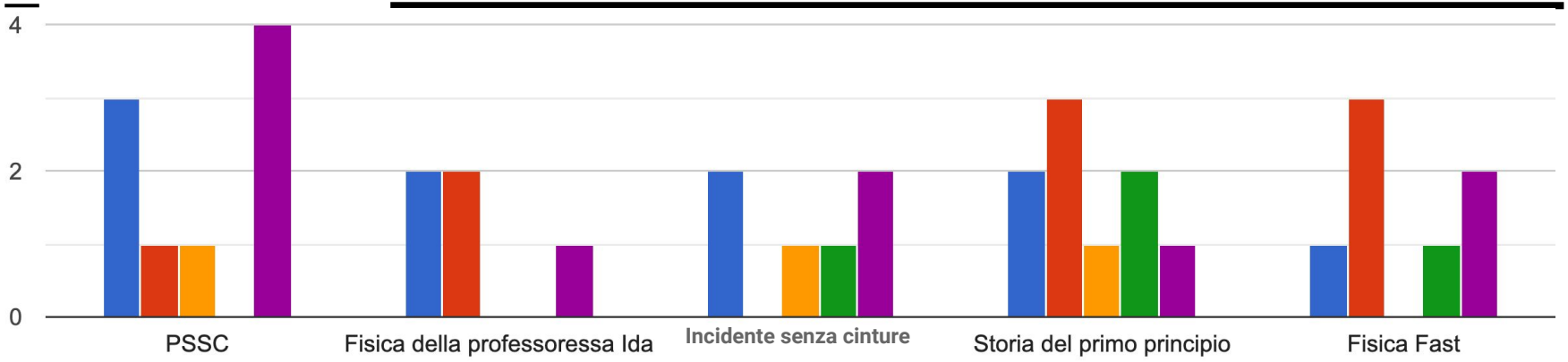
Physics Education Laboratory Lecture 04

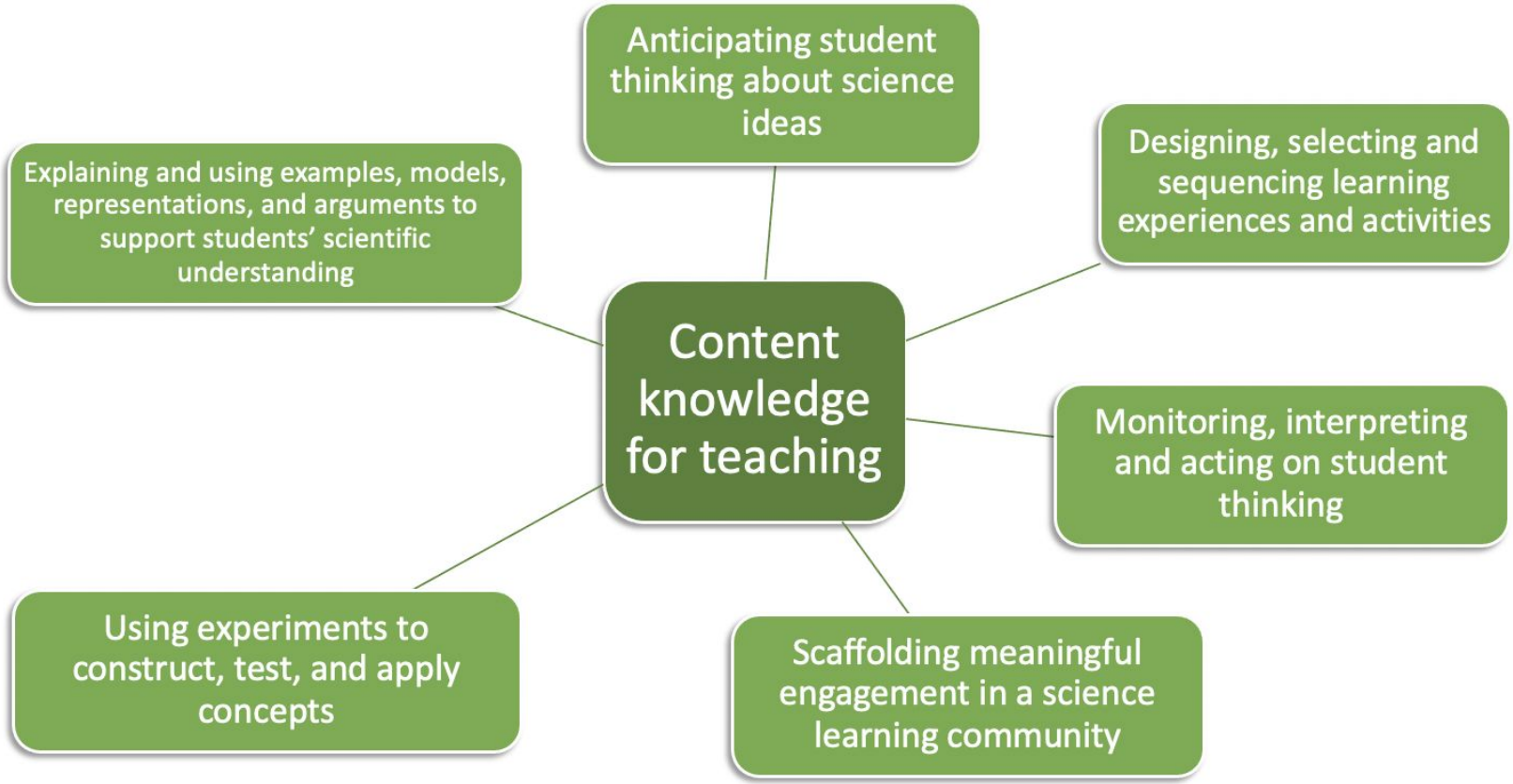
Pedagogical Content Knowledge, Math/Phys interplay vs CKT

Francesco Longo 20/10/2022

1. PCK FOR SCIENCE TEACHING (Magnusson et al., 1999)
2. PCK FOR PHYSICS TEACHING (Etkina, 2010)
   CONTENT KNOWLEDGE FOR PHYSICS TEACHING (Etkina, 2018)
3. DECLINING PCK FOCUSED ON MATH/PHYS INTERPLAY (Lehavi et al., 2014, 2017)

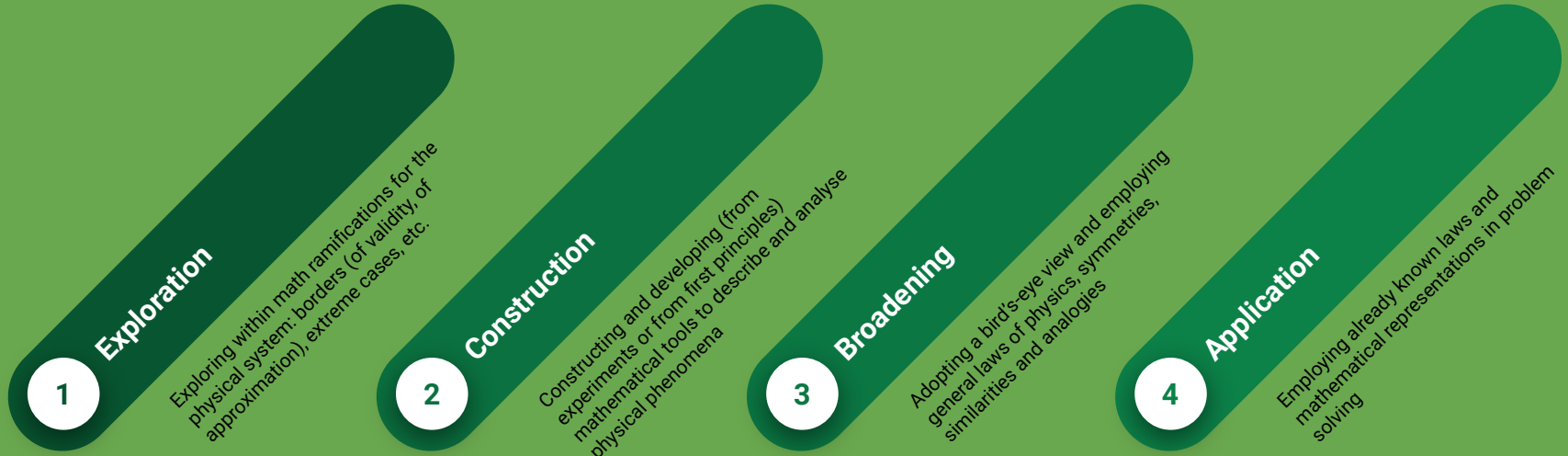


- Orientation towards science teaching
- Knowledge and beliefs about science curriculum
- Knowledge and beliefs about students' understanding of specific science topics
- Knowledge and beliefs about assessment in science
- Knowledge and beliefs about instructional strategies for teaching sciences


Anticipating student thinking about science ideas
Explaining and using examples, models, representations, and arguments to support students' scientific understanding
Designing, selecting and sequencing learning experiences and activities
Content knowledge for teaching
Monitoring, interpreting and acting on student thinking
Using experiments to construct, test, and apply concepts
Scaffolding meaningful engagement in a science learning community

Etkina, 2018

Keep in mind


1
Exploration
Exploring within math ramifications for the physical system: borders (of validity, of approximation), extreme cases, etc.
2
Construction
Constructing and developing (from experiments or from first principles) mathematical tools to describe and analyse physical phenomena
3
Broadening
Adopting a bird's-eye view and employing general laws of physics, symmetries, similarities and analogies
4
Application
Employing already known laws and mathematical representations in problem solving

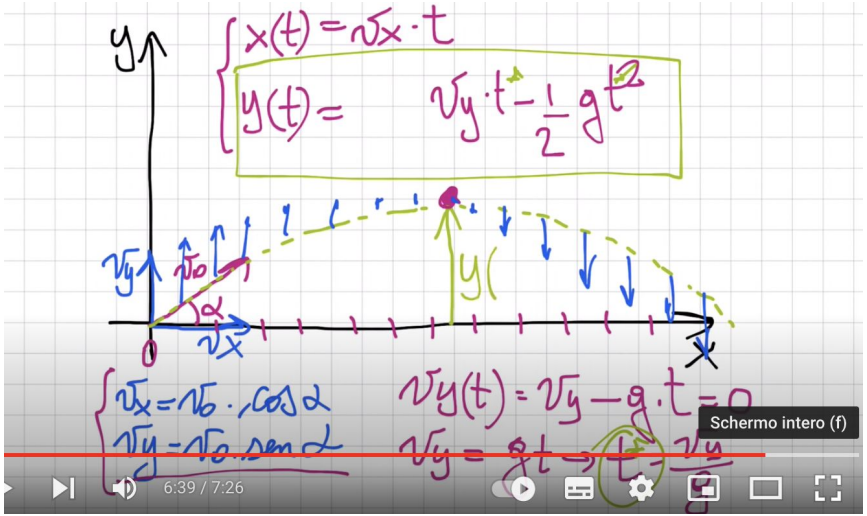
Developing new patterns for integrating Math/Phys Interplay

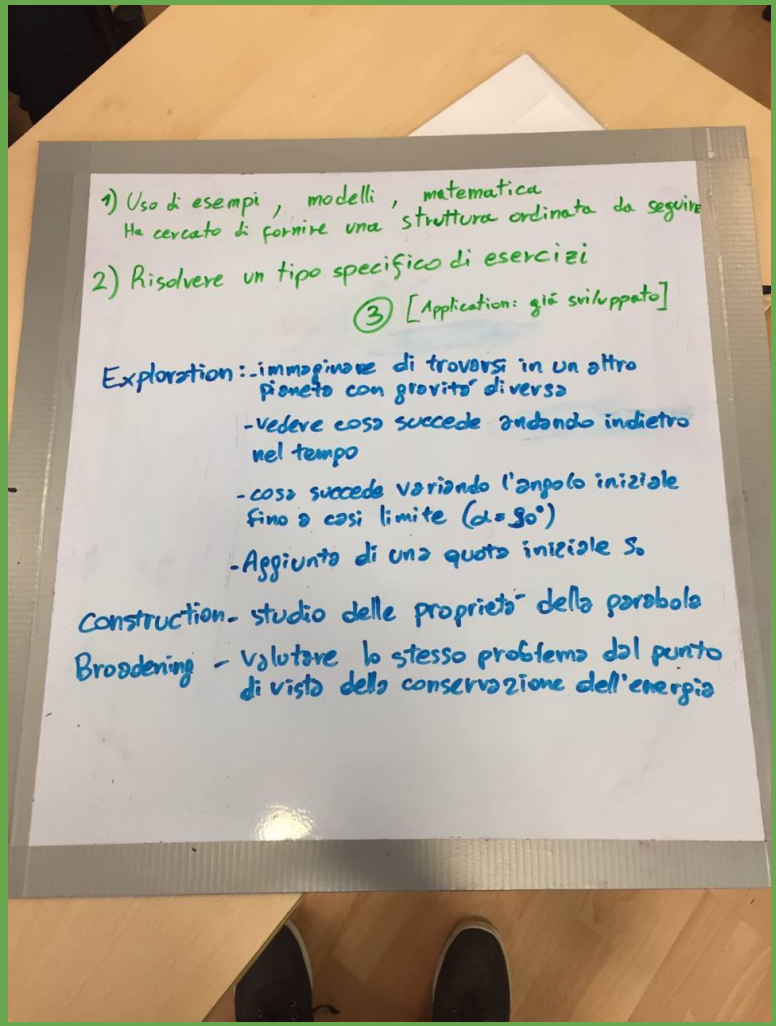
1) Which are the tasks that the teacher has in mind while teaching in the CKT frameworks?

2) Which are student specific target?

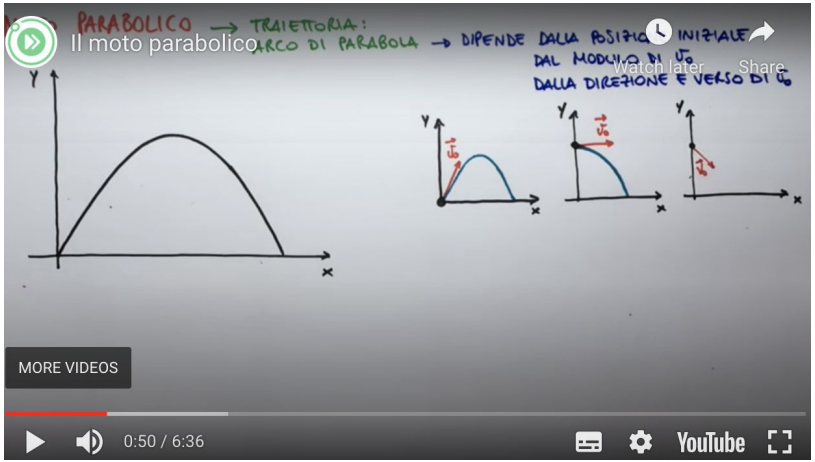
3) How to develop the other patterns? Make at least THREE examples!

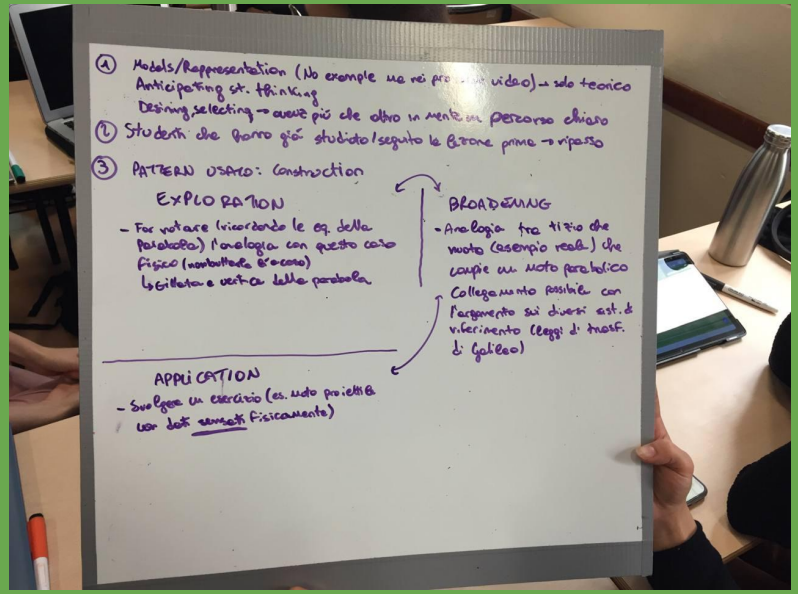
https://www.youtube.com/watch?v=xZ0WN8z3cD0 Moto di un proiettile



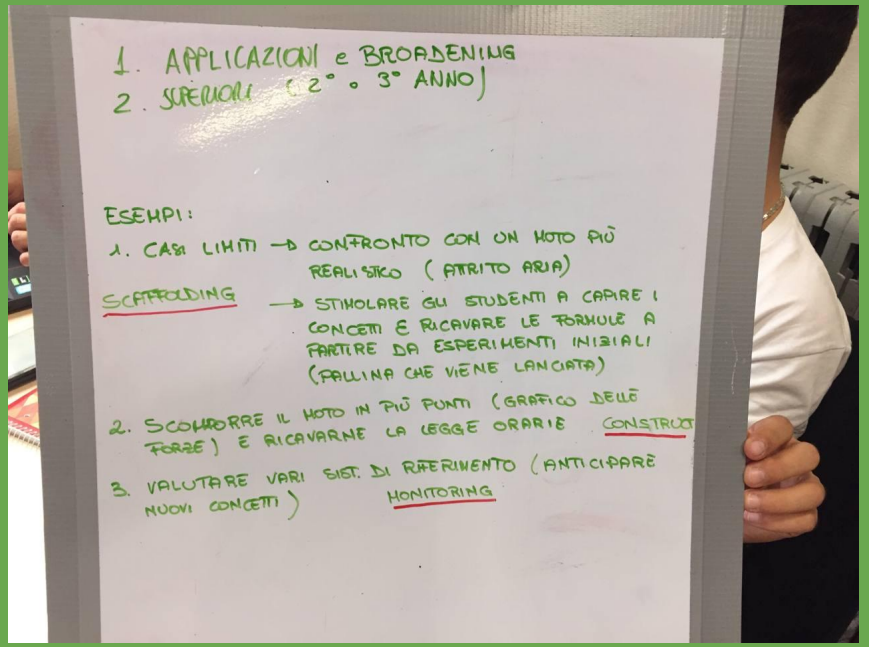


https://www.youtube.com/watch?v=wEQ69qW8Q6I Moto parabolico



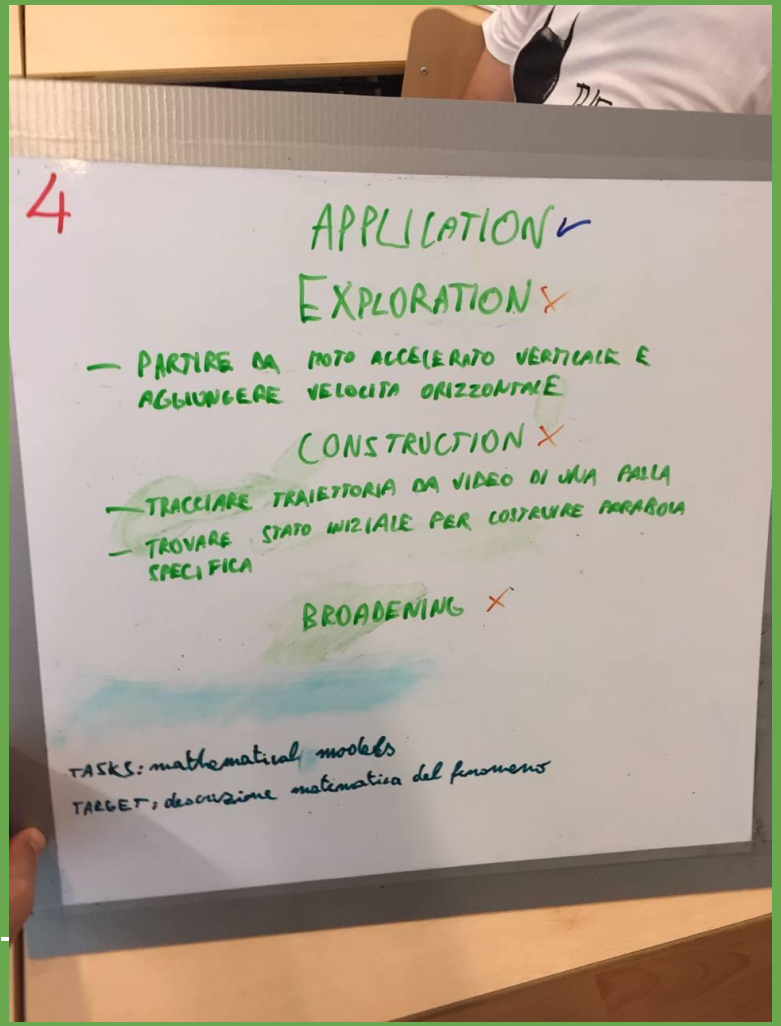


https://www.youtube.com/watch?v=qK3tIupN_Xw Step by step



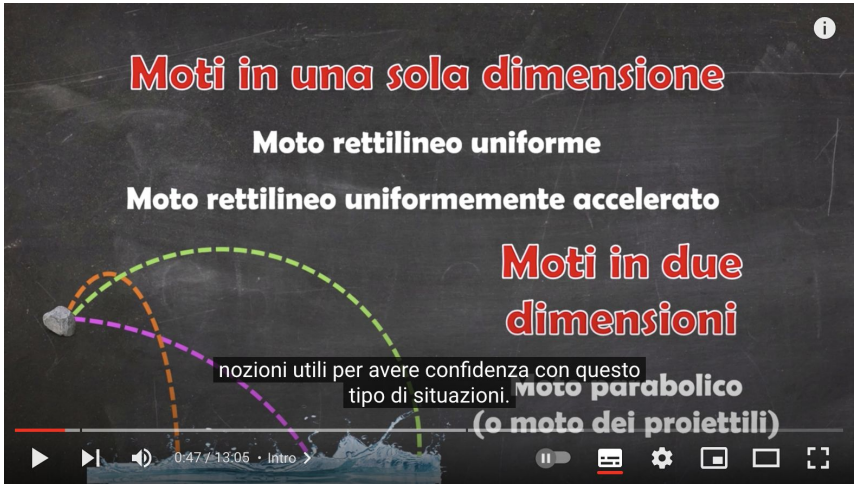
https://www.youtube.com/watch?v=fEvBuROI8as

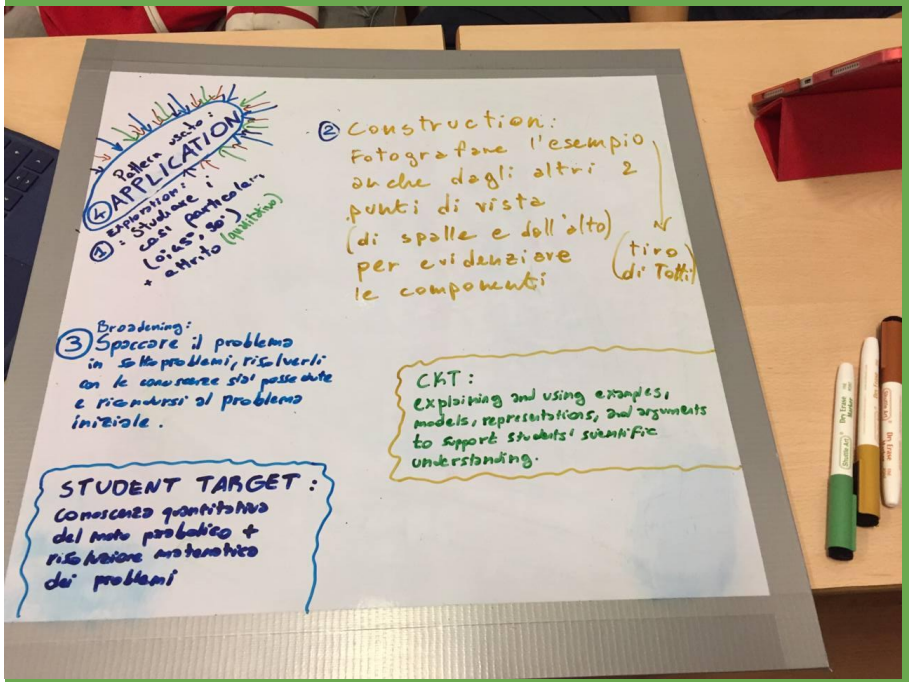
Un quarto d'ora con il prof



https://www.youtube.com/watch?v=Wf9zZyPKTL0

The BlackBoard Physics





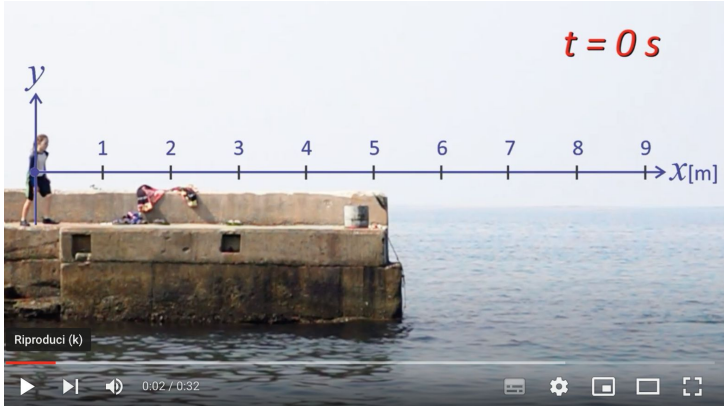
SAME TOPIC,
DIFFERENT PERSPECTIVES!

MATHS PERSPECTIVES
VS
PHYSICS PERSPECTIVES

EXERCISE FOR REASONING

https://www.youtube.com/watch?v=_sCp1igJ3j8

Horizontal Jump



Gorazd Planinsic, University of Ljubljana, Slovenia

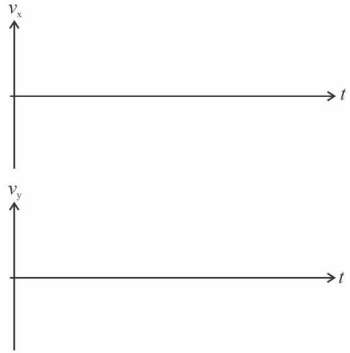
and Eugenia Etkina, Rutgers University, USA

0. FINN'S JUMP

The video https://youtu.be/_sCp1igJ3j8 shows Finn running along the pier and then jumping into the sea.

KINEMATICS

a. Draw a qualitative $v_x(t)$ and $v_y(t)$ graphs for Finn's motion, treating him as a point-like object that is positioned at the spot marked on the photo (let's call this point *center of mass*). Indicate any assumptions that you made.



b. Compare your graphs with the actual graphs https://drive.google.com/file/d/15SZnh2IwHAfodD4CGqAQse3P3JIVBhoh/view?usp=sharing that were obtained by tracking the Finn's motion from the video. Do they match? If not, suggest what might be the reasons for the differences (think of the assumptions that you made) and if necessary, revise your graphs.

c. Using data from the actual velocity-versus-time graphs compare the average magnitudes of Finn's acceleration while he is running along the pier and while he is falling. Which one is larger? How do you know? Are the values reasonable? How do you know?

d. Using data from the actual velocity-versus-time graphs and knowing that the distance between Finn's center of mass and the water level is 2.2 m, determine how far from the pier Finn jumped into the water. Indicate any assumptions that you made.

https://drive.google.com/file/d/1wZ71m7GWmmDTsh9dWkPoPxZ4qcLk7Go6/view?usp=sharing

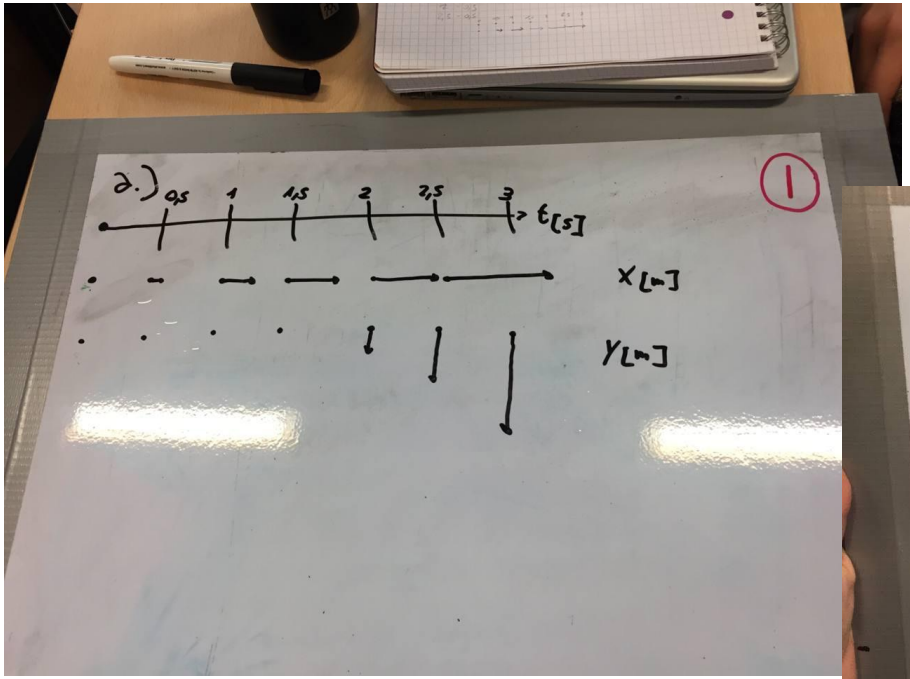
Developing new patterns for integrating Math/Phys Interplay

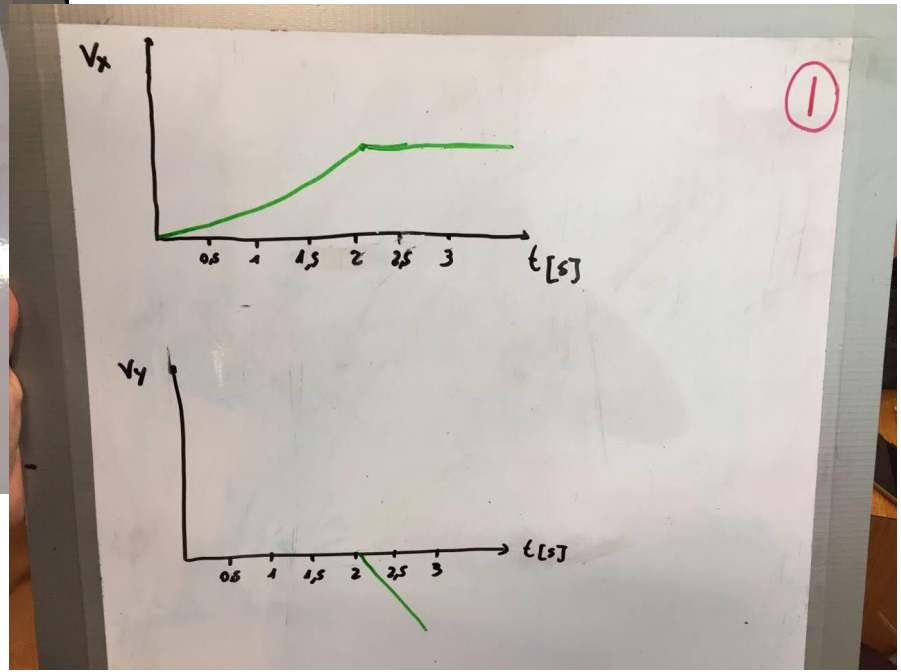
REFLECT on the EXERCISE FOR REASONING!

WHICH PATTERN IS PREVALENT?

Which are student specific target?

Which are the tasks that the teacher has in mind while teaching in the CKT frameworks?


a.)
0,5
1
1,5
2
2,5
3
t[s]
x[m]
y[m]
I


Vx
0,5
1
1,5
2
2,5
3
t[s]
Vy
0,5
1
1,5
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t[s]
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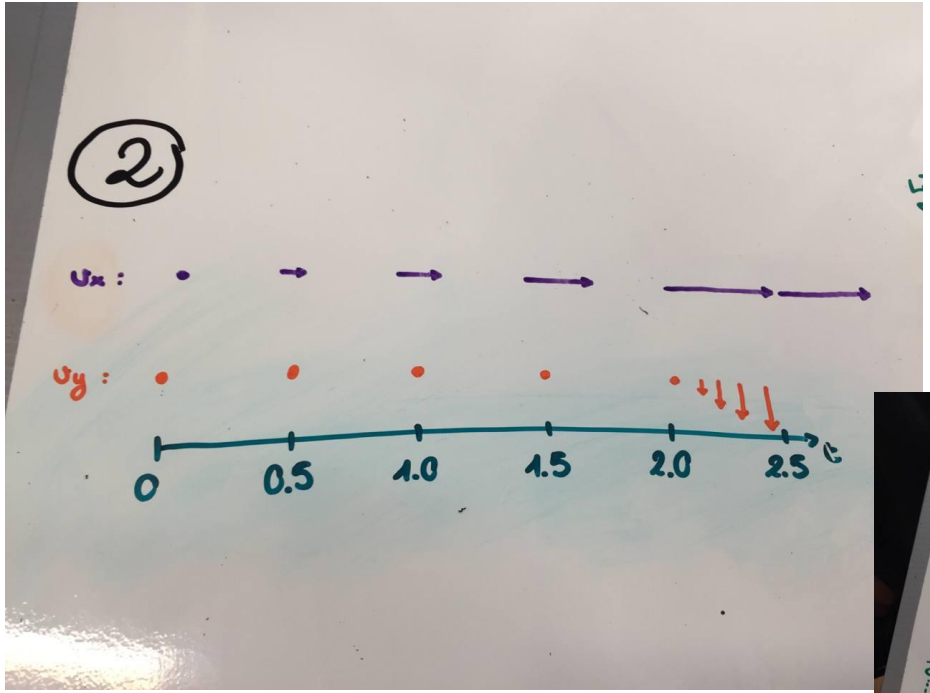
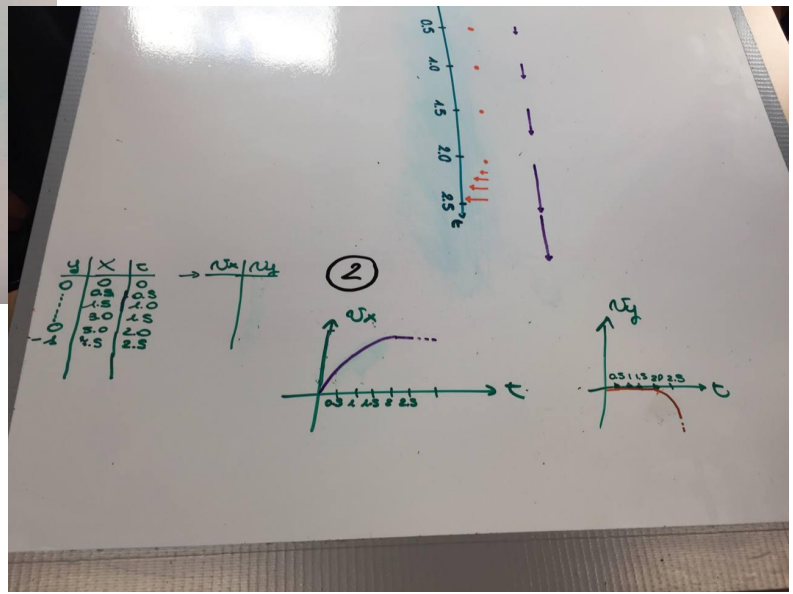
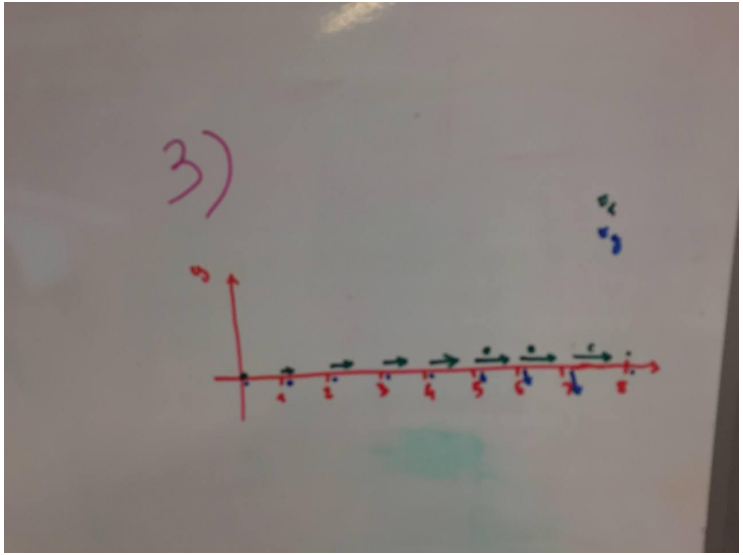
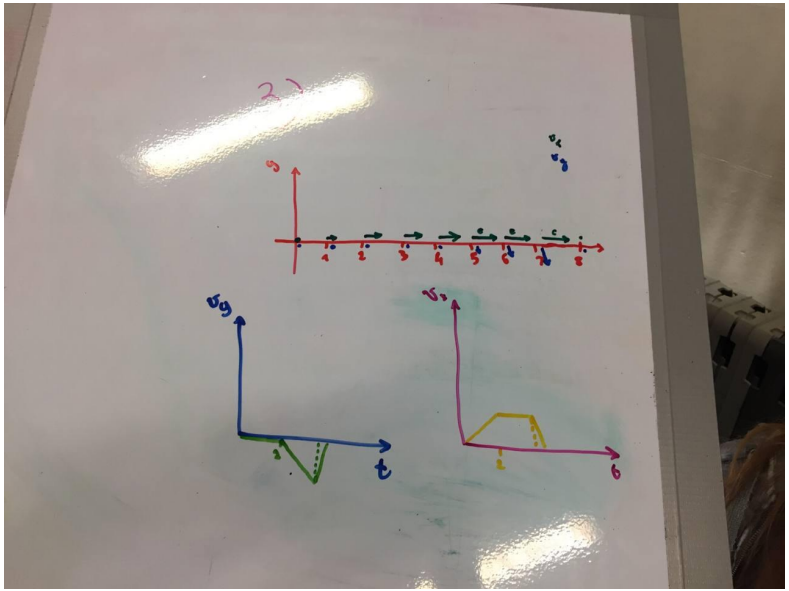
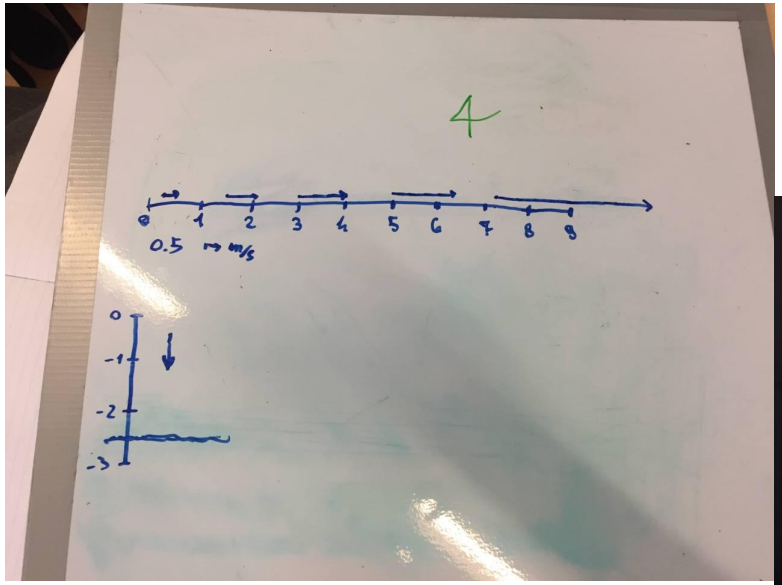
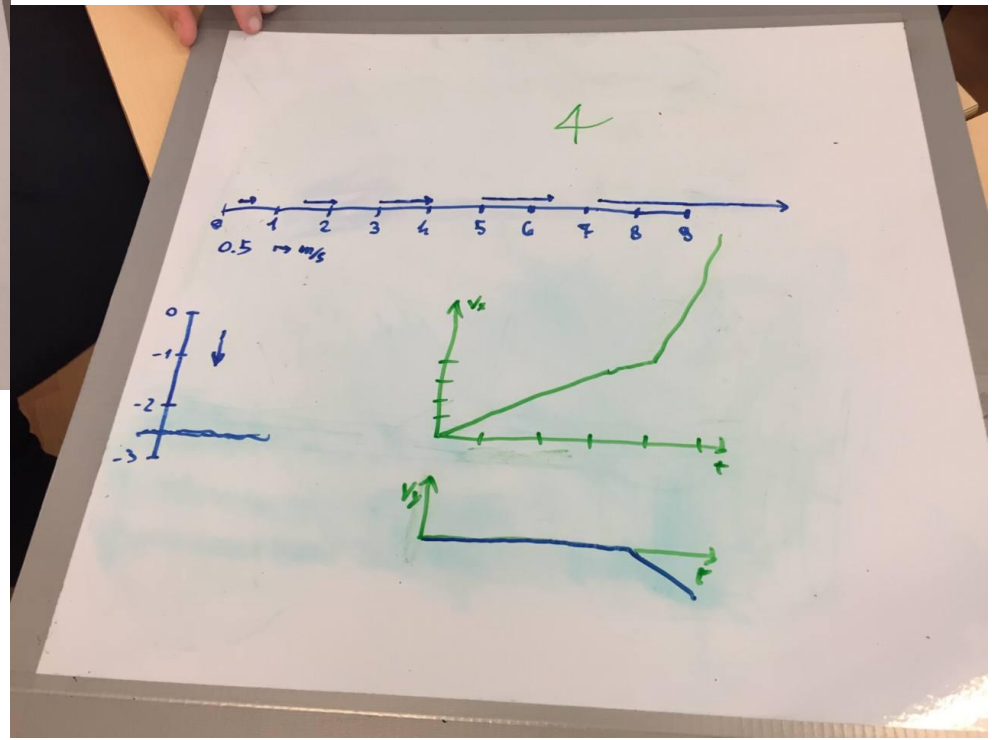

②
v_x :
v_y :
0
0.5
1.0
1.5
2.0
2.5
t

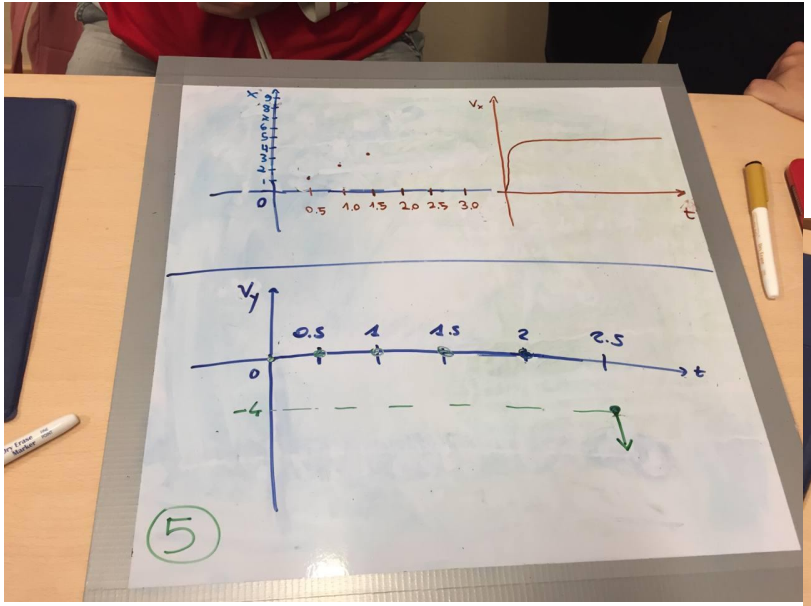

②
v_x
t

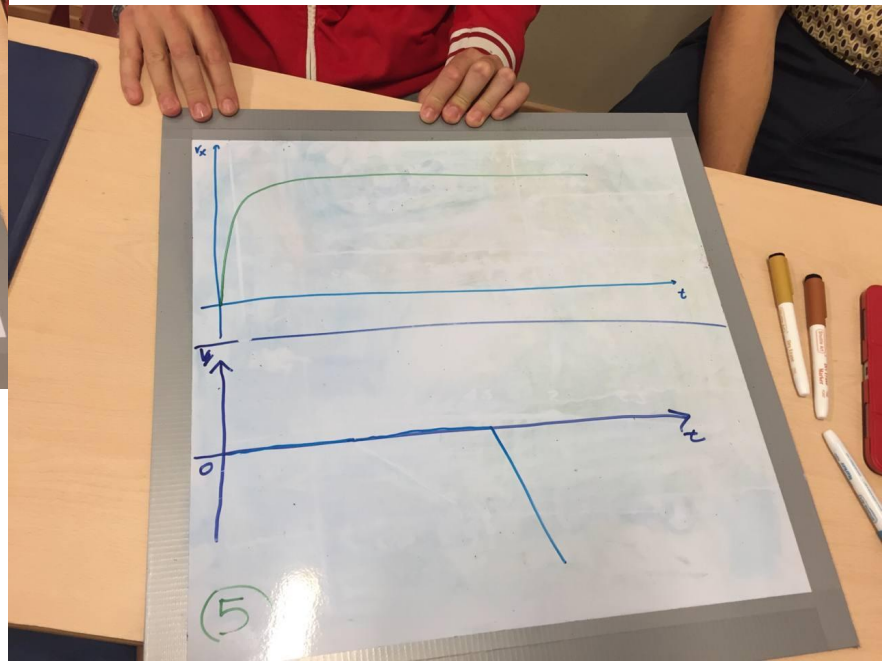

3)


2)


4
0 1 2 3 4 5 6 7 8 9
0.5 m/s
0
-1
-2
-3


4
0 1 2 3 4 5 6 7 8 9
0.5 m/s
0
-1
-2
-3
v_x
t
v_y
t


x
v_x
0
0.5 1.0 1.5 2.0 2.5 3.0
t
v_y
0.5
1
1.5
2
2.5
0
t
-4
5


v_x
t
v_y
0
5