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Learning Physics with Interactive Videos

Possibilities, Perception, and Challenges

Acknowledgement:





Outline:

- 1) Attitudes towards videos in Physics Education
- 2) Findings about learning with videos
- 3) Creating interactive videos with H5P



Initial Situation

- virtual labs about electron motion

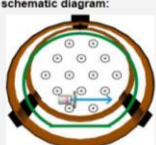
☰
B-Field
Charge-Mass Ratio
Applications
Practice

Task:
Get an universal equation that describes the radius of the trajectory of electrons in the magnetic field.
Therefore use the equations for the forces and enter your solution in the red framed line.

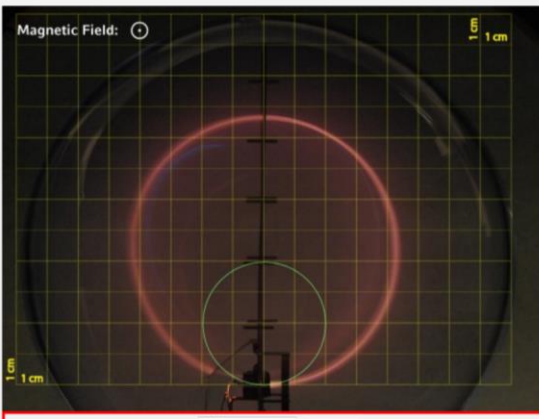
$$F_{\text{Zentripetal}} = m_e \frac{v_0^2}{r}$$

$$F_{\text{Lorentz}} = e \cdot v_0 \cdot B$$

controls:
 acceleration voltage V_a
 $v_0 = 1.027 \cdot 10^7 \frac{\text{m}}{\text{s}}$
 current / through coils
 $B = 1.31 \cdot 10^{-3} \text{ T}$

schematic diagram:


Magnetic Field: \odot



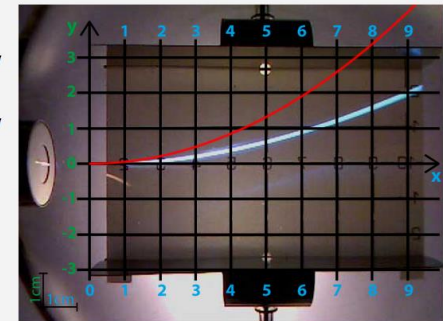
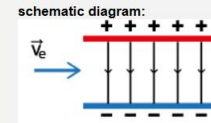
1 cm

$r = \frac{0.02}{1}$

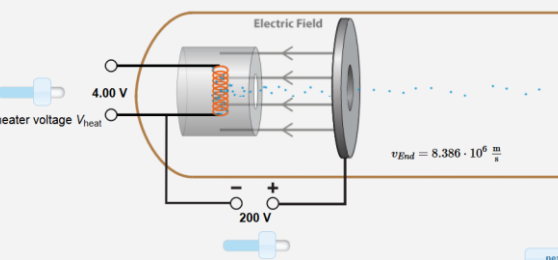
controls:
 acceleration voltage V_a

plate voltage V_p

$$E = \frac{V_p}{d} = 3.70 \cdot 10^4 \frac{\text{V}}{\text{m}}$$



Simulation of an Electron Gun
 Use the simulation to explore the influence of the heating voltage and the acceleration voltage on the electron beam.



heater voltage V_{heat}
 acceleration voltage V_a

$v_{\text{End}} = 8.386 \cdot 10^6 \frac{\text{m}}{\text{s}}$

<http://virtual-experiments.com>



Initial Situation

- virtual lab about electron motion
- usable in class and at home

Specific Questions:

- How should the theory be presented?
- How should summaries be presented?

➔ online survey on website



A (very) short online survey

- What group do you belong to?
- Why are you visiting this page?
- What is useful for you when learning from websites?



Question 3

What is useful for you when learning from websites? (multiple choice)

- Tasks (with solutions)
- Pictures
- Explanations with text
- Formulas
- Videos
- Summaries



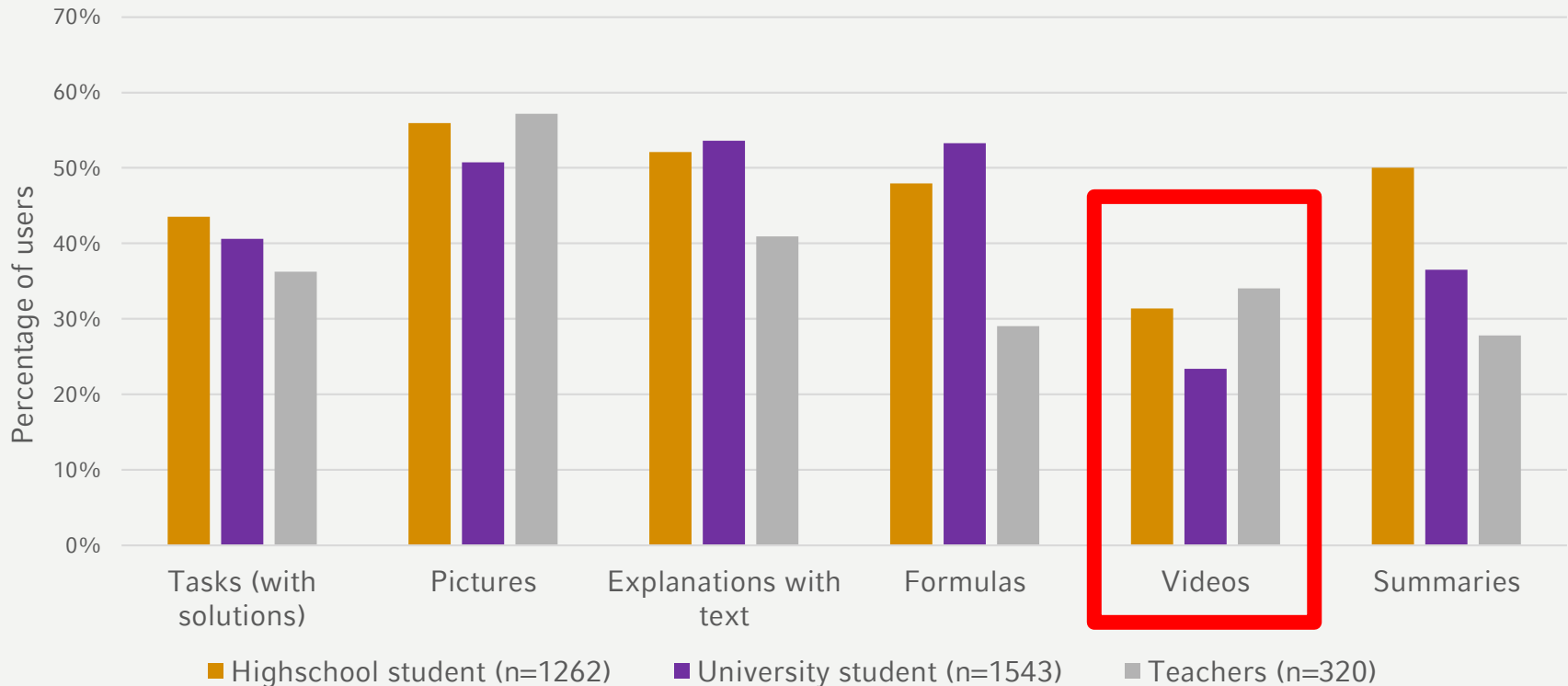
Participants

- Period: 5 month (June – October 2017)
- optional participation
- participation rate: ~ 9% of visitors

User group	German speaking users	English speaking users	Total number	%
Teacher	245	75	320	9,5 %
High school student	1053	219	1272	37,7 %
University student	902	641	1543	45,7 %
Other	130	112	242	7,1 %
Total	2330	1047	3377	100 %

Results:

Useful elements when learning from websites



Are videos just popular but not useful for learning?



Limits of the study

- no random sample
- no data about actual use
- no data about additional activities when learning with videos

➔ different questionnaire

Work in progress!



(Some) Findings about learning with videos

- Television is "easy" and print is "tough"

Salomon, G. (1984). Television is "easy" and print is "tough": The differential investment of mental effort in learning as a function of perceptions and attributions. *Journal of Educational Psychology*, 76(4), 647–658.
<https://doi.org/10.1037/0022-0663.76.4.647>

- Dual coding supports learning

Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review*, 3(3), 149–210.

- Multiple Representations can foster deeper understanding

Ainsworth, S. (2014). The Multiple Representation Principle in Multimedia Learning. In R. E. Mayer (Ed.), *Cambridge handbooks in psychology. The Cambridge Handbook of Multimedia Learning* (pp. 464–486). New York: Cambridge University Press.



(Some) Findings about learning with videos

- Videos should address misconceptions

Muller, D. A. (2008). *Designing effective multimedia for physics education*: University of Sydney.

- Adaption is possible and helpful

Schwan, S., & Riempp, R. (2004). The cognitive benefits of interactive videos: learning to tie nautical knots. *Learning and Instruction*, 14(3), 293–305. <https://doi.org/10.1016/j.learninstruc.2004.06.005>

- Embedding videos in interactive websites can increase students' engagement

Kim, J., Glassman, E. L., Monroy-Hernández, A., & Morris, M. R. (2015). RIMES: Embedding Interactive Multimedia Exercises in Lecture Videos. In B. Begole (Ed.), *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 1535–1544). New York, NY: ACM. <https://doi.org/10.1145/2702123.2702186>

**And what about
YouTube videos?**



Learning with YouTube videos

- videos are very popular



minutephysics
4,383,124 subscribers



100SekundenPhysik ✓
508,009 subscribers



TheSimplePhysics ✓
396,742 subscribers



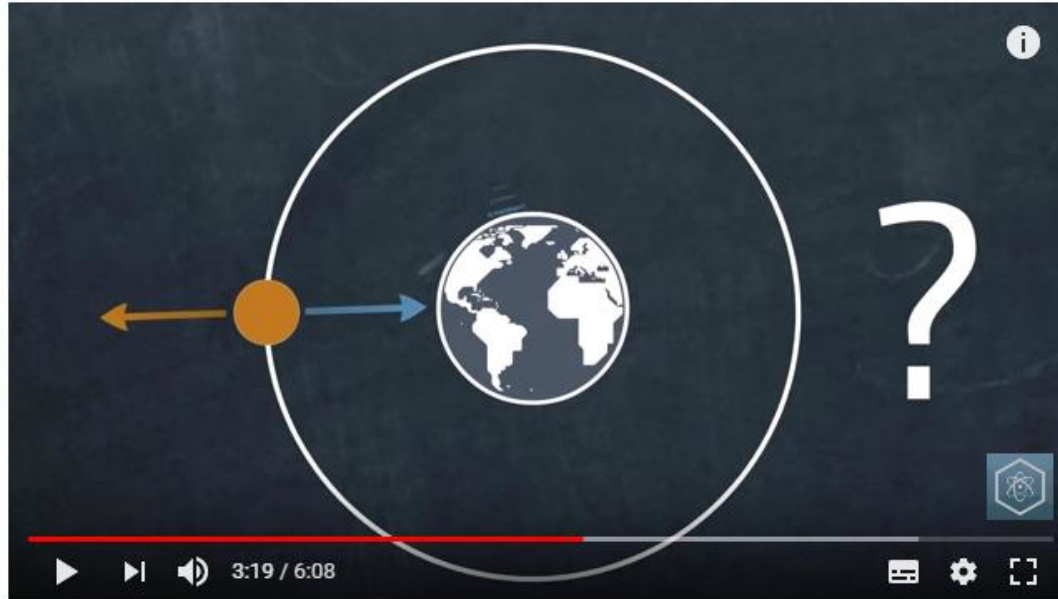
Learning with YouTube videos

- videos are very popular
- no relation between views, and likes and “explaining quality”

Kulgemeyer, C., & Peters, C. H. (2016). Exploring the explaining quality of physics online explanatory videos. *European Journal of Physics*, 37(6), 65705. <https://doi.org/10.1088/0143-0807/37/6/065705>

Learning with YouTube videos

- mistakes are hard to identify



Wie bleiben Satelliten am Himmel?

121,588 views

1.9K 98 SHARE



Learning with YouTube videos

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- mistakes are hard to identify
- YouTube videos are not interactive
- no tasks included

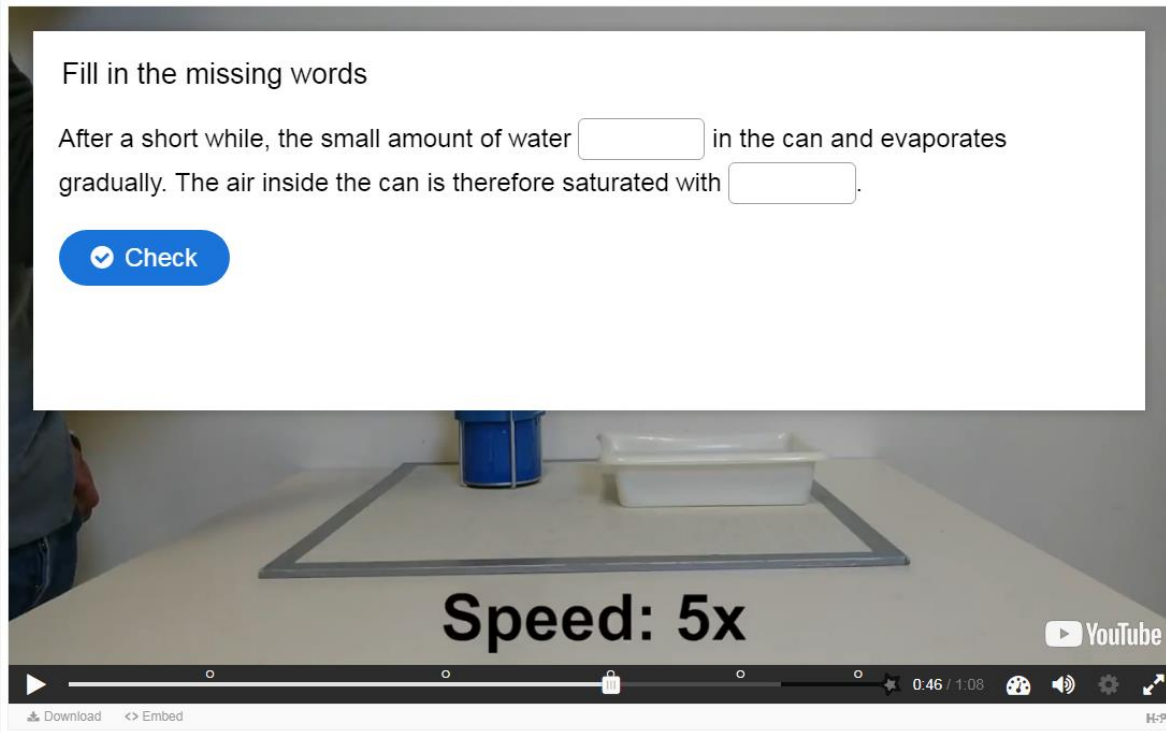
➔ „redesign“ necessary to foster learning



Interactive videos with H5P

- free and open source software (H5P.org)
- can transform any YouTube video
- plugins for Moodle, Drupal, Wordpress
- easy to use – no coding needed!
- content can be shared easily

Demo video with H5P



Fill in the missing words

After a short while, the small amount of water in the can and evaporates gradually. The air inside the can is therefore saturated with .

Check

Speed: 5x

0:46 / 1:08

Download <> Embed

H5P-Video: <https://h5p.org/node/274069>

Original YouTube-Video: <https://youtu.be/VvtbTGxfdEM>



Possibilities with H5P

- add additional text, images, hints
- stop video and ask question
(single choice, multiple choice, text)
- fill in the blanks
- drag and drop tasks
- jump to every point in the video



Advantages of interactive videos

- misconceptions can be addressed directly
- students have to be active → active learning
- students receive instant feedback
- results are visible for the teacher
- content can be shared
- students can create interactive videos
- ...



Conclusions

- YouTube videos have a huge fanbase
- only some students think they are useful
- research: many helpful elements, but interactivity needed for learning
- H5P can help to overcome this and foster learning with science videos