

The “a priori analysis”
in the study of
the T&S didactical joint action

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- **From the didactical contract** (Brousseau's theory, 1997)

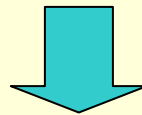
*Teacher expects the student to learn a targeted topic,
meanwhile*

Student expects to learn « something »...

but

Student cannot know what it is like, before encountering it.

Teacher cannot say directly what he expects



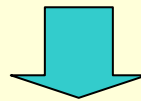
**Intention to teach triggers ...
intention to learn / intention to teach oneself**

- **Chronogenetic and topogenetic constraints**

(Chevallard's theory, 1985/91)

*Teacher must organise the successive occurrence of knowledge topics, i.e. managing **the didactical time** and*

*Teacher must also open a thinking space to the student for each topic presented, i.e managing **the student participation** to the teaching process*



T & S lay into unsymmetrical positions towards knowledge at stake

T&S didactical joint action

- A collective form of action involving overlapping individual **participatory intentions**
 - *A minimalist definition for joint action to be implemented with didactical specificities*
- A collective form driven by an **institutional task**
 - *The “intention to teach” enacted by the teacher originates itself in an institutional demand, by the mean of the definition of a curriculum (Chevallard, 1985/1991)*
- A collective form **typified by ways of presenting / understanding knowledge** in institutional practices.

Methodological issues

**Institutional
constraints**

Teaching
project

Teaching materials

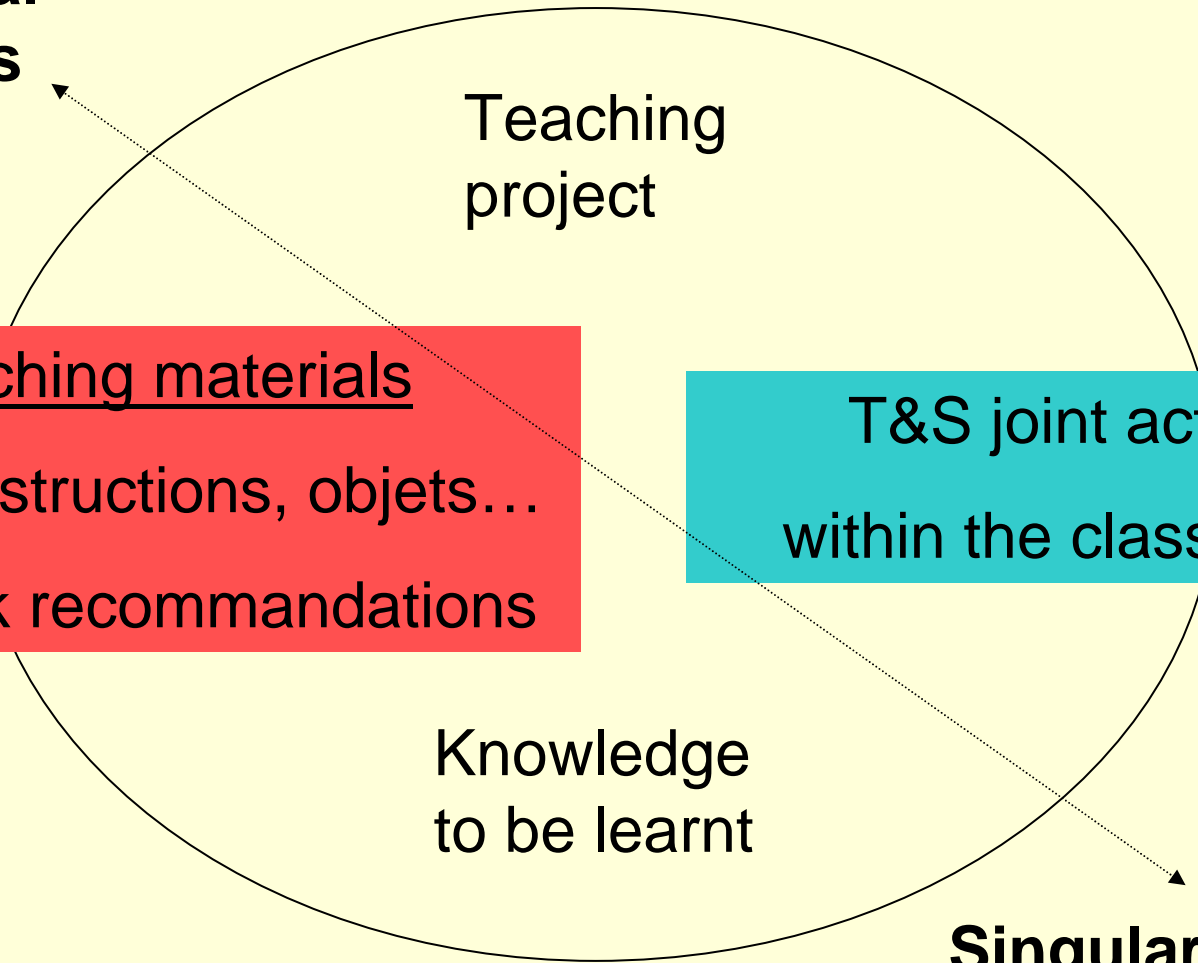
Tasks, instructions, objets...

Textbook recommandations

T&S joint action
within the classroom

Knowledge
to be learnt

**Singular events
observed**



a priori reasoning...

Philosophical

- Examining the possibility of the development of knowledge *independently* of any experiment (E. Kant)

→ apriorism VS empiricism

Methodological

- Making hypotheses *before* realizing an experiment (C. Bernard)

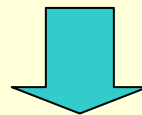
→ hypothetico-deductive approach

Compatibility with theory and practice of research on teaching and learning?

***a priori* reasoning... applied to research
on teaching and/or learning processes
(mathematics)**

Cognitive : An anticipatory thought on the learning possibilities that may be developed against a given background (P. Cobb et al.) → **hypothetical learning strategies**

Didactical : An analysis of the variables of a mathematical situation in order to keep control of the meaning-making process by the students. (G. Brousseau) → **a priori model of knowledge**



A decision-making tool for research design

Observing teaching and learning under ordinary conditions...

Example :
Perimeter & Area

“Quinze”

(4th grade- Vaudoise class - Switzerland)

Compare perimeters of equivalent surfaces area

Tâche

- Comparer les périmètres de surfaces d'aires équivalentes.

Mise en commun

- Les élèves comparent leurs solutions et les valident à l'aide des plaquettes ou de leurs dessins. Ils recensent les périmètres obtenus.

Variable

Matériel

• **Change the number of tiles**

Prolongement

- L'enseignant propose la consigne suivante:
 - Build a rectangle with 2 x 10 tiles
 - Ask to remove tiles, but increase perimeter.
 - Ask to add tiles but decrease perimeter.


Instruction in the student's textbook :

Joining together 2 squared tiles, gives a shape with a perimeter of 6.

-What would be the perimeter of a shape made of 15 squared tiles?

-Find as much different perimeters as you can.

Quinze



Cette forme est constituée de 2 plaquettes assemblées.

• Son périmètre est de 6.

• Quel peut être le périmètre d'une forme constituée de 15 plaquettes assemblées?

• Et entre le plus possible de périmètres différents.

Nombre d'élèves

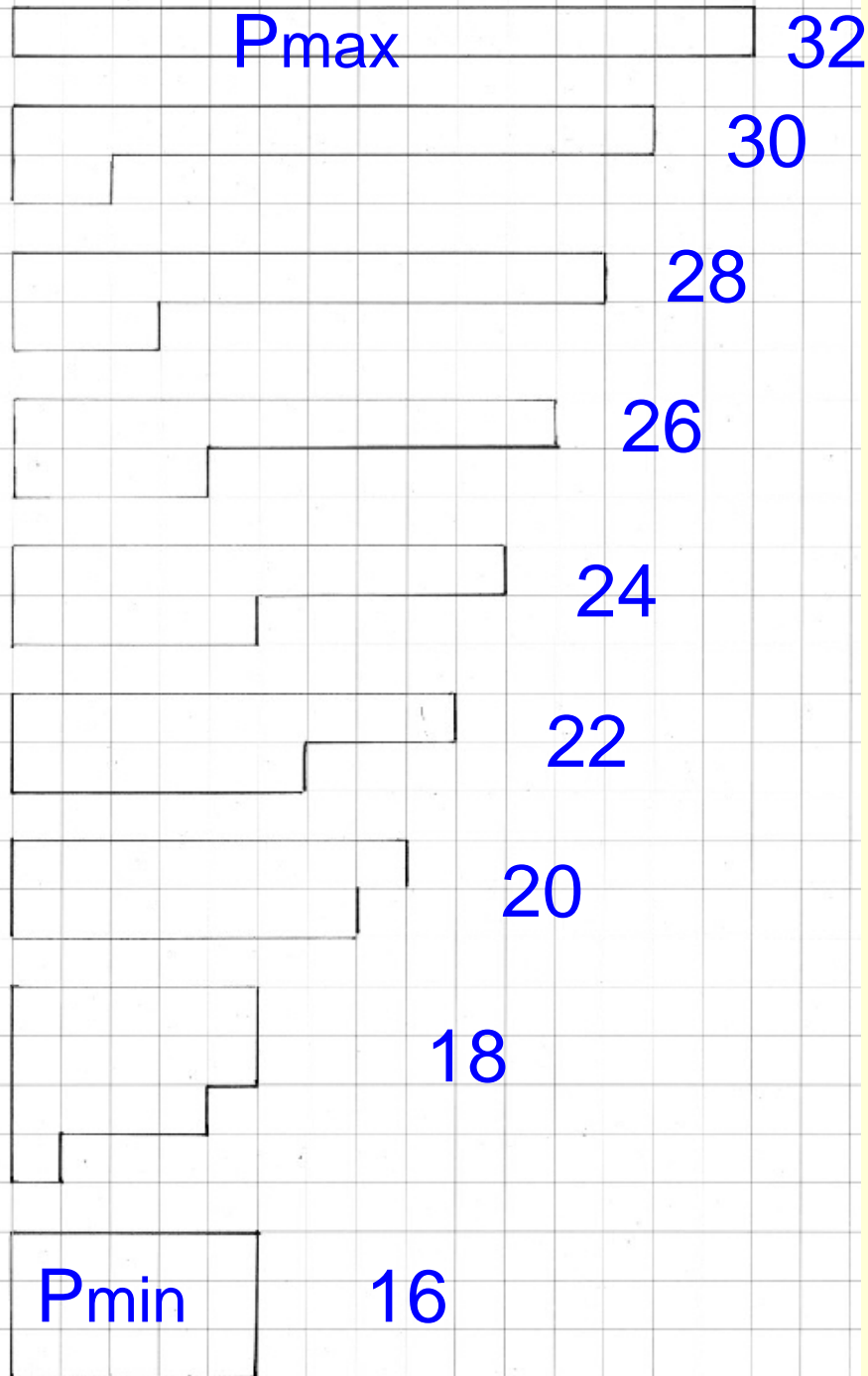
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Pair work

Matériel

- LE p. 64
- MC: 15 plaquettes carrées
- Papier quadrillé

15 squared tiles available + square grid paper



An attempt to solve the task...

From assembling 15 tiles,

- *Different perimeter measures*
- → how can I get all of them?
- → are these values always even nb?
- *Different shapes may be found for a given perimeter*
- → how can I make sure that I have found all of them?
- *P_{max} is twice P_{min}*
- → is it always the case?
- → is there a method to calculate them?

What knowledge is at stake in this task?

Magnitudes :

- Area and perimeter are **two independent** magnitudes
- If area is constant, perimeter may change / if perimeter is constant, area may change.
- Each of these magnitudes are independent of the shape in which they can be measured
- Assembling n tiles : **area measures add to each other, but perimeters don't.**
- Formula for rectangular shapes may be drawn $[A = a * b]$ and $[P = (a+b)*2]$



$A = 15$

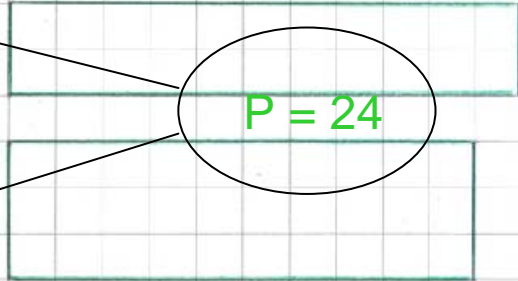
$P = 24$



$A = 15$

$P = 22$

$P = 26$



$P = 24$

$A = 20$

$A = 27$

What are the conditions for this knowledge to be taught ?

“Area and perimeter are two independent magnitudes”

- It can be disclosed only by **comparing measures** for each of the magnitudes
- Instructions to students have to evolve in order to introduce the variation of area (change number of tiles), with the constraint of keeping perimeter constant
- Student's findings (shapes and measures) will have to be organized in order to plot variations against a constant.
- Focusing on rectangular shapes allow to derive the calculation formula for perimeter

“Quinze” : T&S joint action in the classroom

Timing :

- For explaining the task : 10 min
 - Checking that every one knows what a perimeter is.
 - Assembling 3 tiles (→ a shape) and counting the outer sides.
 - No need to use a ruler.
- For student research of perimeter with 15 tiles : **43 min**
- For the overall discussion : **17 min**
 - about P values only : **10 min**
 - Considering area VS perimeter : **3 min**
 - Considering area formula for rectangular shapes : **6 min**

“Quinze” : T&S joint action in the classroom

An overview of the overall discussion (17 min) :

- S : Eliciting $P_{\max} = 16$ and $P_{\min} = 32$
- T : Need to count again for correcting mistakes
- S : $P_{\max} = 2 * p_{\min}$ / T → It is interesting
- S : **Perimeters values are always even numbers ?** / T → it is not today's goal
- T : What would be P_{\min} for 20 tiles?
- S : different answers : 21, 22, 24 – Counting P_{\min} with 20 tiles ($P_{\min} = 18$) and **deducing $P_{\max} = 2 * P_{\min} = 36$ without experimental checking / T acknowledges for this result.**
- T : remind some previous work about area – she states : 15 tiles is a surface area of 15 units – **is there a change in area in your shapes?**
- S : yes / no – always and only 15 tiles → T : **there is no area change**
- T : let's consider the 20 tiles assembled as a rectangle – can we find **a calculation to give the area straight away?**
- S : $4*5$ or $4*$ / also $2*10$ → T congratulates.

a priori reasoning... adapted to the study of T&S joint action in ordinary conditions

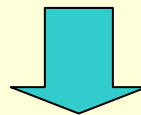
Step 1 : what Knowledge could learnt from the task ?

→ Anticipating learning possibilities and difficulties

Step 2 : What Knowledge can be taught

→ Anticipating teaching acts (the layout of the milieu)

Step 3 : Use “a priori” model as an insight for observing effective joint actions.



**Observe teaching and learning intentions in
the T&S joint action**