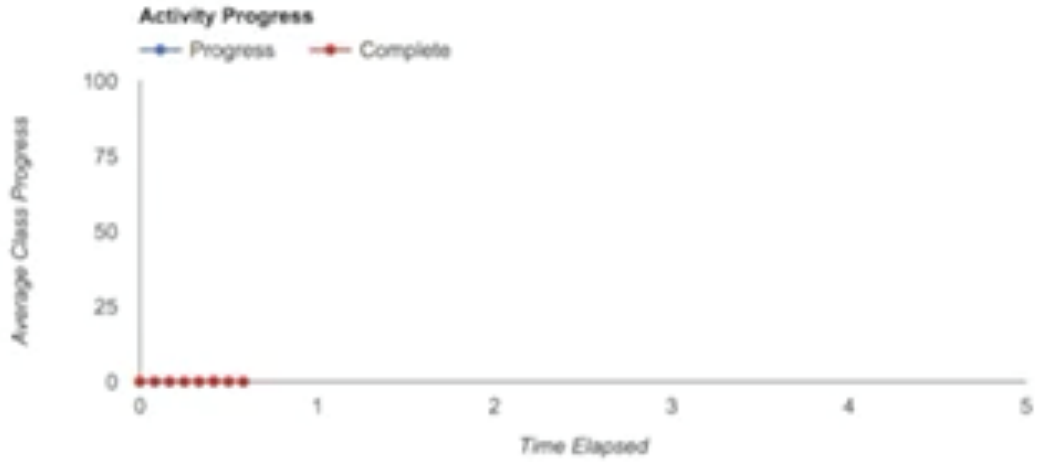
Admin Graph Editor Preview Teacher View

Next Activity | Toggle dashboard/graph view | Pause | Stop | Edit student list | Restart session | Start Countdown | +10s | -10s | Download log csv | Export session | 10s

session: UY56

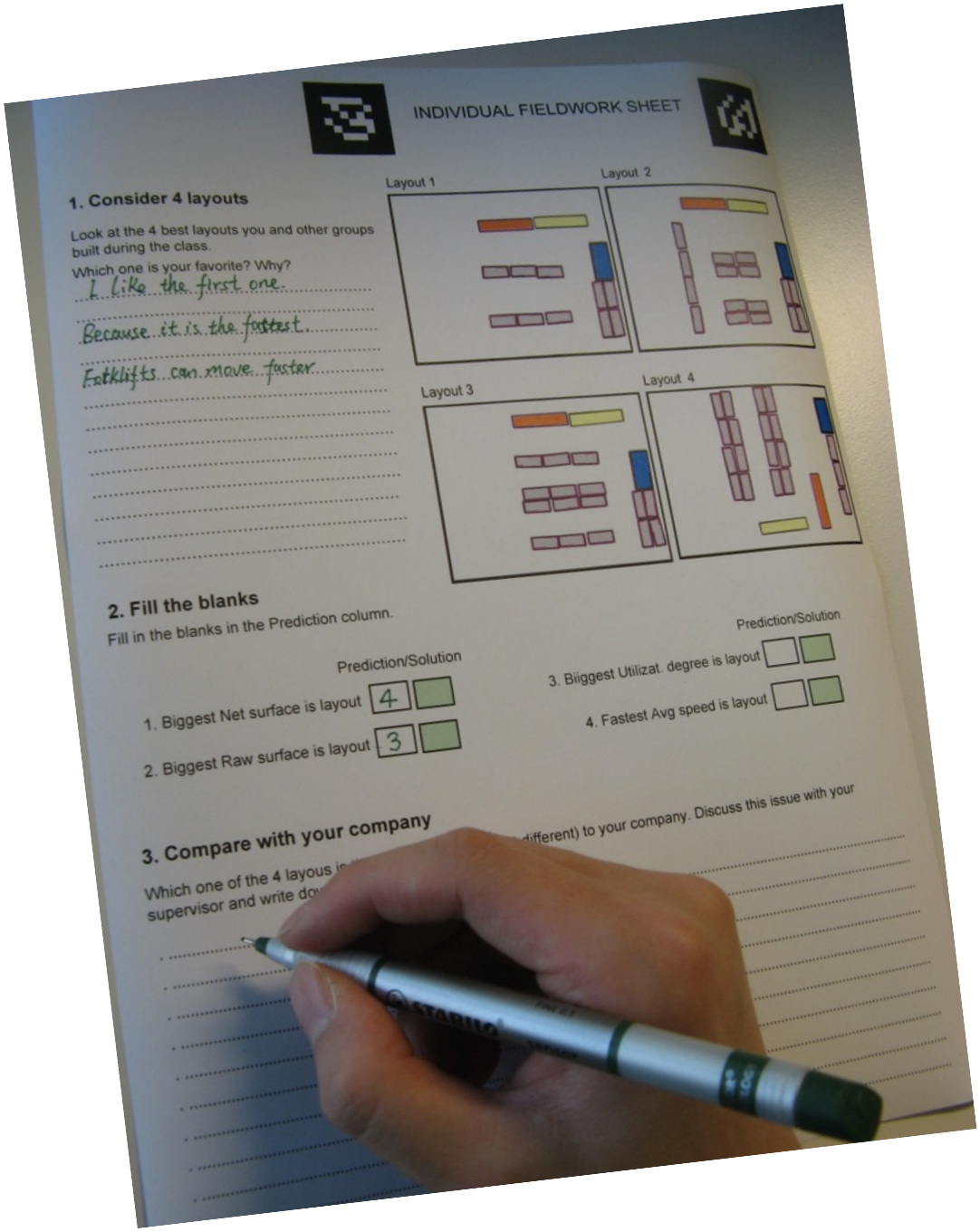
Dashboards

Stroop (open) | progress | leaderboard | stroop

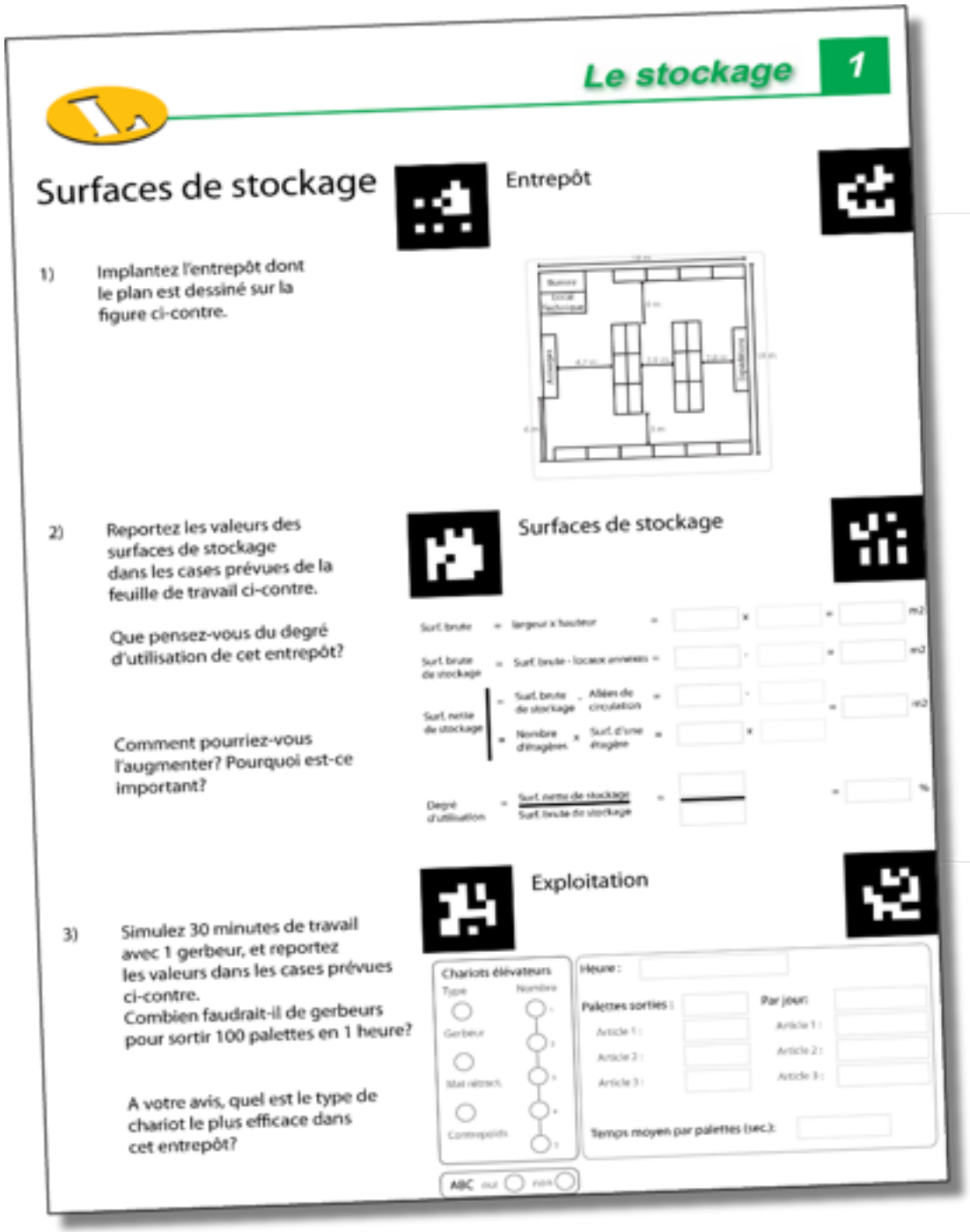


Users who started activity	3
Users who completed activity	0

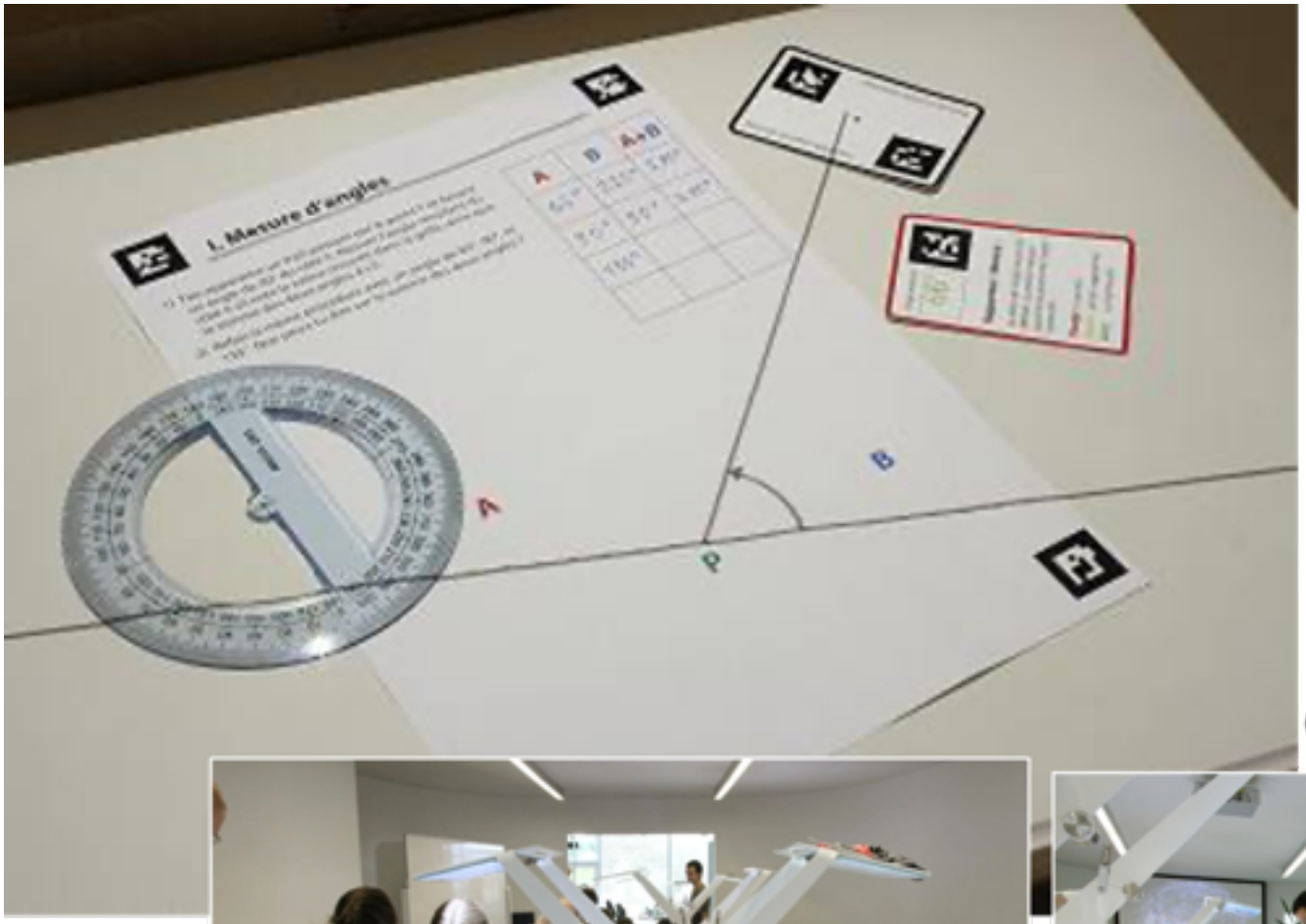
Create Session ▾ Switch Session ▾


INDIVIDUAL FIELDWORK SHEET
1. Consider 4 layouts
Look at the 4 best layouts you and other groups built during the class.
Which one is your favorite? Why?
I like the first one.
Because it is the fastest.
Forklifts can move faster
Layout 1
Layout 2
Layout 3
Layout 4
2. Fill the blanks
Fill in the blanks in the Prediction column.
Prediction/Solution
1. Biggest Net surface is layout 4
2. Biggest Raw surface is layout 3
3. Biiggest Utilizat. degree is layout
4. Fastest Avg speed is layout
Prediction/Solution
3. Compare with your company

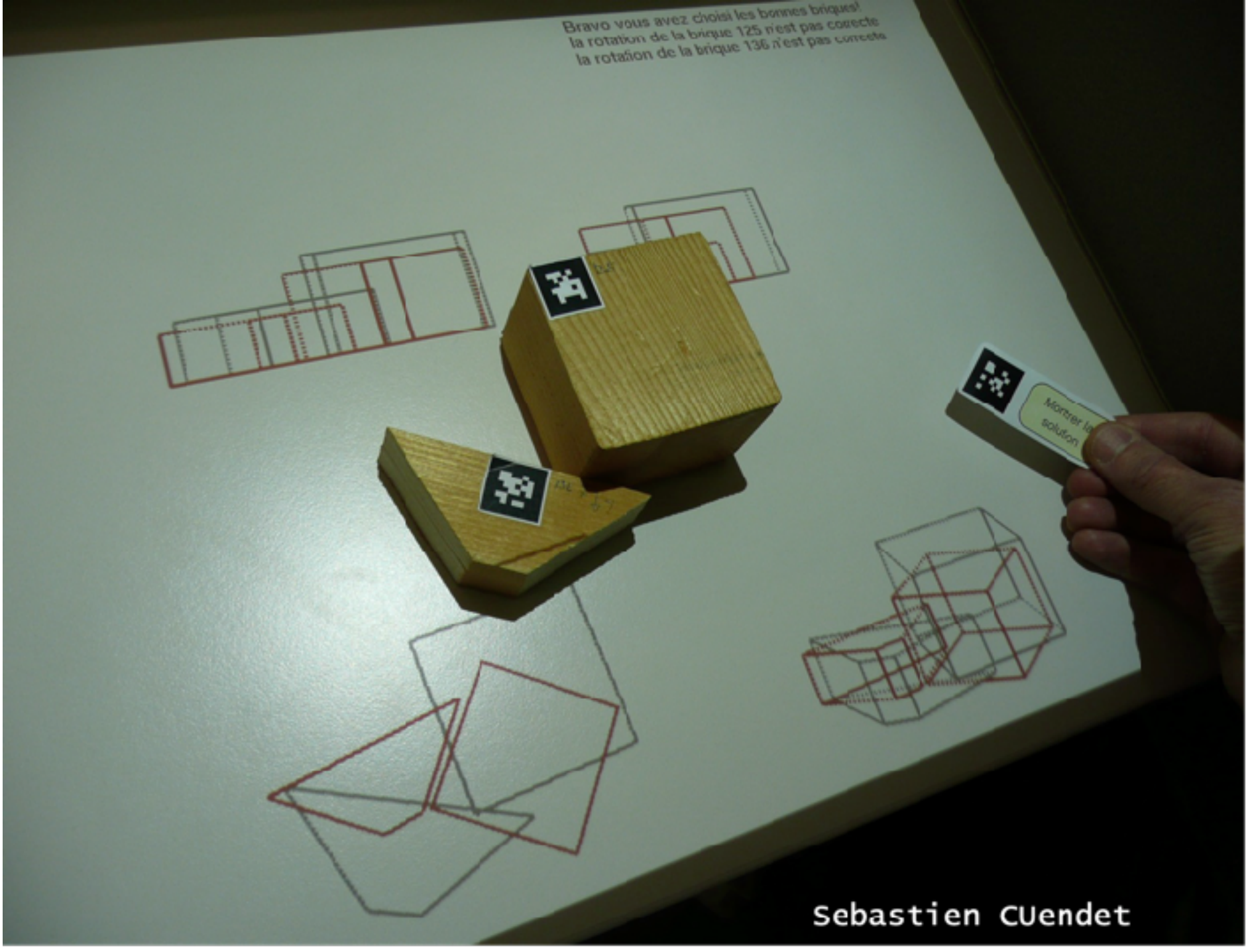
Homework

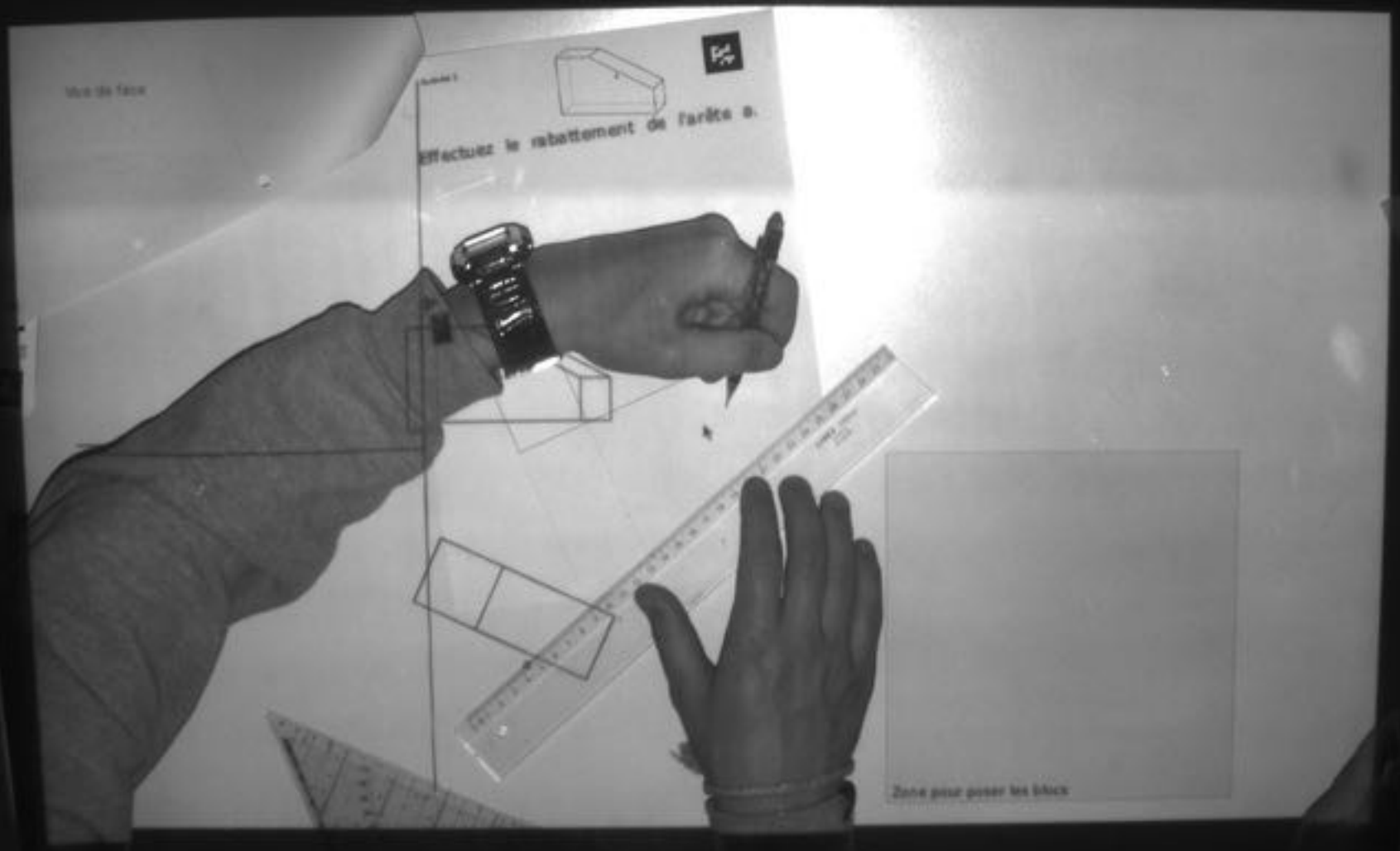


Curriculum Relevance



Quentin Bonnard


Bravo vous avez choisi les bonnes briques!
la rotation de la brique 125 n'est pas correcte
la rotation de la brique 136 n'est pas correcte
Sebastien CUendet

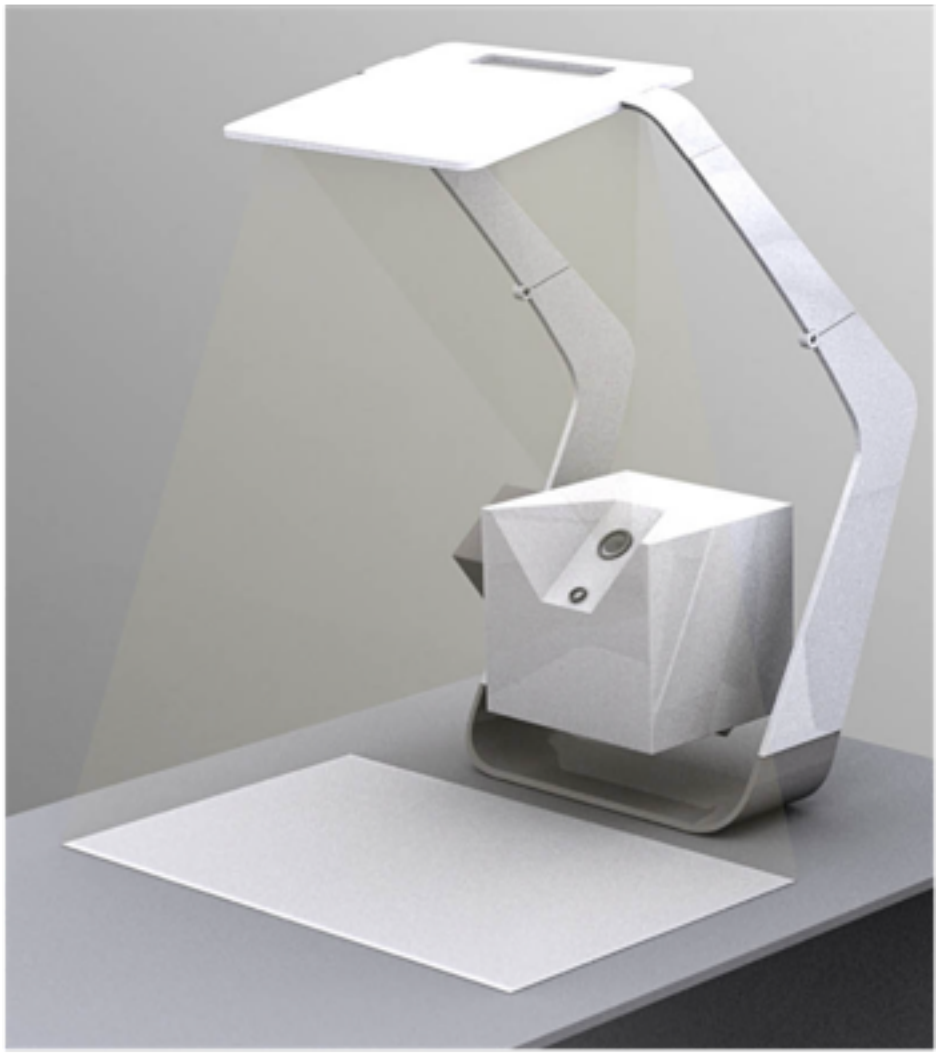

Vue de face
Effectuez le rabattement de l'arête a.
Zone pour poser les blocs

The « logistics » of education

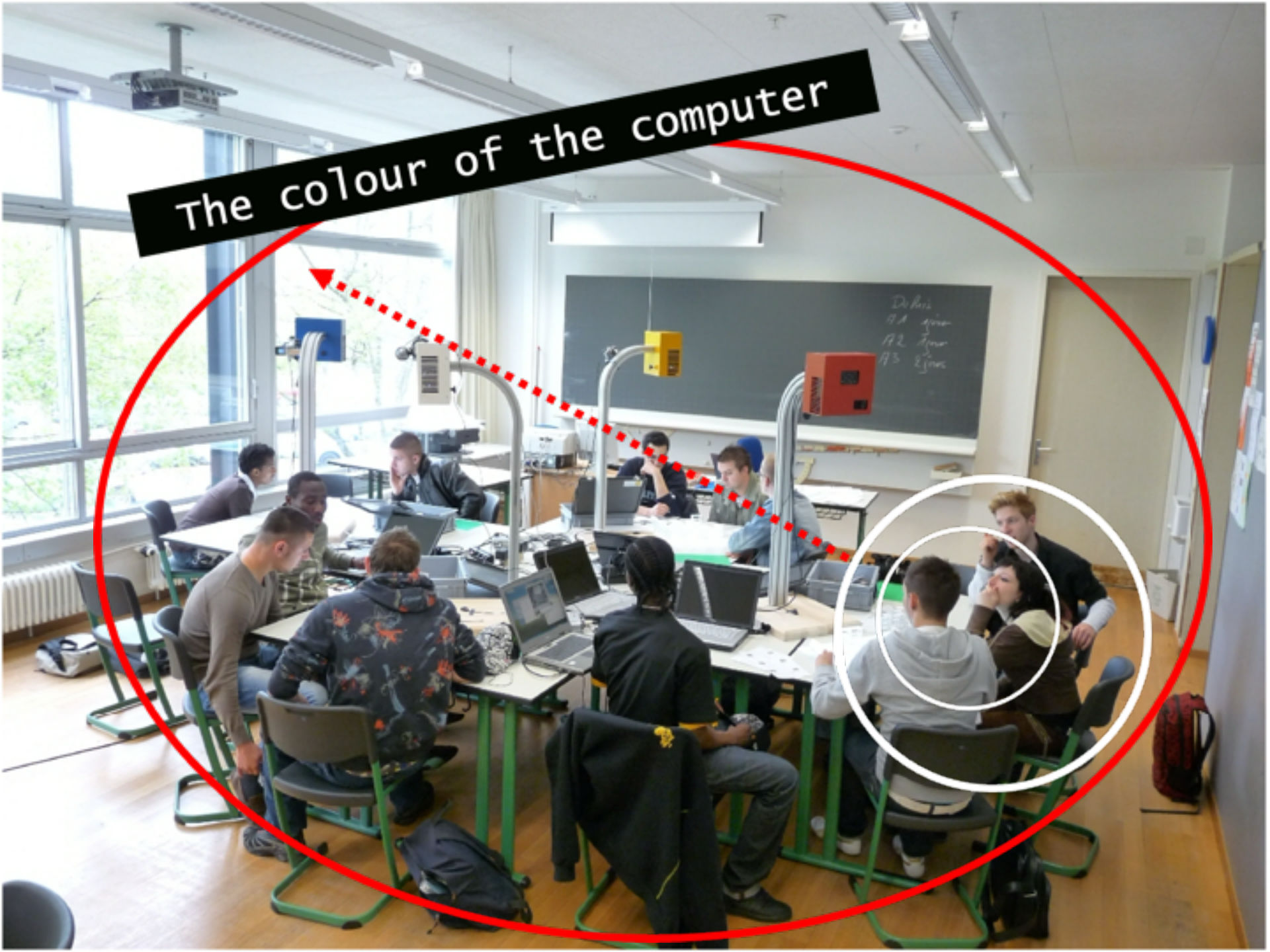
- How much time is lost before they really start?
- Does the teacher see what the students are doing?
- Can the teacher walk between the tables?
- How to cope with absences?
- Does the activity leave traces?

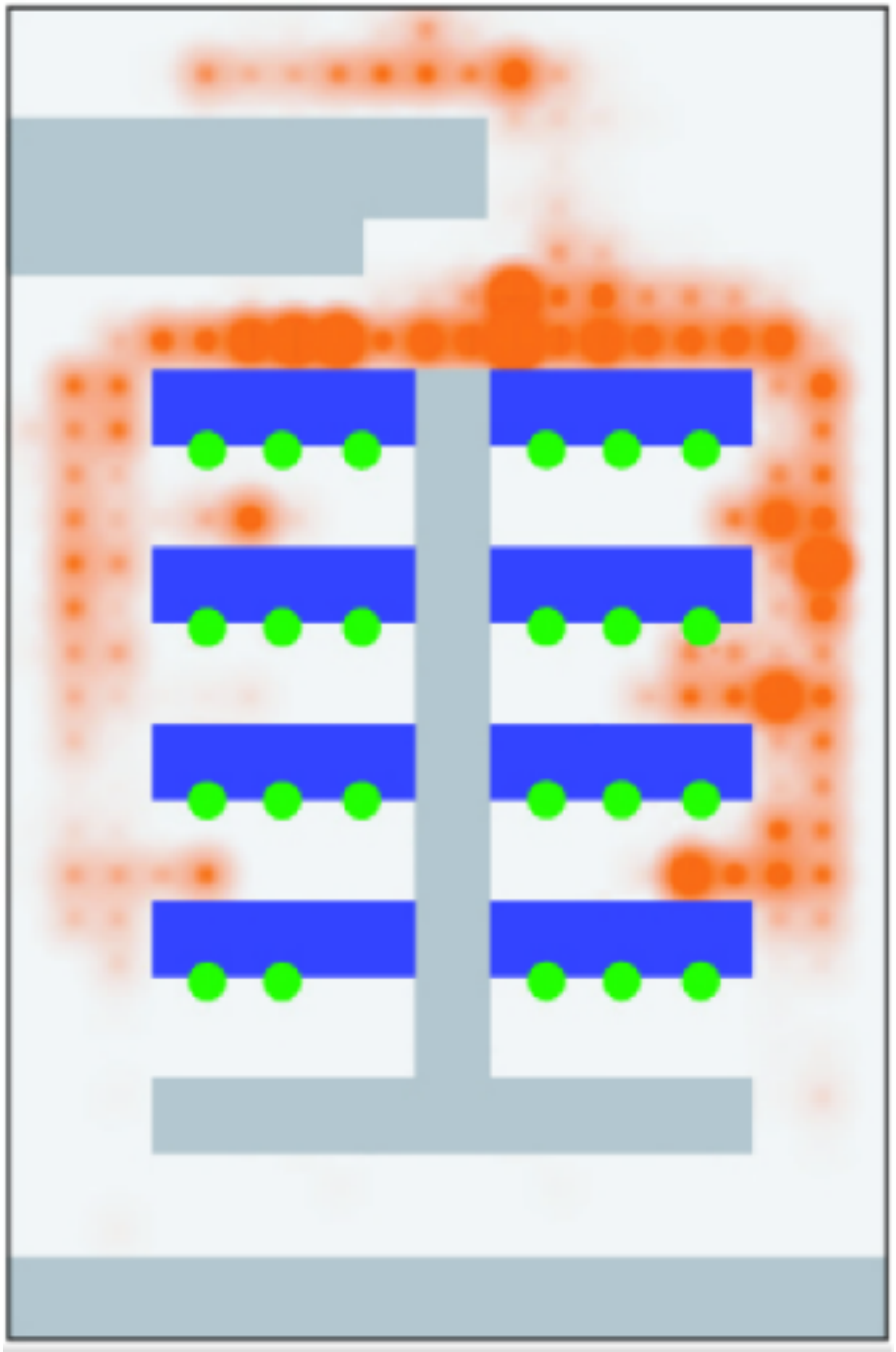
"no worth a theory"

D'Esposito & Gaillard



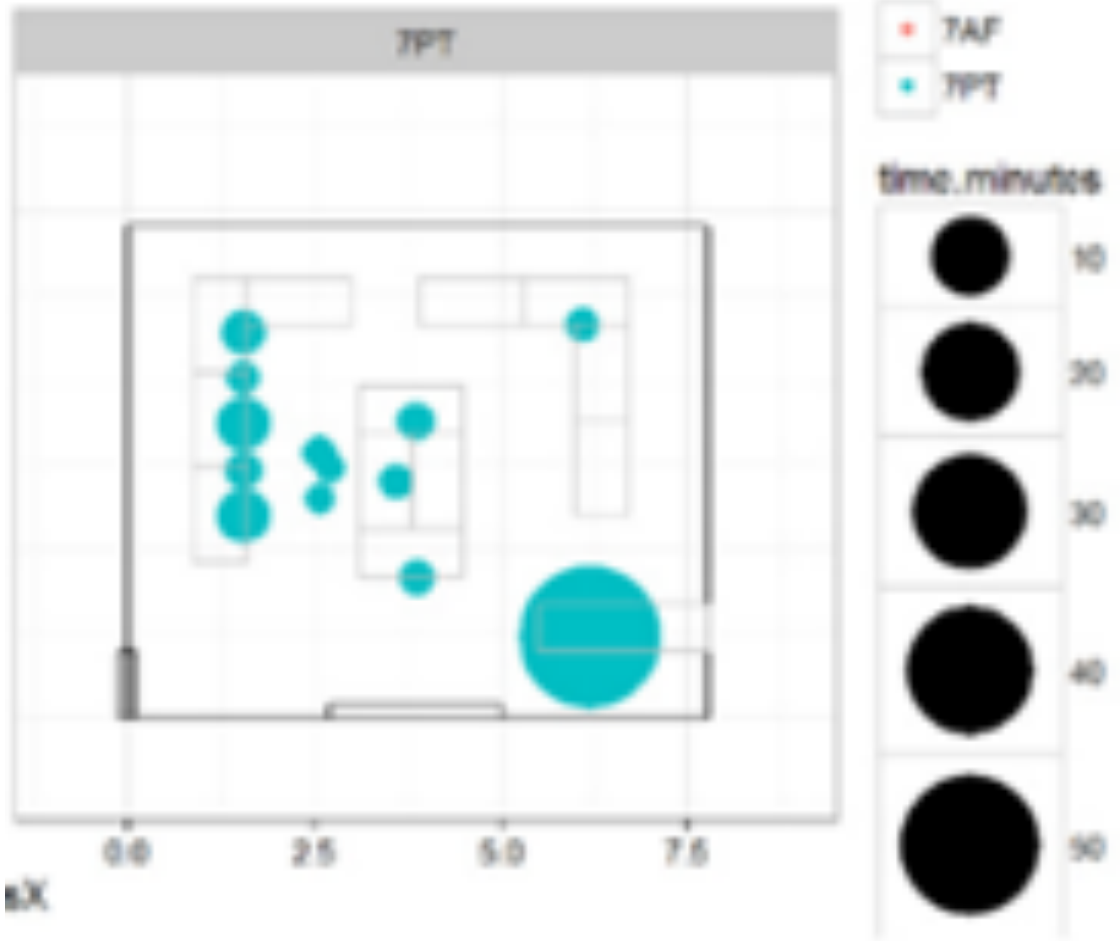
Y. Guibinelli


The colour of the computer



Teacher position heat map

I. Sarrade


7PT
0.0
2.5
5.0
7.5
aX
7AF
7PT
time.minutes
10
20
30
40
50

EPFL Exercises Session

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

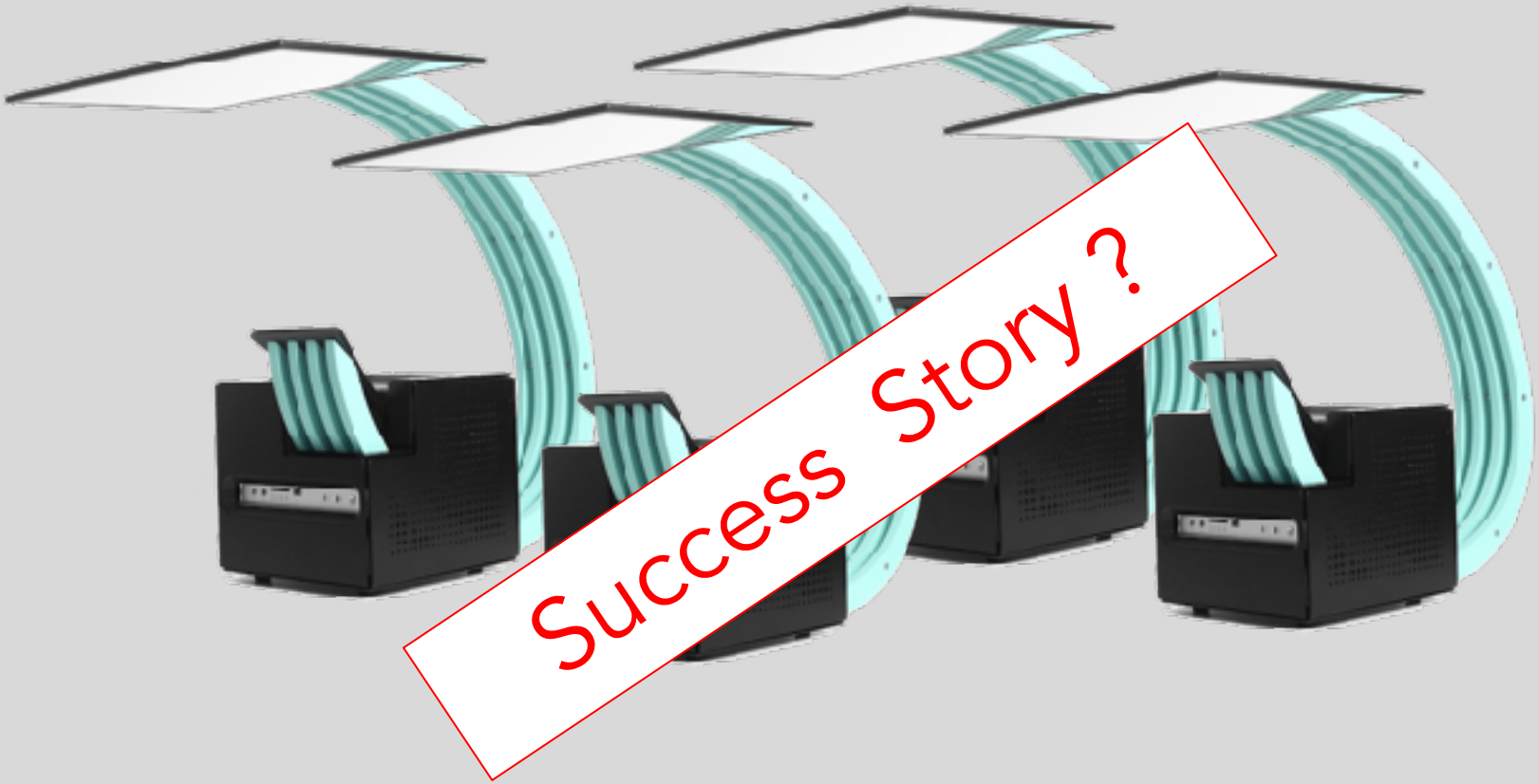
H. Alavi, Olivier Guédat

Success Story ?

"While Wal g Productivity" LOSS : 62% ➔ 6%

H. Alavi, Olivier Guédat

EPFL


Success Story ?

The 3 circles of usability

The user is…	Usability constraints are…
3. Classroom	*Discipline, Curriculum, time, Time segmentation, Safety, sustainability,grading, …*
2. Group	*Interdependence, WYSIWIS,…*
1. Individual	*Cognitive load, pre-requisites,...*

The future of learning is personal

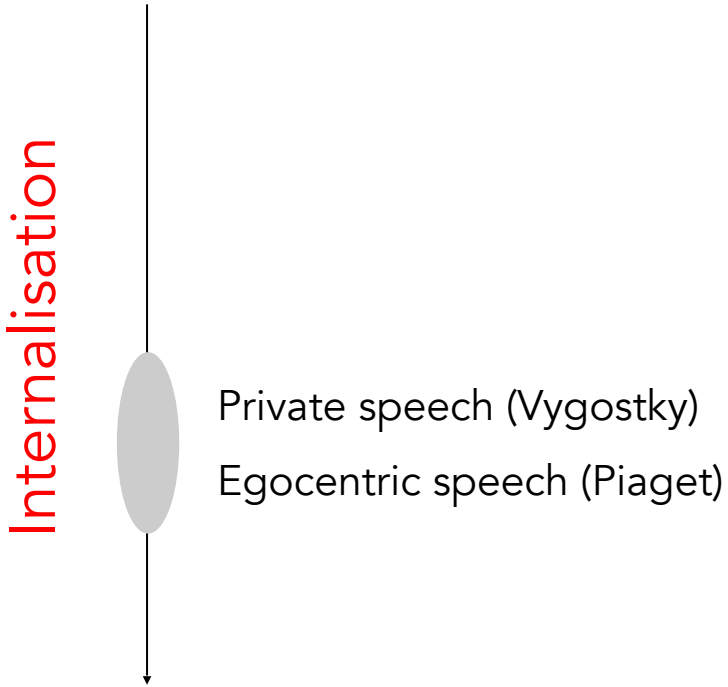
By Gary Martin

EDUCATION OPINION FREE TO READ

OPINION: Far from making teachers obsolete, personalised learning requires them to use their current skills while developing new ones.

Technology has been a game changer in terms of individualised learning. Photo: iStockphoto

Social Interaction



Reasoning

Thinking is a dialogue with oneself .

The hardware is individual
but the software is social

Summary of chapter 7

1. Collaborative learning is often effective, but not systematically.
2. Effective tasks require some degree of interdependence among team members
3. It is effective when rich verbal interactions occur such as explanation, argumentation, mutual regulation
4. To make it more effective, classroom scripts increase the probability for students to produce these interactions by integrating team, individual and class wide activities
5. It takes a talented teachers to orchestrate these scenarios
6. The theory behind emphasizes that cognition is inherently social because thinking mostly relies on language.