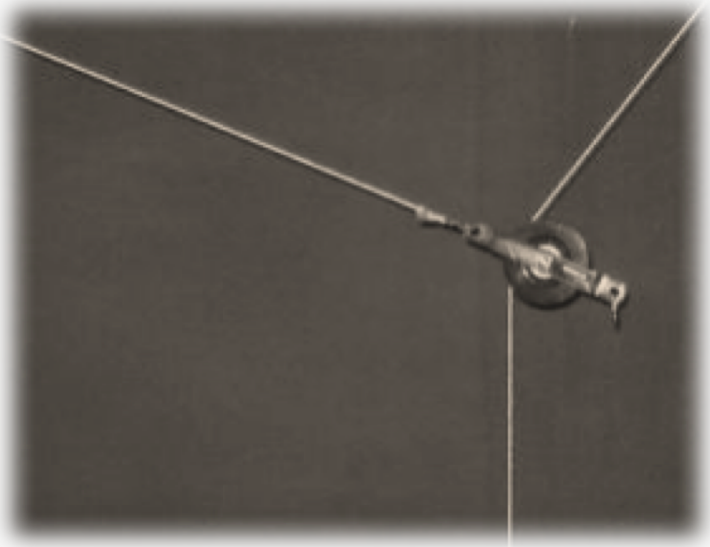
L'HOSPITAL'S WEIGHT PROBLEM
Crossing ~~a new~~ the Border

… into Mexico



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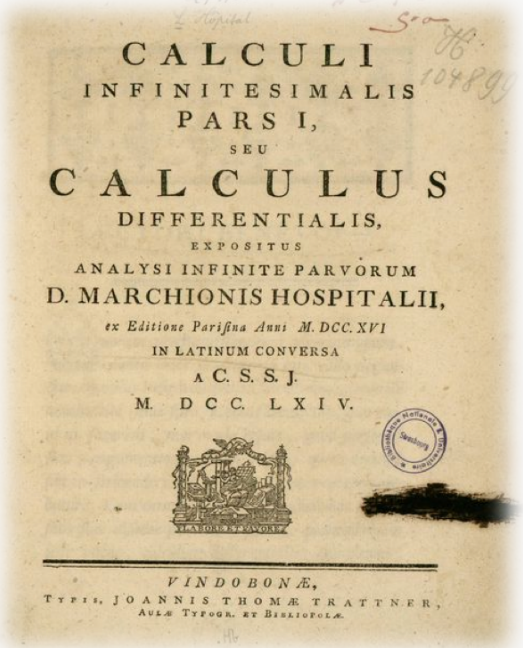
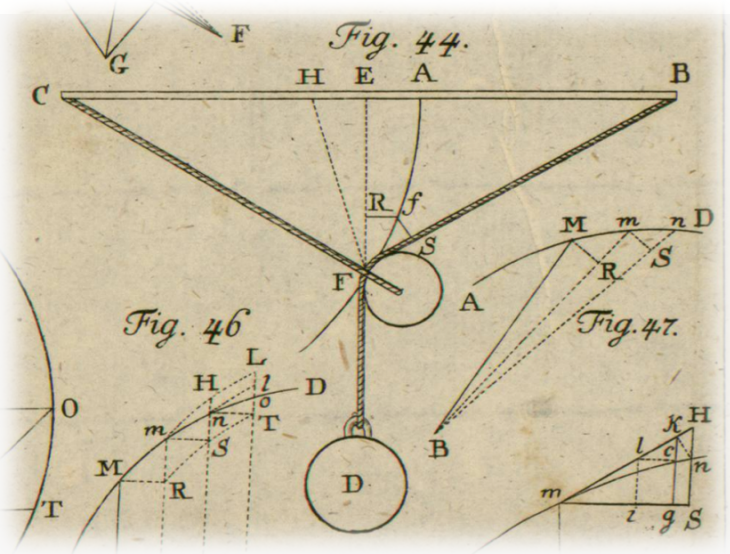
Outline

- The original weight problem
- The activity
- Its adaptation and use in Mexico
- Observations
- Conclusions

From Bernouilli to L'Hospital


CALCULI
INFINITESIMALIS
PARS I,
SEU
CALCULUS
DIFFERENTIALIS,
EXPOSITUS
ANALYSI INFINITE PARVORUM
D. MARCHIONIS HOSPITALII,
ex Editione Parisina Anni M. DCC. XVI
IN LATINUM CONVERSA
A C. S. S. J.
M. DCC. LXIV.
VINDOBONÆ,
TYPIS JOANNIS THOMÆ TRATTNER,
AULÆ TYPOGR. ET BIBLIOPOLÆ.



To introduce differential calculus…

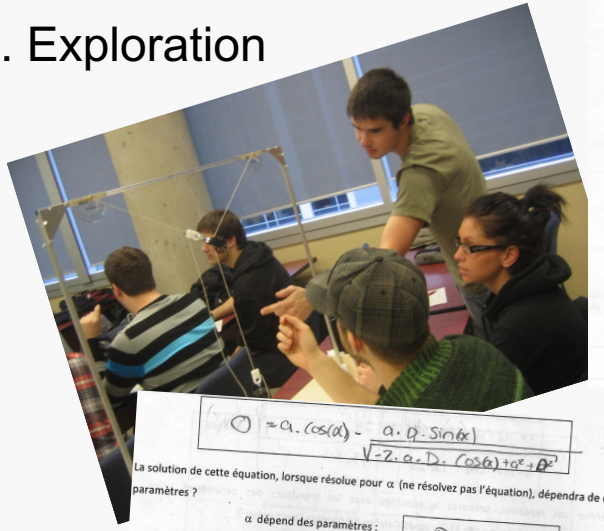
The activity and its variations

- Initially envisioned for high school
  - Hands-on activity
  - Synthesis of knowledge
- Designed for the transition course at ÉTS (engineering school)
  - By physics lecturer, math lecturer, and math educator
  - Review of secondary mathematics (trig), leading to calculus
  - Introduction to modelling
- Reused at the college level
  - In both pre-university and technical programs
- **Shortened and used in high school (Montreal & Mexico)**

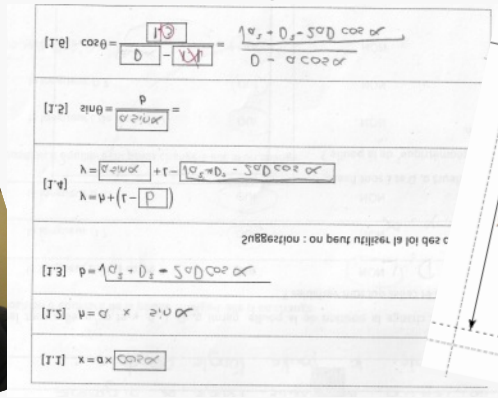
- Teams of 2 or 3
- Each team had
  - its own apparatus
  - measuring instruments
  - symbolic calculators (TI Nspire – CAS)

Overview of the (whole) Activity

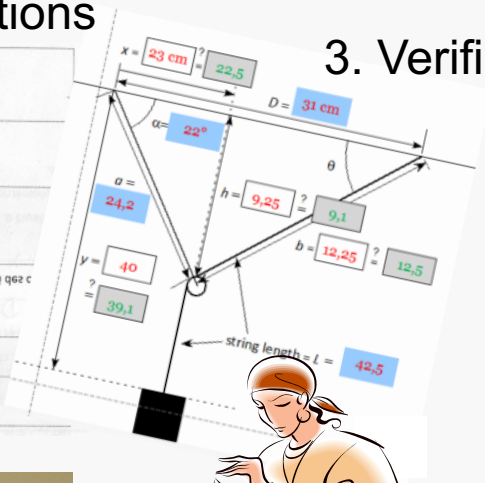
1. Exploration

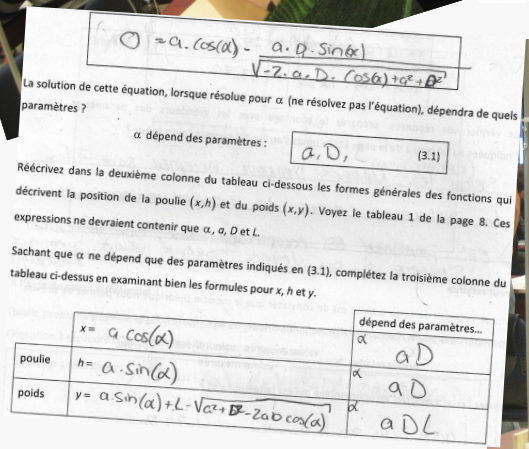


2. Constructing Equations



3. Verification





La solution de cette équation, lorsque résolue pour α (ne résolvez pas l'équation), dépendra de quels paramètres ?

α dépend des paramètres : a, D, (3.1)

Réécrivez dans la deuxième colonne du tableau ci-dessous les formes générales des fonctions qui décrivent la position de la poulie (x,h) et du poids (x,y). Voyez le tableau 1 de la page 8. Ces expressions ne devraient contenir que α, *a*, *D* et *L*.

Sachant que α ne dépend que des paramètres indiqués en (3.1), complétez la troisième colonne du tableau ci-dessus en examinant bien les formules pour *x*, *h* et *y*.

		dépend des paramètres...
poulie	$x = a\cos(\alpha)$	α aD
	$h = a\sin(\alpha)$	α aD
poids	$y = a\sin(\alpha) + L - \sqrt{a^2 + D^2 - 2aD\cos(\alpha)}$	α aDL

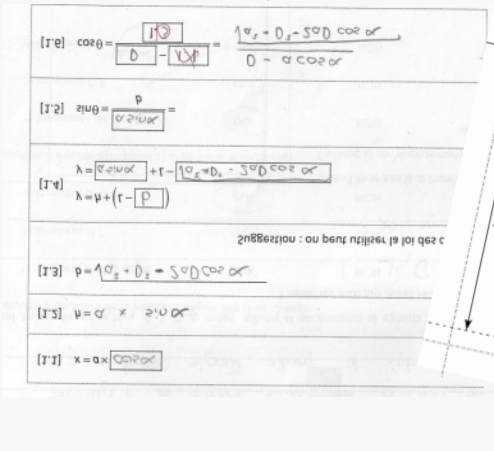
4. Prediction

5. Validation

6. Revisiting intuitions

Variation for Mexico

2. Constructing Equations



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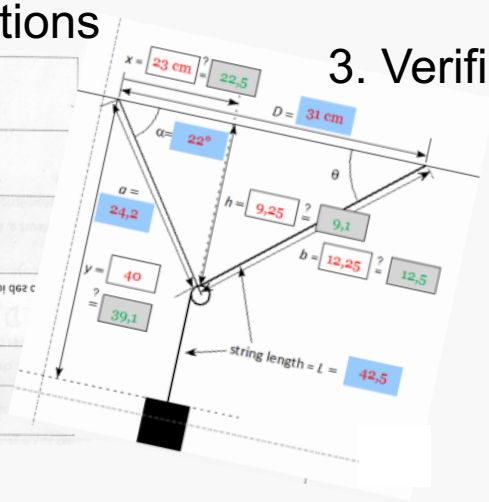


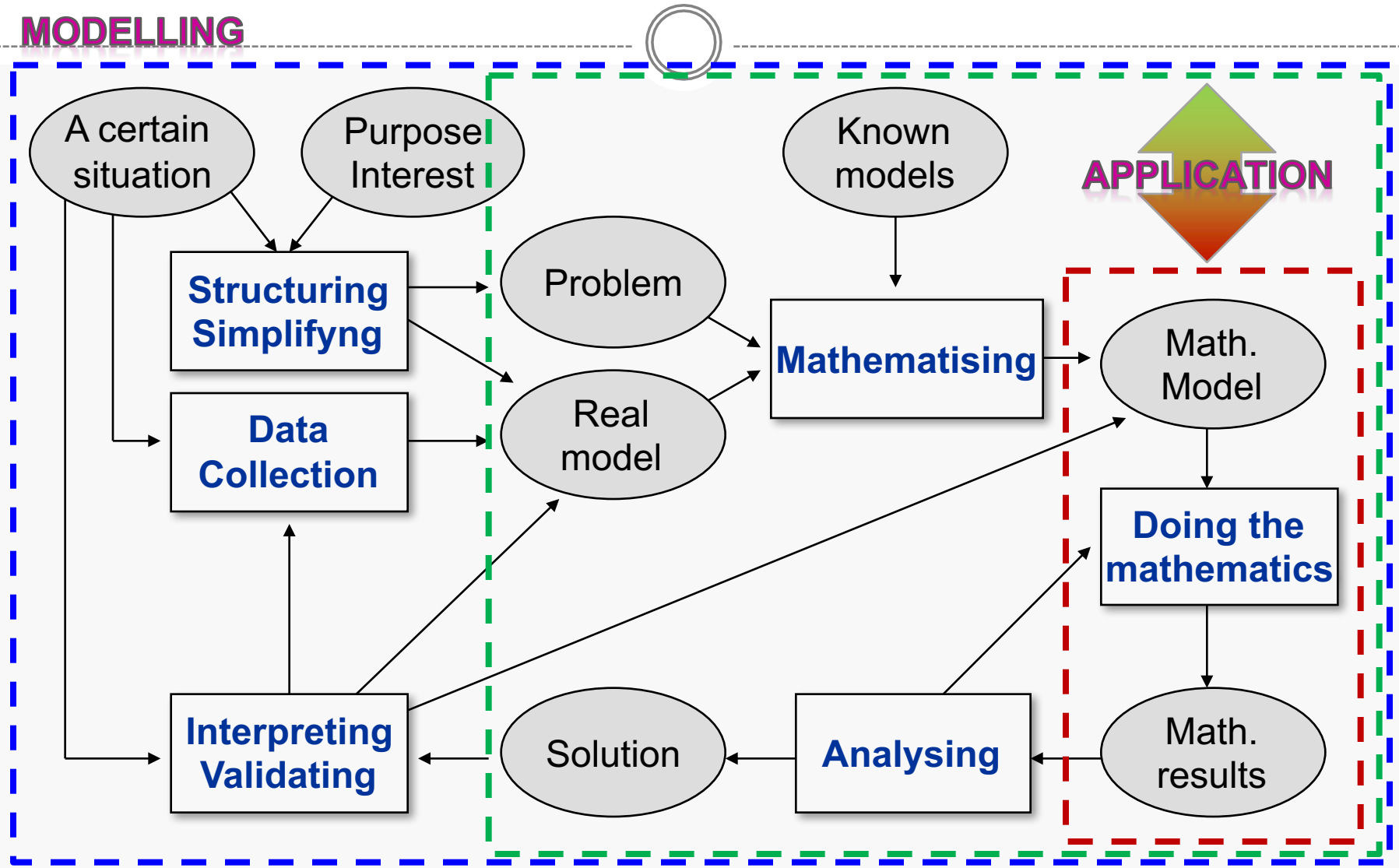
CCH, UNAM & IPN

- bachillerato: 15 to 17 year-olds
- groups of about 25 students,
- in 2nd or 4th semesters
- 2 or 3 teachers participated in the activity each time

CCH – Sur
IPN

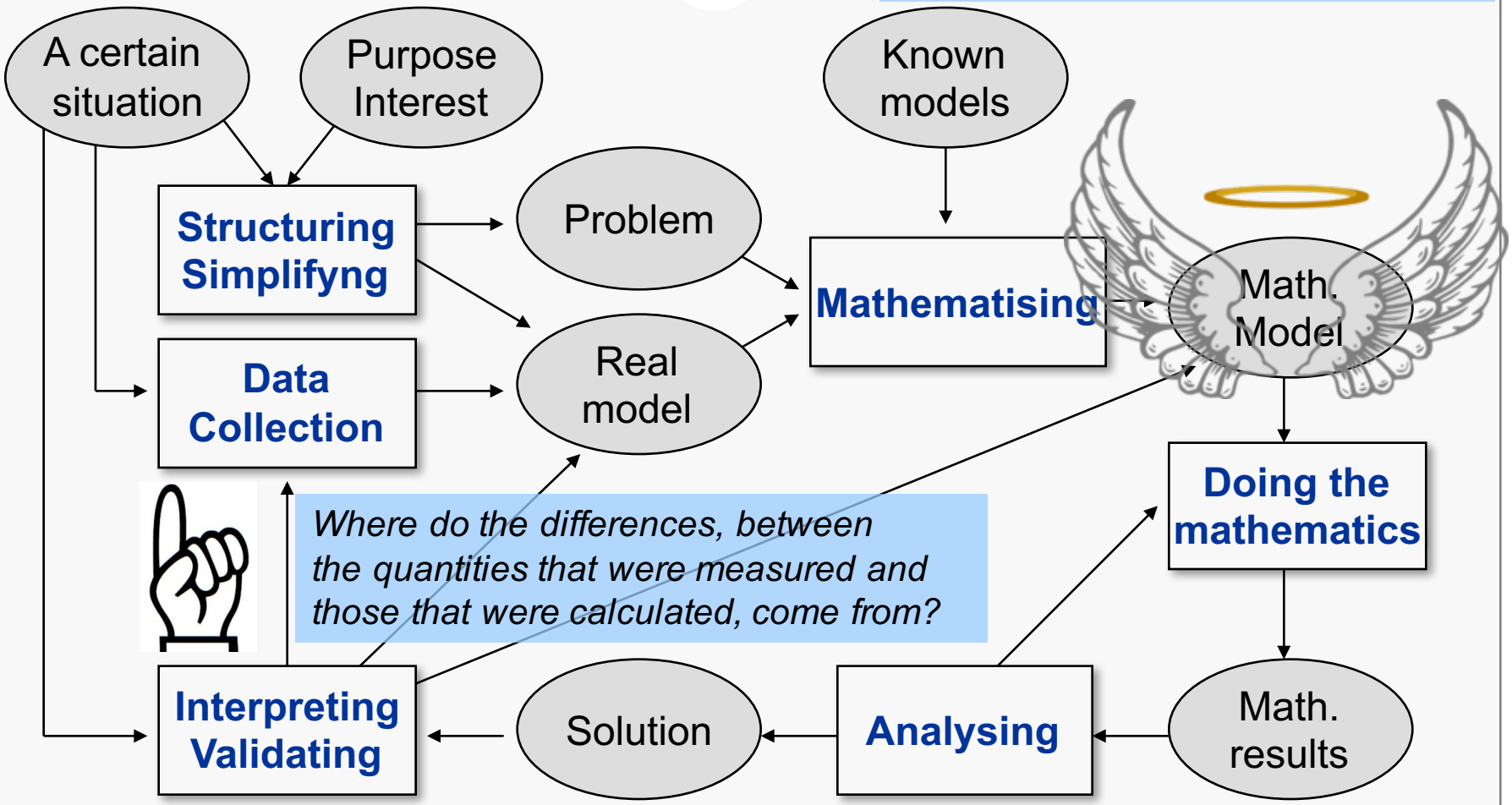
Teams of 3 to 5 students
2 apparatus with measuring tapes
Each team had its own calculator (phone, …)

The Modelling Cycle (adapted from Blum & al., 2002)

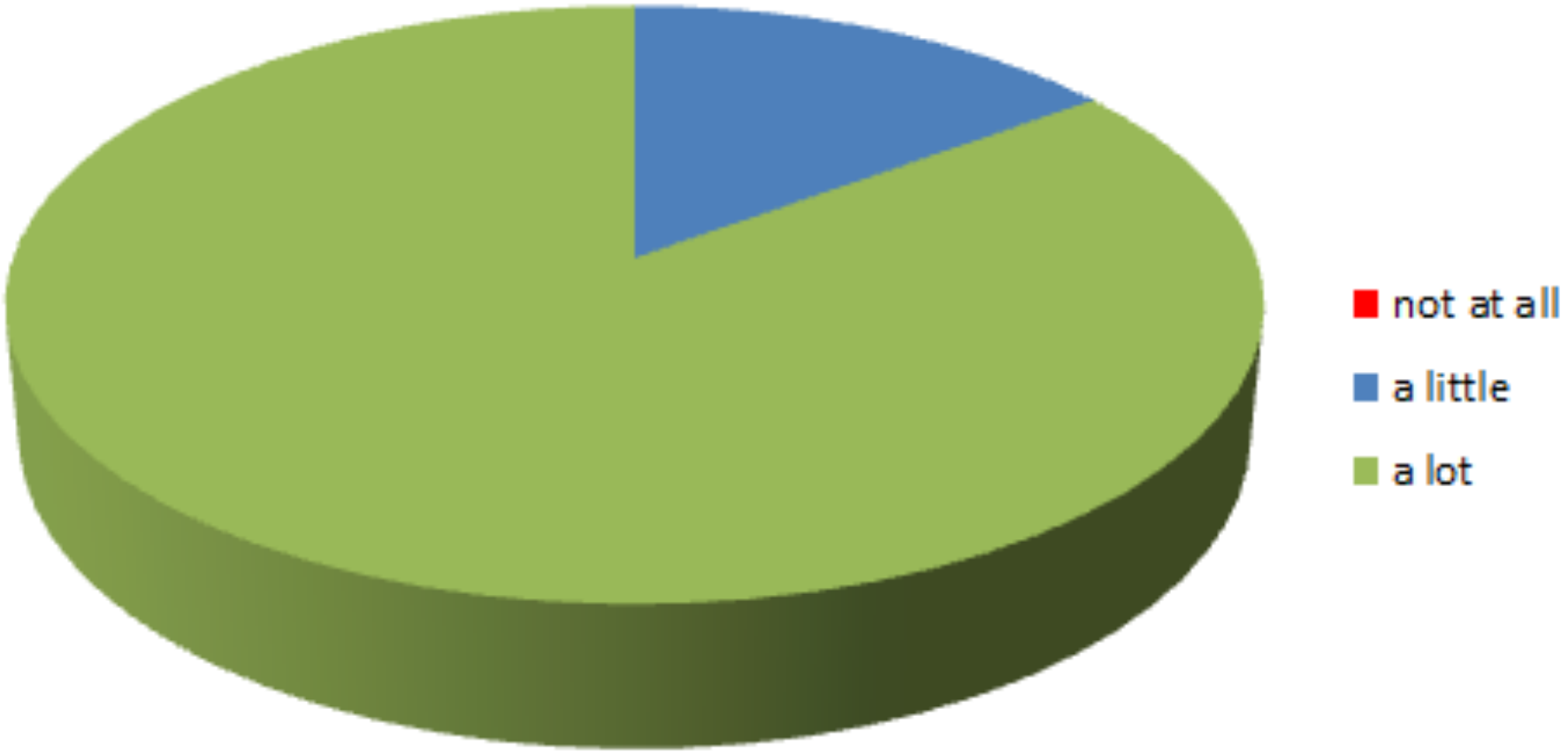


The Modelling Cycle (adapted from Blum & al., 2002)

"las medidas son una predicción y lo calculado es exacto"



The Student's Perspective



The Student's Perspective

What I liked	*What I didn't like*
• **Theory** put in **practice. Application** in real life**.** • **Manipulation.** Concrete, visual. **Interactive.** • History. • **Different approach** than **physics.** • **Learning** Guide. **Progressive** approach. • Possibility to **review** and **understand**, to **validate** and **self-correct.** • **Team dynamics**. • Visiting teacher. **More than one teacher** during the activity.	• **Measuring**. • **Time** constraints. • **Team dynamics**. *My team didn't cooperate. My team didn't communicate enough.* • My profs at CCH do **not usually** have us do this type of activity. • Formulas were difficult to find.

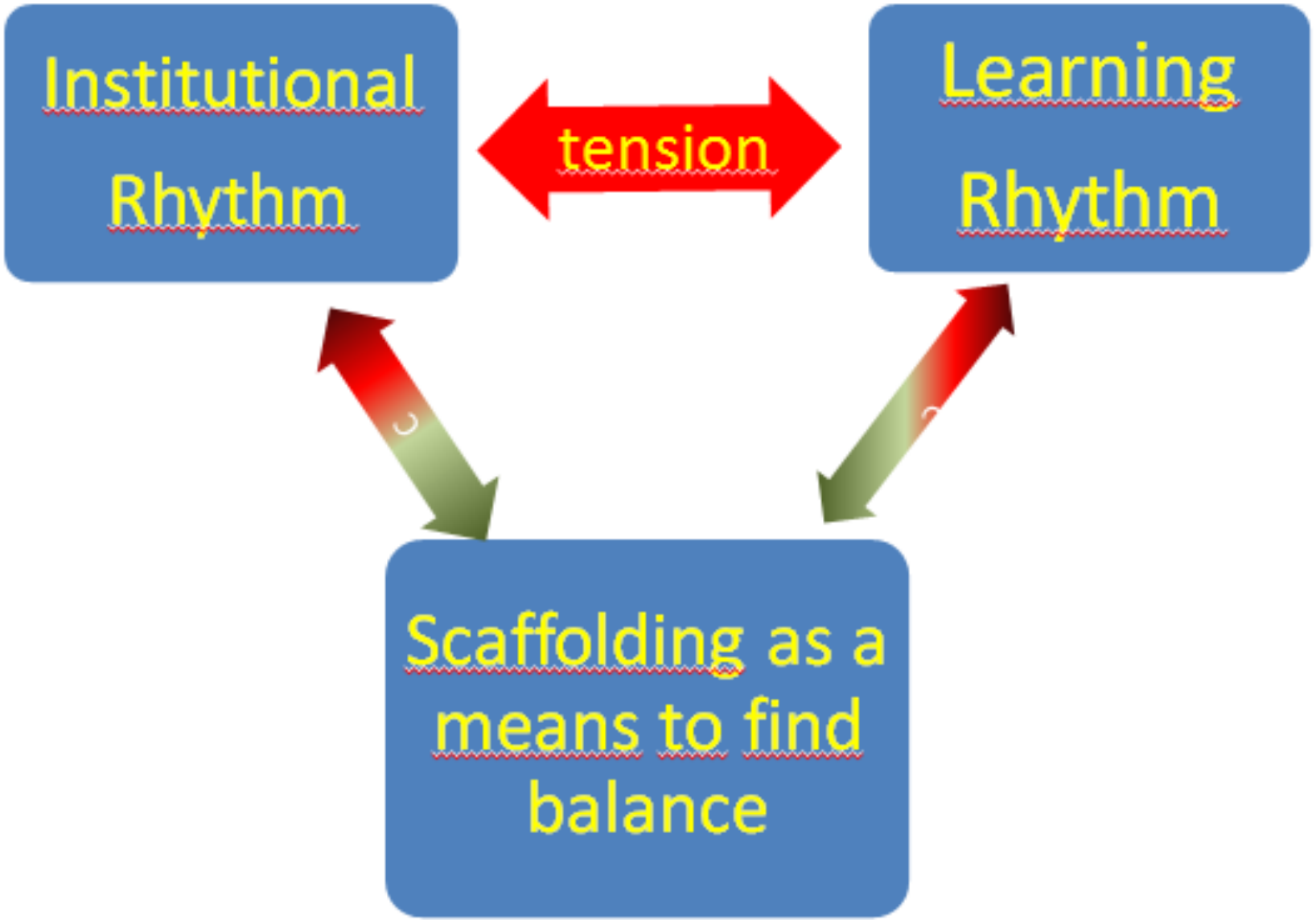
The Student's Perspective

What I learned	*What remains unclear*
• **Relationships between variables**, between side lengths and angles. • That we can **validate** our work **mathematically**. • Trigonometric functions. Pythagoras' theorem. The cosine property. • To **find formulas** and to **measure**. • To **substitute** in order to find values. • To **think** (due to the difficulty of finding formulas.) • **Reviewed** themes from math and physics.	• Properties of sine and cosine functions. • **Why** there are **differences** between what is measured and what is calculated.

Observations

- Acknowledge that the model is a simplified (imperfect) representation of a real situation; to discuss assumptions, limitations,…
- Value other disciplines to revisit assumptions.

> *"When we deduce or find a formula and apply it, we can see if the formula is correct or not."*


Institutional Rhythm
tension
Learning Rhythm
Scaffolding as a means to find balance

Observations

Scaffolding

- Physical – structure of the activity – is key
  - to **empowering** students
  - to **avoid** their **straying** too far away from course content
- Natural – team work (Vigosky)
  - **empowers** students
  - **empowers** profs to develop and try activities
- Technology as scaffolding

Conclusions

- Modelling would benefit from Institutionalisation
- Institutionalisation would benefit from modelling

FIN

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