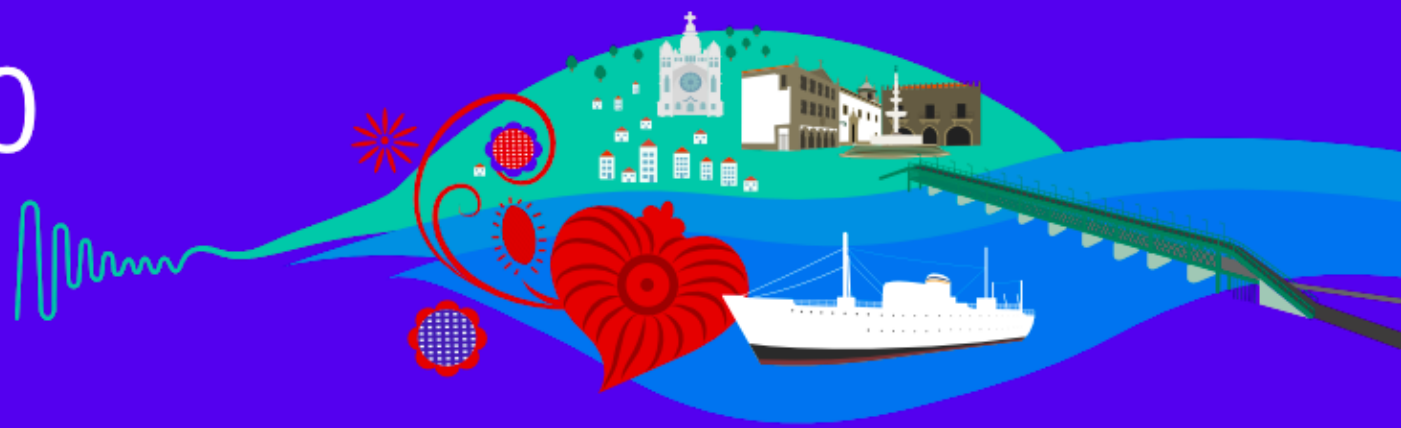


# HSCI2020

Viana do Castelo  
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## Physics and Math Integration using Digital Tools

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# Our Background

Some distances:

- Belo Horizonte to Timóteo  
~ 200 km
- Belo Horizonte to Rio de Janeiro  
~ 440 km
- Belo Horizonte to São Paulo  
~ 590 km



# Our Background



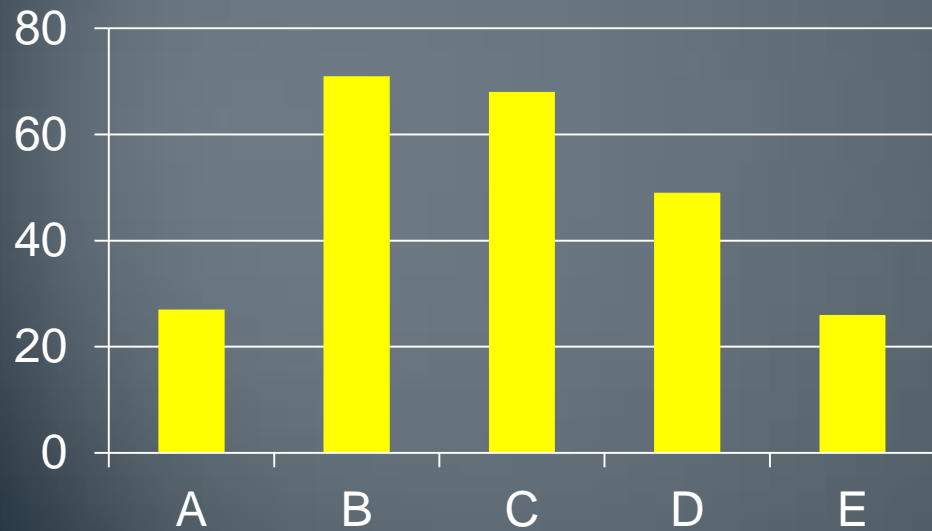
# Our Background

- 53 % of our students come from government funding schools
- About 38% of students need some financial support
- The monthly mean income for their families is about R\$ 500 per capita (€84)\*
- This low income is related with poor education and high rates of reading and mathematical illiteracy of entering students

\* Minimum wage in Brazil is about R\$1000 (€167)

# Our Background

Students' family income per capita



Category	Income per capita
A	€ 24
B	€ 52
C	€ 86
D	€ 121
E	€ 152

# Mathematical Illiteracy

- Math illiteracy, or innumeracy, is the “inability to deal comfortably with the fundamental notions of number and chance”

As seen in *Innumeracy: Mathematical illiteracy and its consequences* (2001)

Common mistakes and misconceptions:

$$x = \frac{1 + \cancel{2}\sqrt{3}}{\cancel{2}} = 1 + \sqrt{3}$$

$$x = x_0 + vt \quad \Leftrightarrow \quad y = Ax + b$$

# The Project

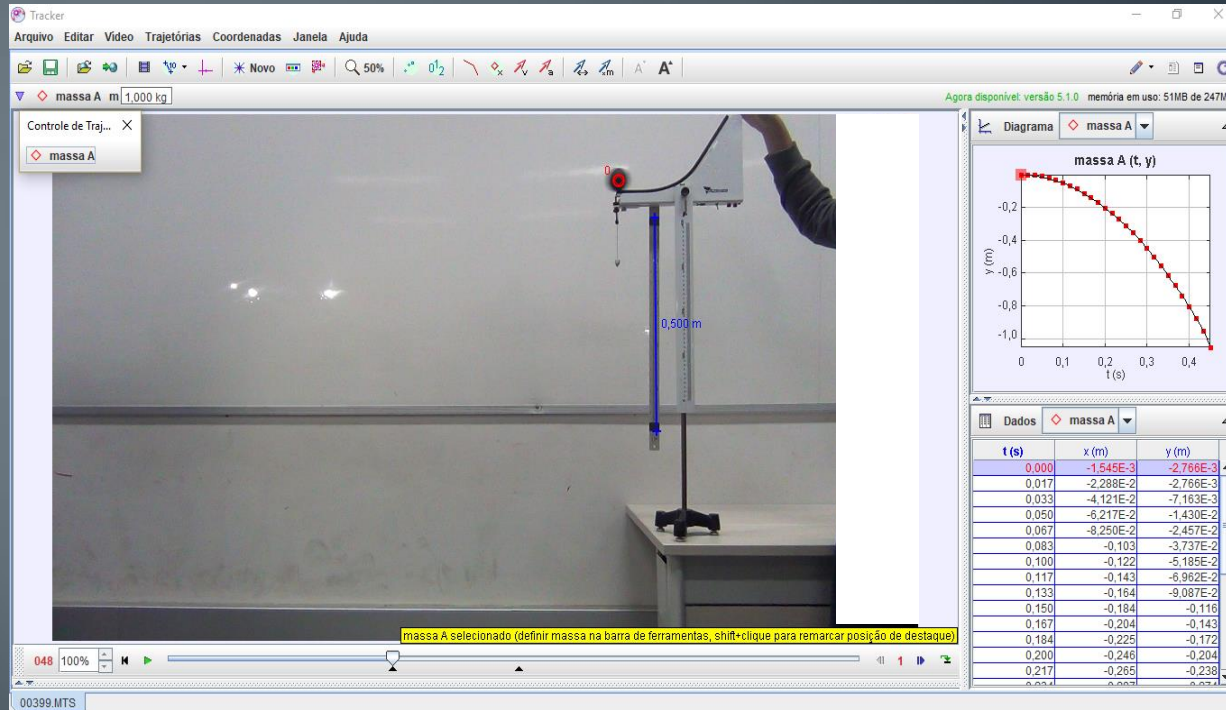
- Aims to work mathematical language with the concepts seen in physics
- Shows the interdependence between physics and mathematics
- Brings the experimentation into classroom with the use of DICTs (digital information and communications technologies)

# The Project

- It was performed in three consecutive years:
- In year one, the experiment was with a ball thrown horizontally from a slope;
- In the second year students used a game scene;
- And in the third year they recorded a chosen scene.



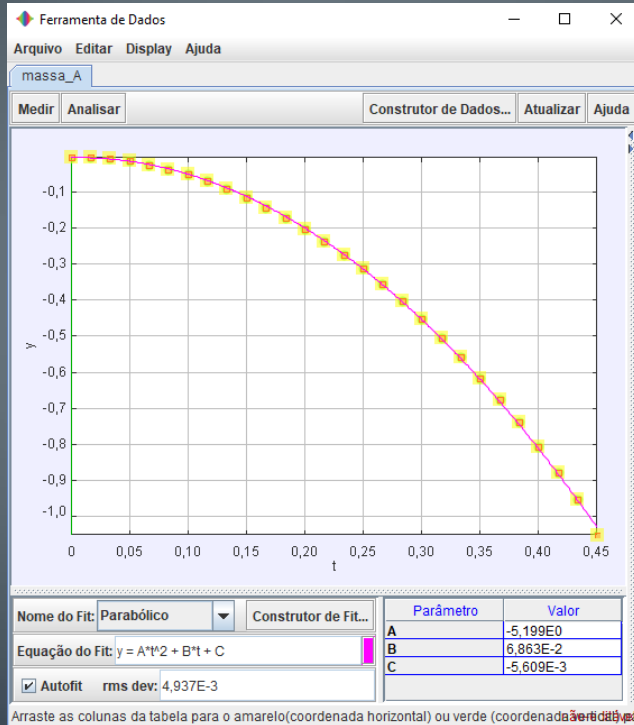
# The Project: ball thrown horizontally



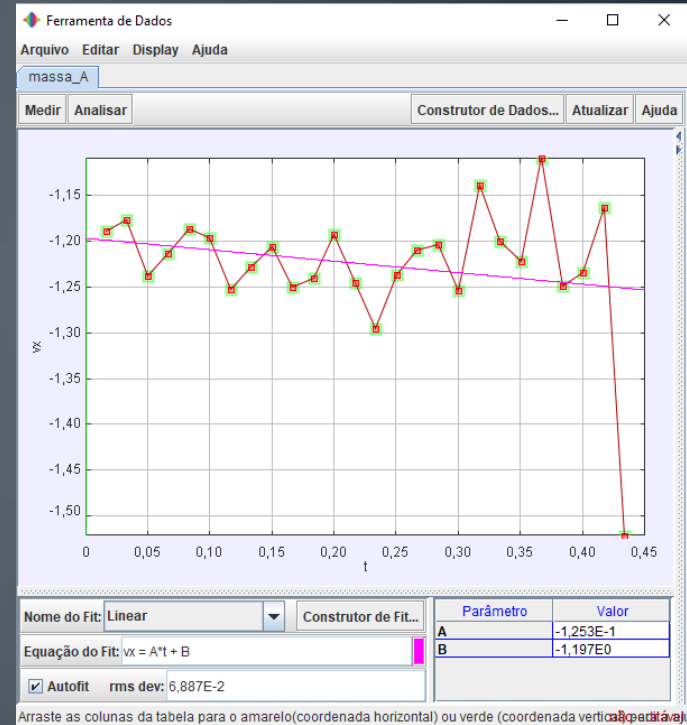
The screenshot shows the Tracker software interface. The main window displays a video of a ball being thrown horizontally from a height of 0.500 m. The software has tracked the ball's path, and a graph titled "Diagrama massa A" shows the trajectory of the ball. The graph plots vertical position  $y$  (m) against time  $t$  (s). The data table below the graph provides the following information:

t (s)	x (m)	y (m)
0.000	-1.545E-3	-2.766E-3
0.017	-2.288E-2	-2.766E-3
0.033	-4.121E-2	-7.163E-3
0.050	-6.217E-2	-1.430E-2
0.067	-8.250E-2	-2.457E-2
0.083	-0.103	-3.737E-2
0.100	-0.122	-5.185E-2
0.117	-0.143	-6.962E-2
0.133	-0.164	-9.087E-2
0.150	-0.184	-0.116
0.167	-0.204	-0.143
0.184	-0.225	-0.172
0.200	-0.246	-0.204
0.217	-0.265	-0.238

# The Project: ball thrown horizontally

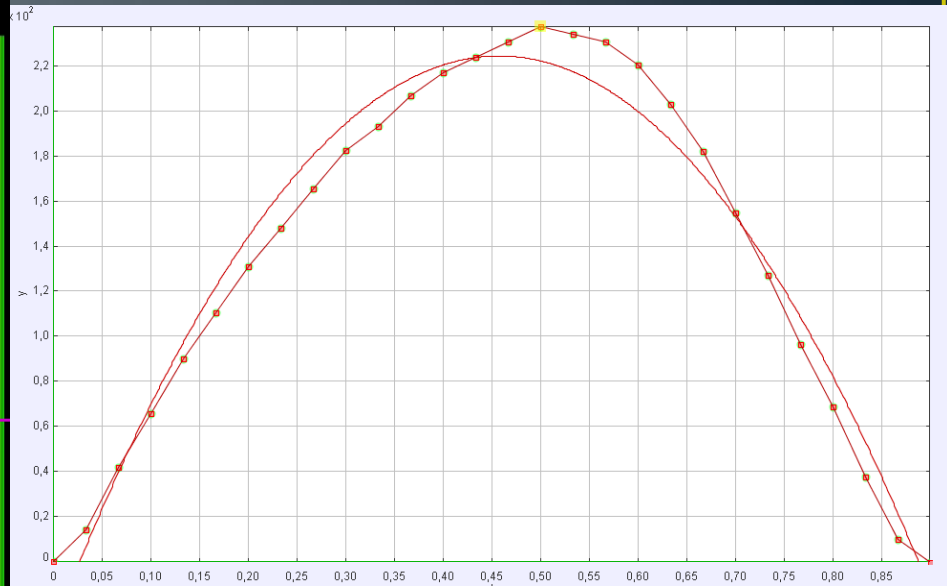
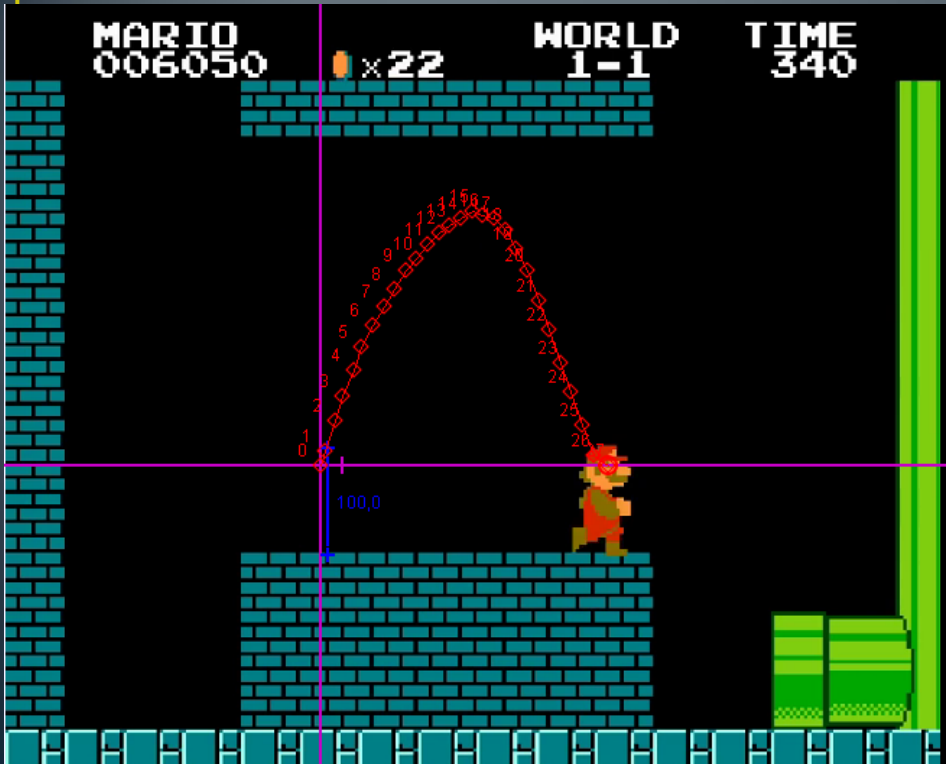


Time dependence of the vertical position



Time dependence of the horizontal velocity

# The Project: game scene



massa A selecionado (definir massa na barra de ferramentas, shift+clique pa

# The Project: recorded scene

Arquivo Editar Vídeo Trajetórias Coordenadas Janela Ajuda

memória em uso: 49MB de 247MB

▼ massa A m [1,000 kg]

Controle de T...  
▼ massa A

Diagrama ▼ massa A  Sincronizar

massa A (t, x)

massa A (t, y)

Dados ▼ massa A Gaps

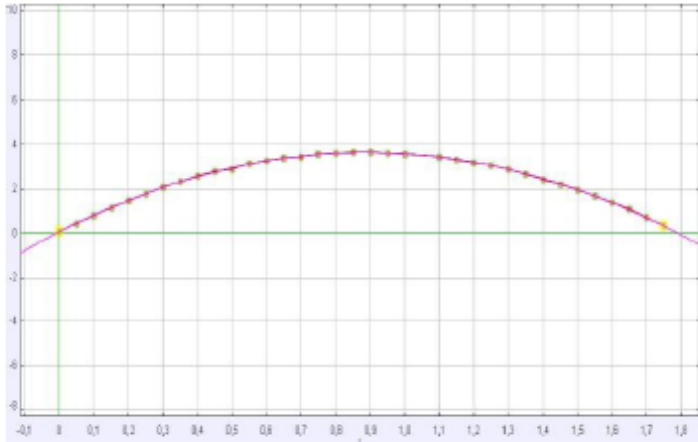
t (s)	x (m)	y (m)
0,000	2,938E-2	1,612
0,067	5,037E-2	1,587
0,133	7,136E-2	1,524
0,200	9,654E-2	1,402
0,267	0,105	1,272
0,333	0,113	1,100
0,400	0,109	0,881
0,466	0,118	0,634
0,533	9,235E-2	0,386
0,600	7,556E-2	0,113

047 100%

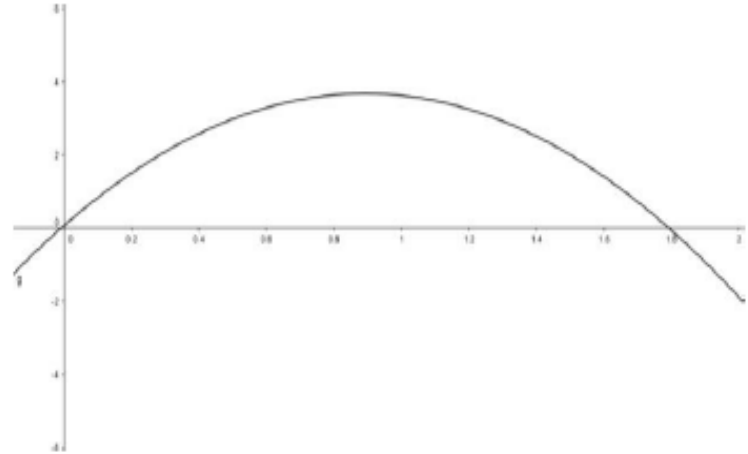
20190802\_130836.mp4

massa A selecionado (definir massa na barra de ferramentas, shift+clique para marcar as posições)

# The Project: representation with Geogebra



A – Time dependence of the vertical position of a character of a game made via Tracker.



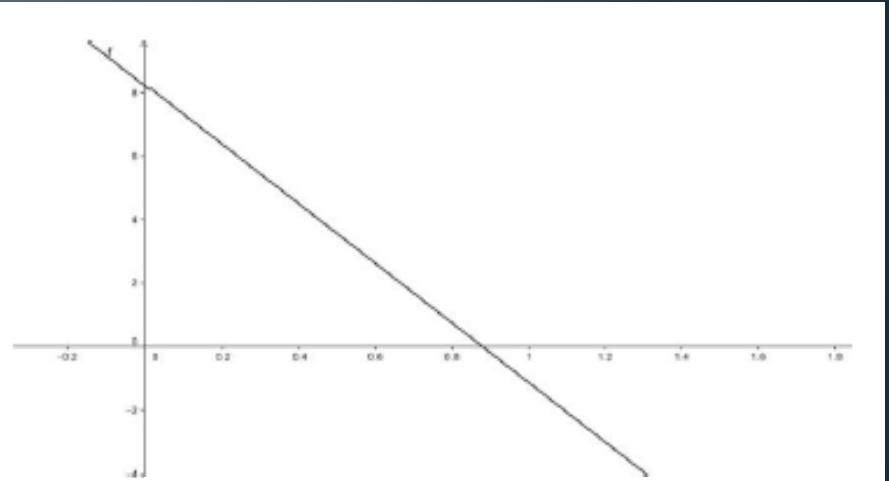
B – Plot of the movement in A, deduced by students using Geogebra.

# The Project: representation with Geogebra



Fig3.Velocidade em Y do Tracker

C – Time dependence of the vertical velocity for the movement in A, using Tracker



D – Deduced curve of C using interpolation in Geogebra

# Conclusions and Future

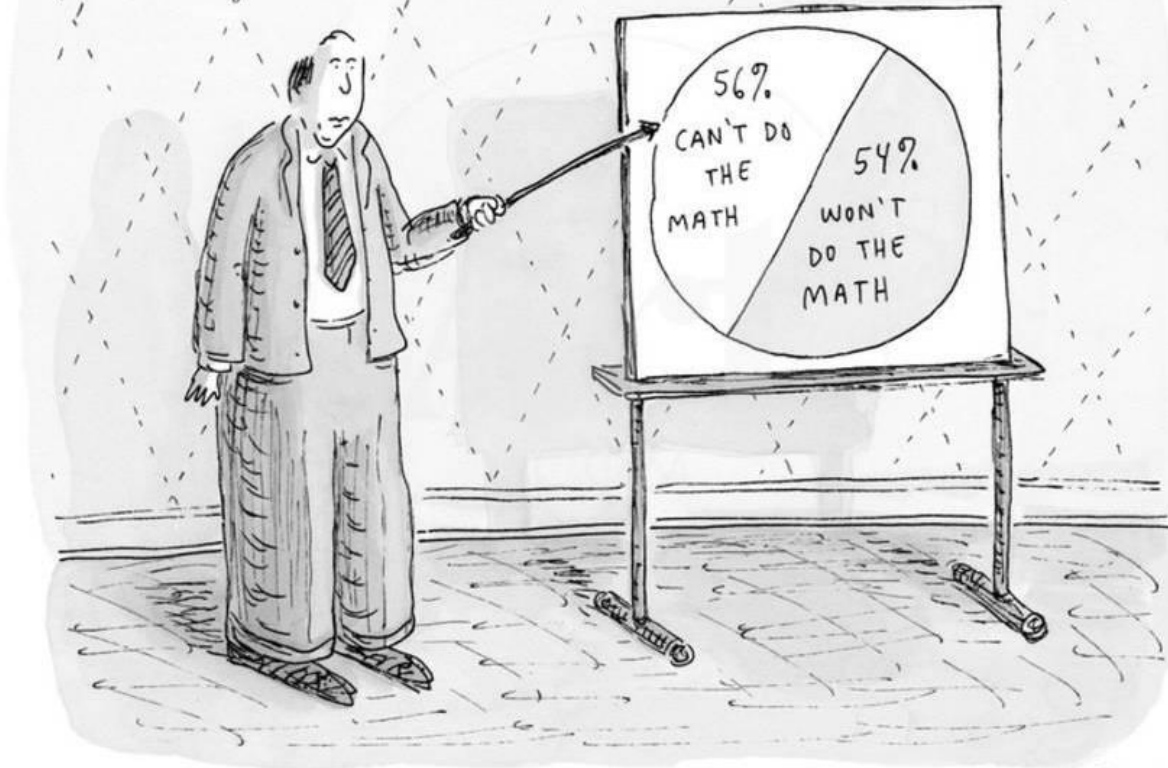
- The difference between the fit equations and the observed graphics stimulates a rich debate.
- Sometimes the games do not follow the physics law, which arises the discussion about reality and virtualized entertainment worlds.
- The experimentation, allied to simulation, engages the students in the comprehension of the phenomena, as compared with only conventional exercises.
- The results are presented in paper format, which assist their writing skills.

# Conclusions and Future

- Evaluate the improvement of the students learning
- Develop specific students training in math and physics
- Start specific programs for math and physics collaborative teaching in basic education
- Select other software and apps that can be used in classroom



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Thank you

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