Use of Smartphones in High School Physics Teaching to Improve Learning and Motivation

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Outline

1. Introduction
2. Work with High School Students
3. Work with High School Teachers
Introduction

Shortage of STEM students?

Different factors influence the choice of science subjects: socioeconomic, person of influence, teaching quality, careers, ...

Intrinsic factors seem to dominate over other factors: student’s interest in a subject, their performance in it and the need for choosing subjects that will be useful in their careers

Improving student’s attitude towards physics will imply making them interesting.

We must also search for tools to improve students’ results.
Introduction

In this work we want to study the influence of using mobile devices in teaching physics.

These mobile devices are rich in built-in sensors that can be used in physics experiments.

How does students and teachers see the use of these devices to learn physics?

Difficulties, advantages and disadvantages?
Introduction

Here we show preliminary results of our work with:

- Students: (16 years old) in a normal baccalaureate. Short talks and autonomous work.
- Students: (17 years old) in a STEM reinforced baccalaureate. Guided work, discussions, autonomous work.
- Teachers: Short talks and survey.
- Teachers: Talks, guided work, discussions, work with students, surveys.
Students: Normal Baccalaureate

Experiment with 22 students: 16 years old, 13 boys and 9 girls
- Survey
- Talk with demonstrations
- Students' work in groups (two weeks) with some assistance
Students: Normal Baccalaureate, survey

Experiment with 22 students: 16 years old, 13 boys and 9 girls

Classroom: search for information, use of some apps.
Outside: search for information.
Sensors: sport measurements.

![Bar chart showing the use of smartphones and sensors in the classroom and outside. The chart indicates that most students use smartphones in the classroom and are aware of sensors, but fewer use them outside.](chart.png)
Students: Normal Baccalaureate, experiments

Experiment with 22 students: 16 years old, 13 boys and 9 girls

Results

- 17 students worked with the smartphone (8 boys and 9 girls)
- Groups of 2 to 4 students
- Measurements: acceleration in an elevator, circular movement, pendulum, parabolic movement.

In general, the students’ work should have required more supervision to help them obtain more complete results.

The use of the smartphones motivated those students that were more interested in physics, while the rest tended to do the minimum required.

What could we have obtained if we would have done more experiments once they learned the technique and what we expected?
Students: Scientific Baccalaureate, structure


Structure:

- Approximately 15 two-hour sessions, nearly half of them face-to-face and the other of autonomous work:
  - Supervised: 1 Explanations of the experimental technique and tools
  - Supervised: 2-3 Supervised lab work with smartphones
  - Autonomous: Several sessions performing experiments proposed by us
  - Supervised: 2-3 Sessions for discussing results and improving the analysis
  - Autonomous: Experiments along students’ every-day activities
- Final writing of a report describing all the experiments and discussing their results
Students: Scientific Baccalaureate, examples

Smartphones in High School Physics

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Teachers: Talks describing the use of smartphones

Talks including: importance of active learning, description of smartphone sensors, use of apps to acquire data, discussions on the teaching use of the smartphone and examples of simple experiments:

- analysis of an elevator movement
- uniformly accelerated motion
- circular motion, centripetal acceleration
- measurement of gravity acceleration (fall)
- simple pendulum
- magnetic field due to conductors
- Doppler effect
- ...

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Teachers: Talks describing the use of smartphones, survey

Survey: 19 teachers of 5 different high schools

- Utility for learning
  - Improves assimilation of knowledge
  - Improving understanding
  - More dynamical and interesting lectures
- Easy for the students
- Possible use outside the classroom
- Increases collaborative work
- More participative interaction teacher-student
- Improves understanding and interesting lectures
- Estimated frequency of use
  - Utility for learning
  - Increases collaborative work
  - More participative interaction teacher-student
  - Improves understanding and interesting lectures

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Teachers: Talks, lab work and work with students

13 teachers from 11 different high schools
Four two-hour sessions:

1st session: Theoretical fundamentals and demonstrations of simple experiments
One week gap for personal work

2nd session: Teachers’ practical work with smartphones and discussion of their personal work
One week gap for personal work

3rd session: Teachers’ practical work with smartphones and discussion of their personal work
Three weeks gap for work with students

4rd session: Discussion of their work with students
Teachers: Talks, lab work and work with students

Do you know the smartphone has sensors? Use of smartphone in teaching Improves assimilation of knowledge Improving understanding More dynamical and interesting lectures More participative lectures Increases interaction teacher-student

13 teachers from 11 different high schools: Initial survey

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Teachers: Talks, lab work and work with students

13 teachers from 11 different high schools: Final survey

- Improves assimilation of knowledge
- Improving understanding
- More dynamical and interesting lectures
- More participative lectures
- Increases collaborative work in the classroom
- Increases interaction teacher-student

% of total
- Low
- Medium-Low
- Medium
- Medium-High
- High

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Teachers: Talks, lab work and work with students

13 teachers from 11 different high schools: Comparison

- Improves assimilation
- Improves understanding
- More dynamical lectures
- More participative lectures
- Increases communication teacher-students

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Smartphones in High School Physics
Teachers: Talks, lab work and work with students

167 students of 7 different high schools (112 14-16 y.o., 55 17-18 y.o.)

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Conclusions:

- Students and teachers are interested in this technique.
- Teachers: this technique allows more participative learning and increases students' interest.
- Teachers: difficulties due to wrong use of the smartphones and higher amount of work.
- The students' work with the smartphone gives good results if the students are guided and supervised. The only use of the smartphone does not produce magical results.

Next work:

- More students and more teachers.
- Quantitative measurement of learning results.
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