Educational Technology: No Benefits without Appropriate Teacher Training

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Overview

- Findings from Educational Research
- ICTforIST modules & Teacher Training Courses
- Research Questions
- Methods & Samples
- Results
- Conclusions

Findings from Educational Research

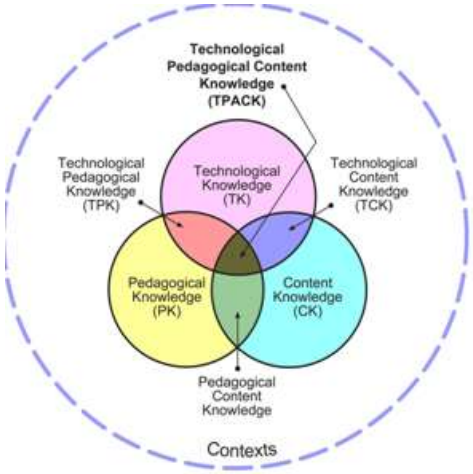
- Students have conceptual difficulties in physics
- ICT-rich environments can enhance learning
- MBL activities, for example, seem to be effective
- Teachers mainly focus on technological issues
- Teachers do not use technology in sophisticated ways
- Teachers feel inadequately prepared
- TPACK Framework for Technology Integration

Purpose of the study

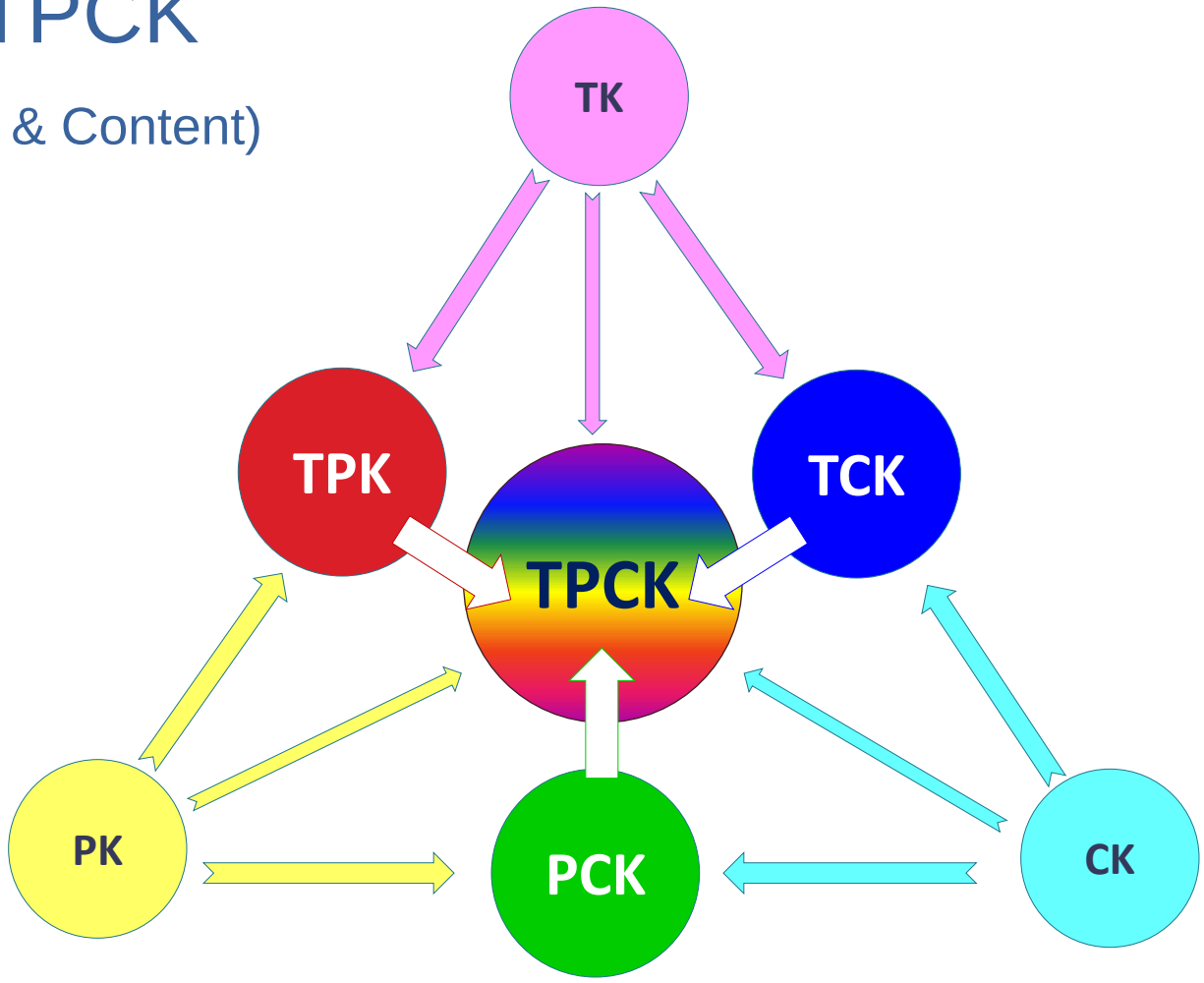
- Provide training in technology integration to teachers
- Test ICTforIST modules in teacher training
- Develop teacher training courses (TTC) based on
  - TPCK Framework
  - LoTI Framework
  - Assessment Rubric
  - Constructivist approaches to pedagogy
  - Confronting students‘ alternative physics conceptions
- Compare different types of TTC

Framework for TPCK

(Technology & Pedagogy & Content)

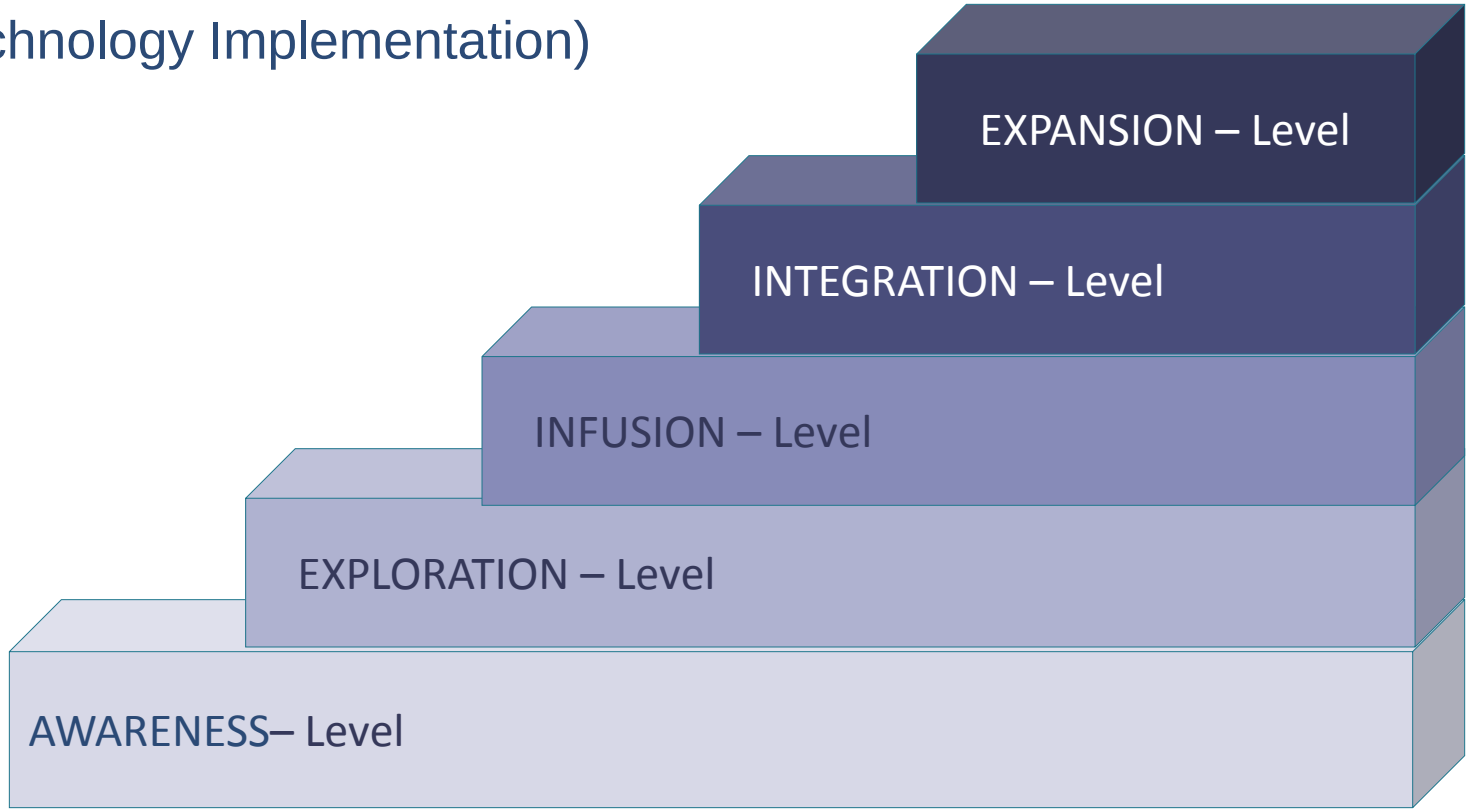


Based on Koehler & Mishra (2008)



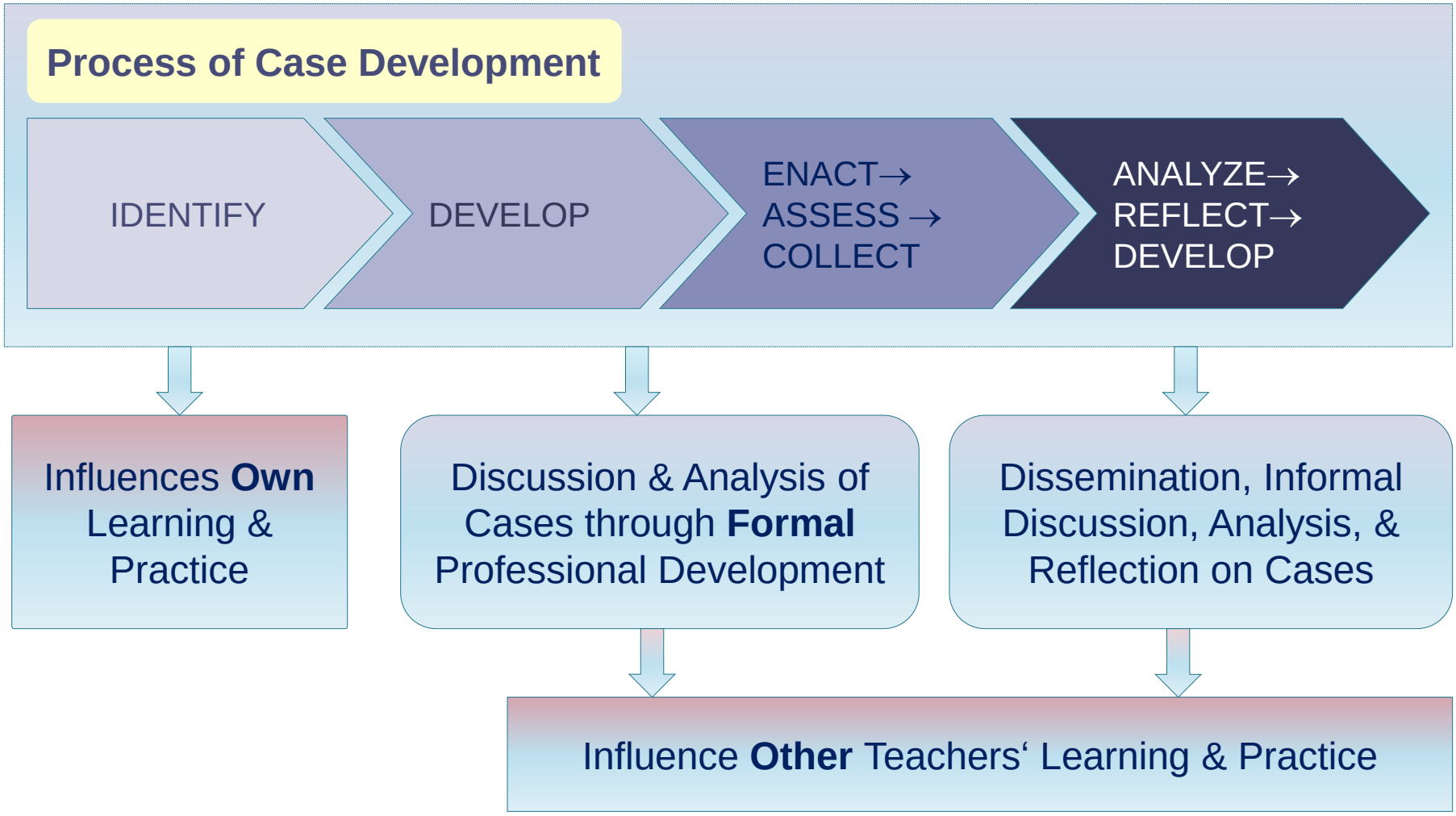
Framework for LoTI

(Levels of Technology Implementation)



Based on Moersch (1995)

Framework for Case Development



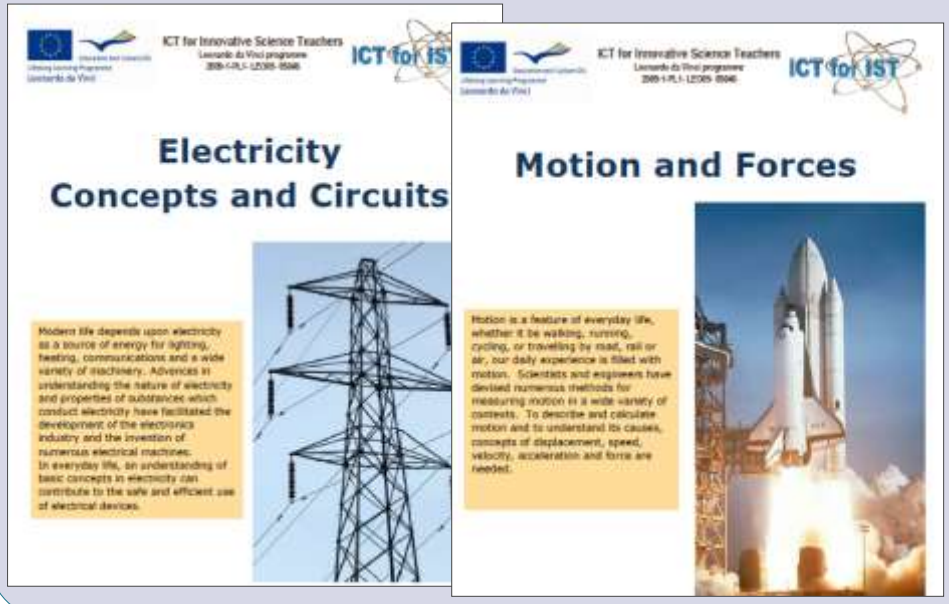
Based on Mouza & Wong (2009)

Education and Culture DG
Lifelong Learning Programme
Leonardo da Vinci

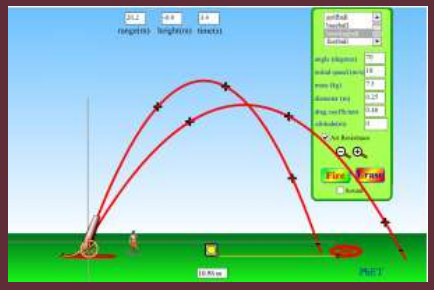
ICT for Innovative Science Teachers

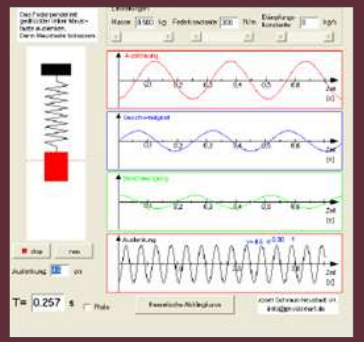
ICT for IST

Resources



Simulation

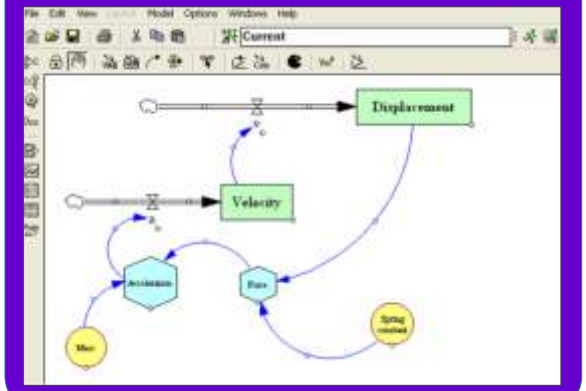




Data logging

Video measurement

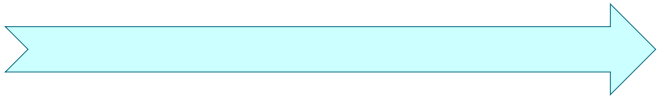
Modelling



Course design for practicing physics teachers

10 Months Online Course

- View and study materials
- Exchange ideas and materials
- Reflect and refine ideas
- Discuss lesson plans
- Communicate and collaborate



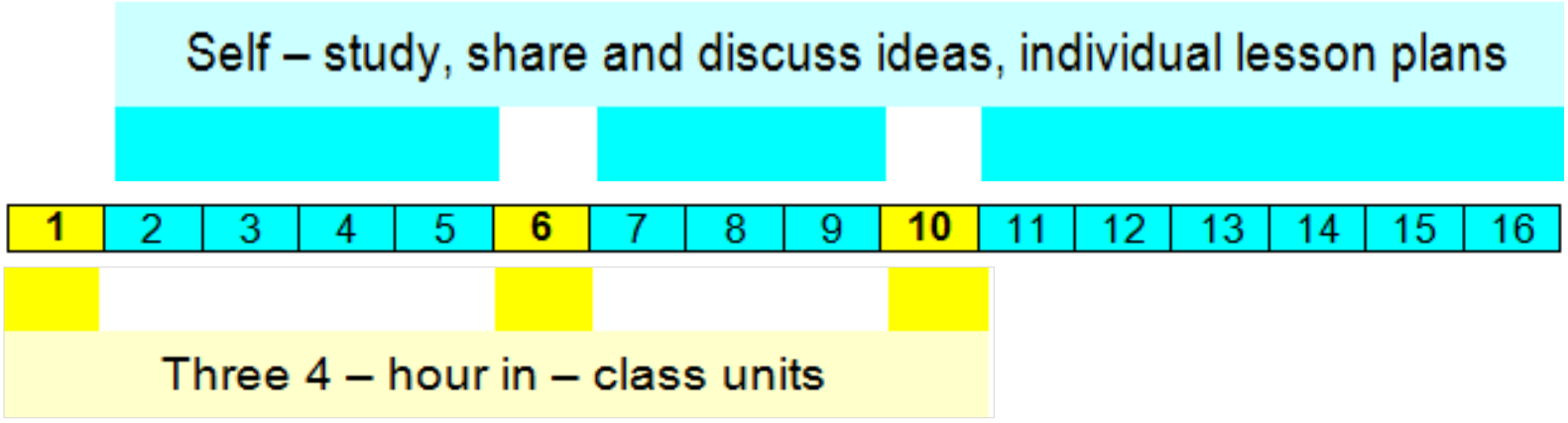
1	2	3	4	5	6	7	8	9	10

One half – day face to face meeting

- Basics of technology use
- Emphasizing TCK
- Pedagogical issues
- Various examples

Course design for future physics teachers

- Blended learning course (embedded into a regular course)
- Pre – service teachers
- 16 weeks
- Three 4-hour in-class units
- Supported by a Moodle platform



Video analysis with VIANA

- Free fall
- Accelerated car
- Rebounding trolley
- Motion in 2 dimensions

Designing 3 Lesson Plans for 3 Topics

- Motion and Forces
- Simple Electrics Circuits
- Newton's Law of Cooling

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Data - logging activities

- Walking motion
- Free fall
- Accelerated trolley
- Rebounding trolley

Modelling with VENSIM

- Free fall
- Accelerated trolley
- Rebounding trolley
- Newton's Law of cooling

Simulation

- Terminal velocity
- Mass on a spring
- Rebounding trolley
- Electric circuits

Research Questions

RQ 1: Is there a relationship between motivational orientations and the self-reported evolution of TPCK?

RQ 2: Are self-reported knowledge gains in TPCK in agreement with external assessment of lesson plan designs?

Methods and Samples

- Two different types of TTC
  - Course A: 17 prospective physics teachers (9 ♀, 8♂)
  - Course B: 12 practicing physics teachers (8 ♀, 4♂)
- Four different types of Educational Technology
  - Data Logging
  - Video measurement
  - Simulations
  - Modelling

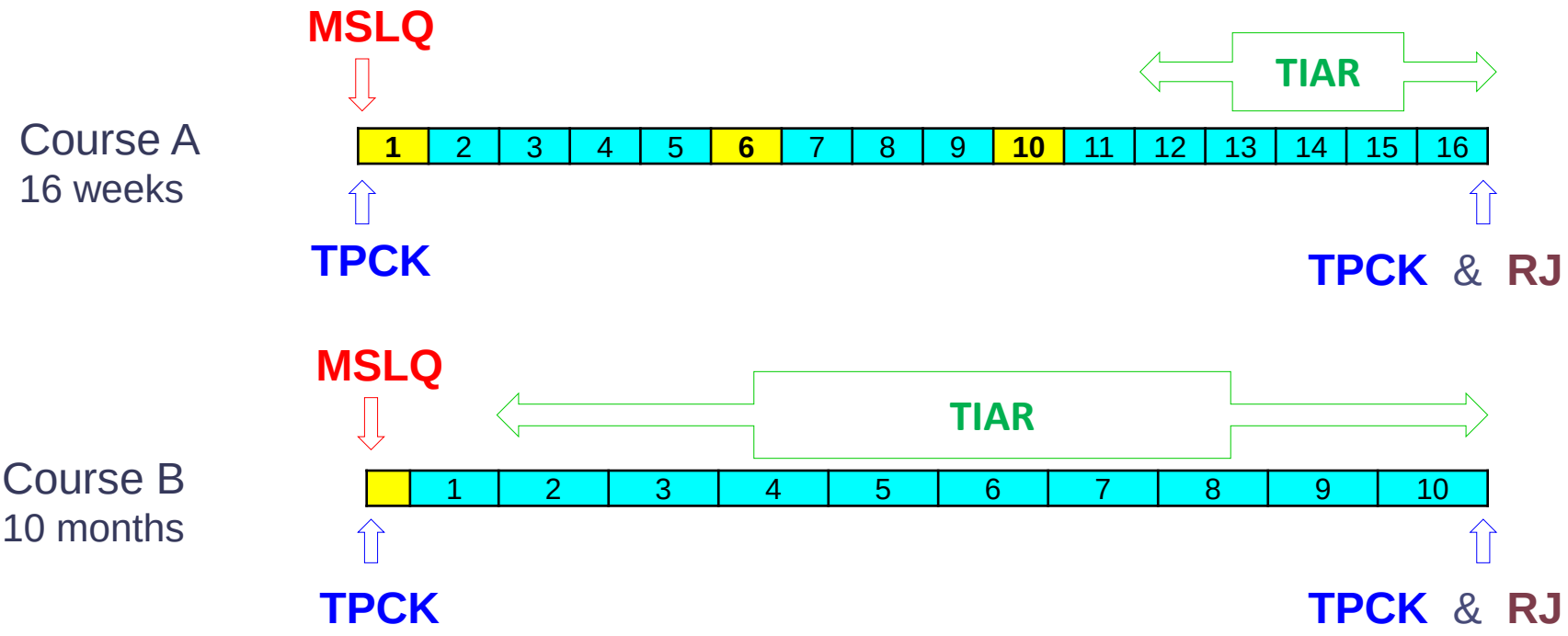
Instruments

MSLQ Inventory (adapted from Pintrich et al., 1992)

TPCK Inventory (adapted from Schmidt et al., 2009)

TIAR Technology Integration Assessment Rubric (Harris et al., 2010)

RJ Reflection Journals

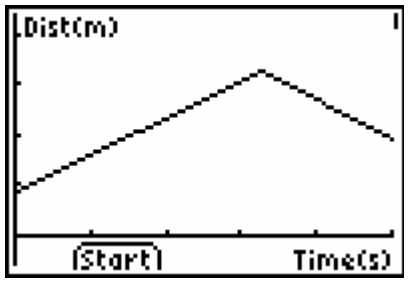


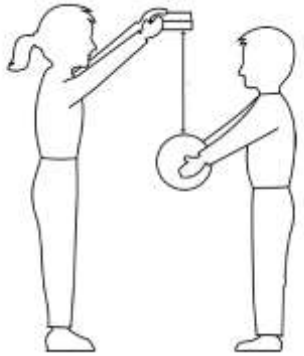
Technology Integration Assessment Rubric

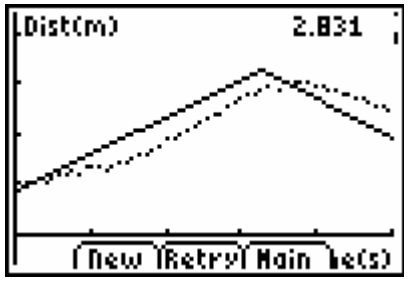
Criteria	Awareness	Exploration	Infusion	Integration
Curriculum Goals (CG)	Technologies are **not aligned** with CG	… **partially** aligned with CG	…. **aligned** with CG	… **strongly** aligned with CG
Instructional Strategies (IS)	Technology use **does not support** IS	… **minimally** supports IS	… **supports** IS	… **optimally** supports IS
Technology Selections (TS)	TS are inappropriate given CG & IS	… **marginally** appropriate	… **appropriate**, but not exemplary	… **exemplary**
„Fit“ TPCK	Content, IS and Technology **do not fit together**	… fit together **somewhat**	… **fit** together	… fit together **strongly**

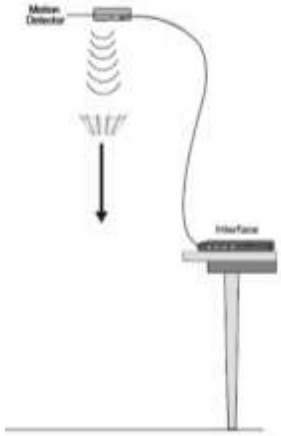
Based on LoTi Framework (Moersch, 1994) & TIAR (Harris et al., 2010)

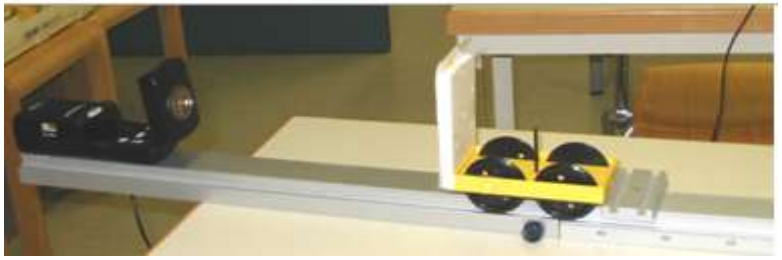
Entry – Stage (Data logging)





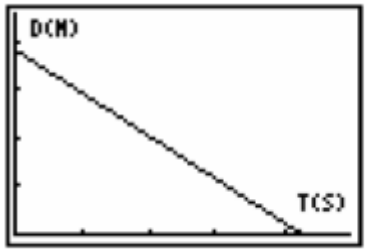


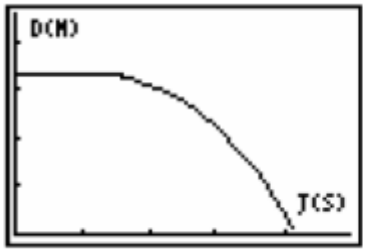


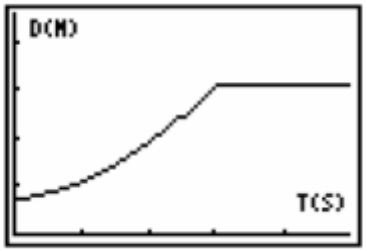


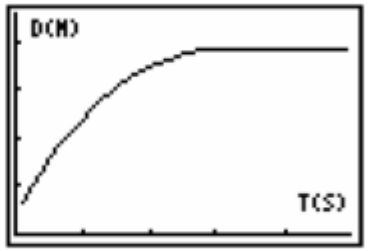
Strongly addressing PCK

Which plot best matches the motion of the ball?





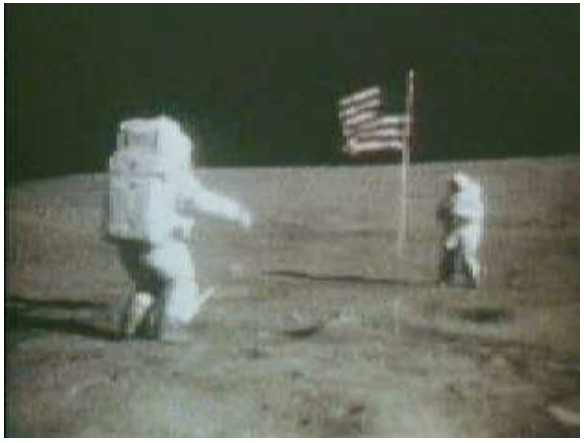




Further questions

- Examine, what happens for differing inclines
- Predict, what will happen if the incline increases.

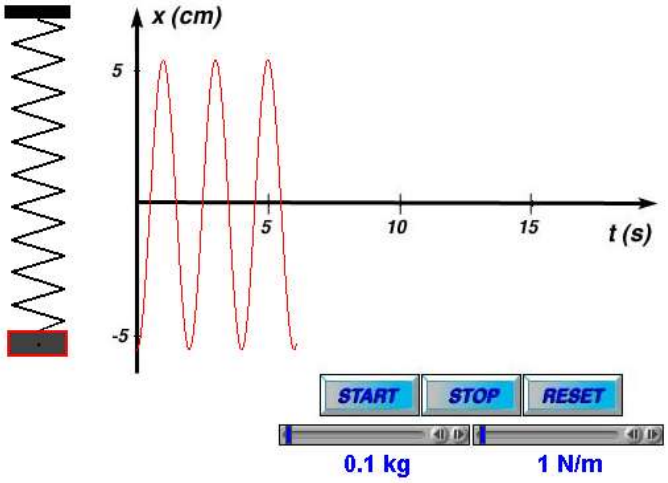
Continuing with Video measurement

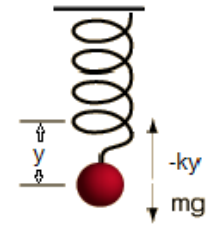


- **Measure** the position of an astronaut during his jump on the moon
- **Determine** the acceleration due to the moon gravity

- **Obtain** graphs of position vs time and velocity vs time for a moving car
- **Interpret** the motion graphs
- **Explain** how force, acceleration and mass are related

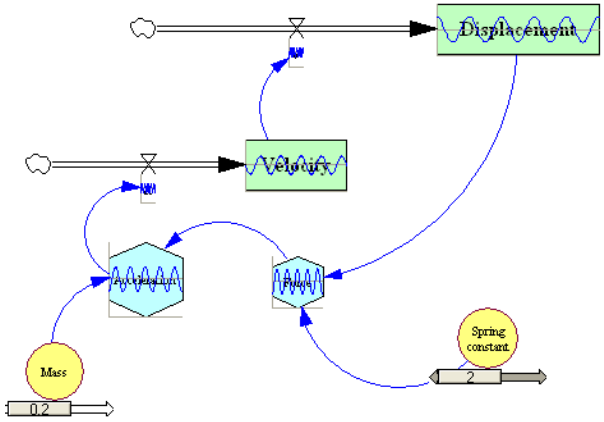
Example: Mass on a spring





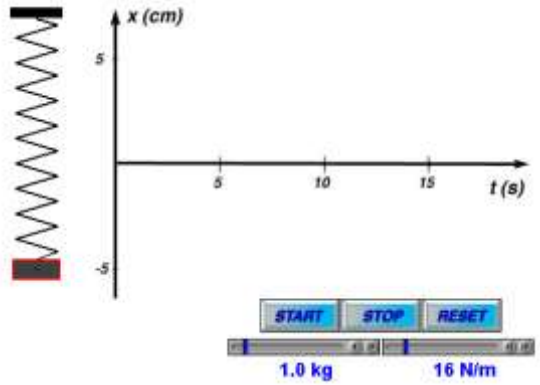
Hooke's Law:

$$F_{spring} = -ky$$



Data-Logging Simulation Modelling

Getting an intuitive feeling for how oscillators behave



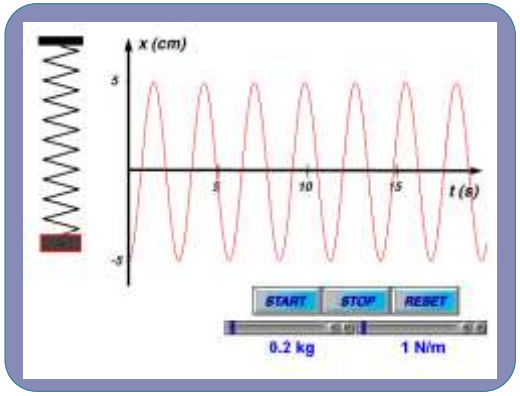
How to use the applet?

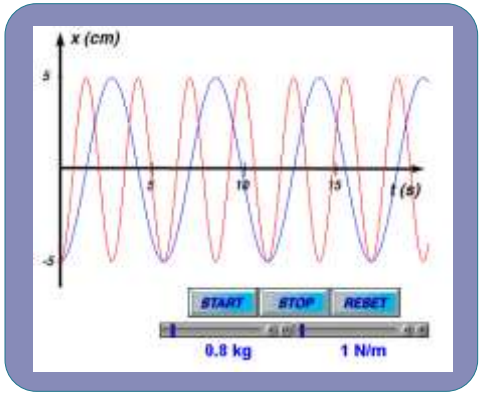
- Assign a value for the mass
- Assign a value for the spring constant
- Select the amplitude of the motion by grabbing the mass with the mouse

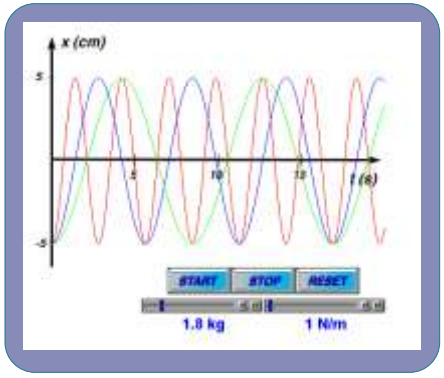
How to promote the shift from playing to learning?

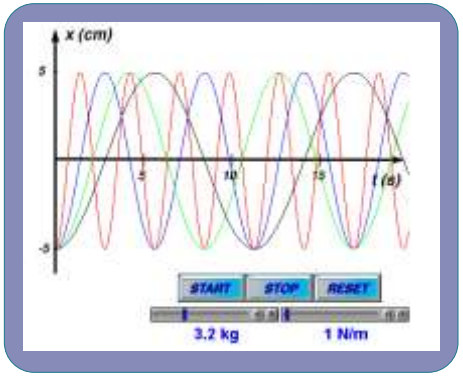
Teacher decisions

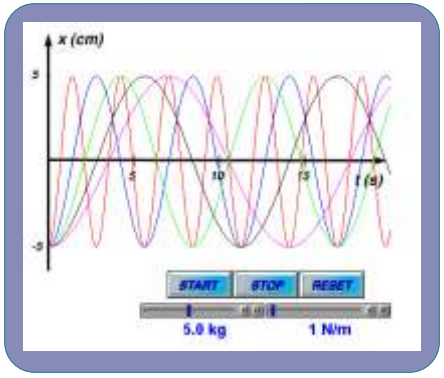
- Alignment with Curriculum & Learning Goals?
- What are fitting instructional strategies?

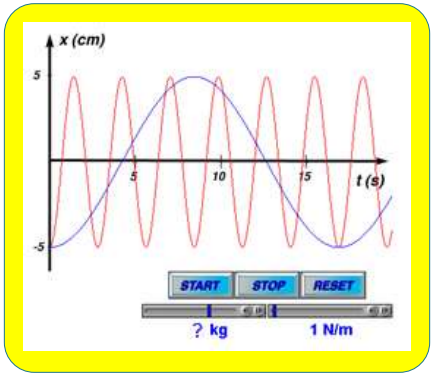




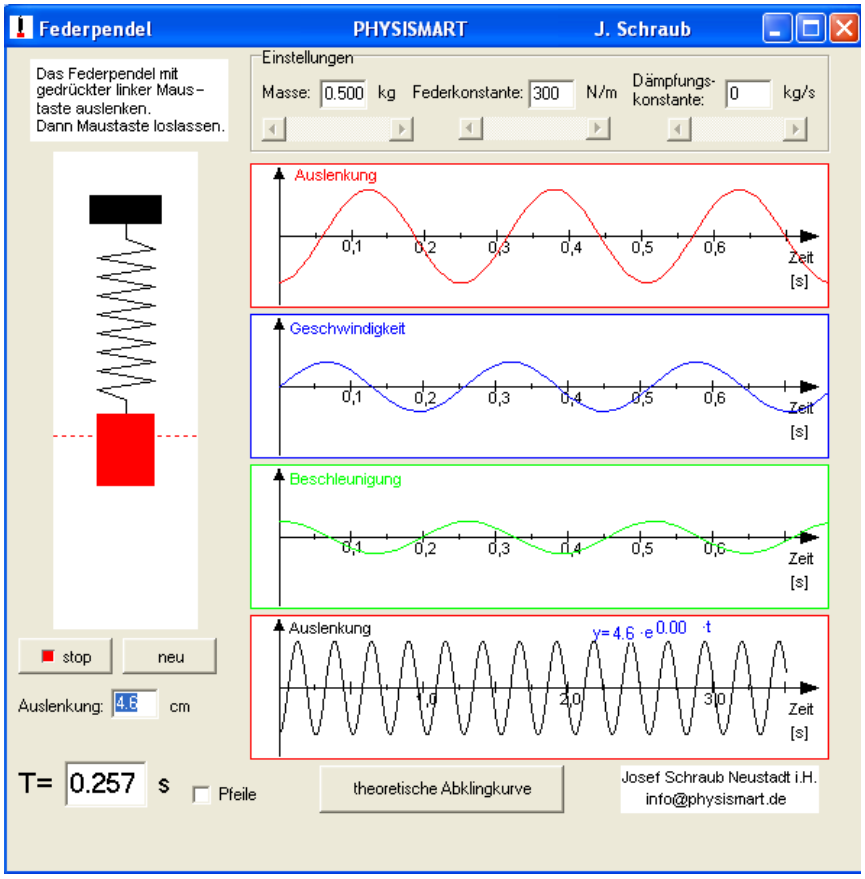








Exploring by changing parameters



Choose

- m = 0,125 kg
- spring constant = 300 N/m and
- damping factor = 0

Change

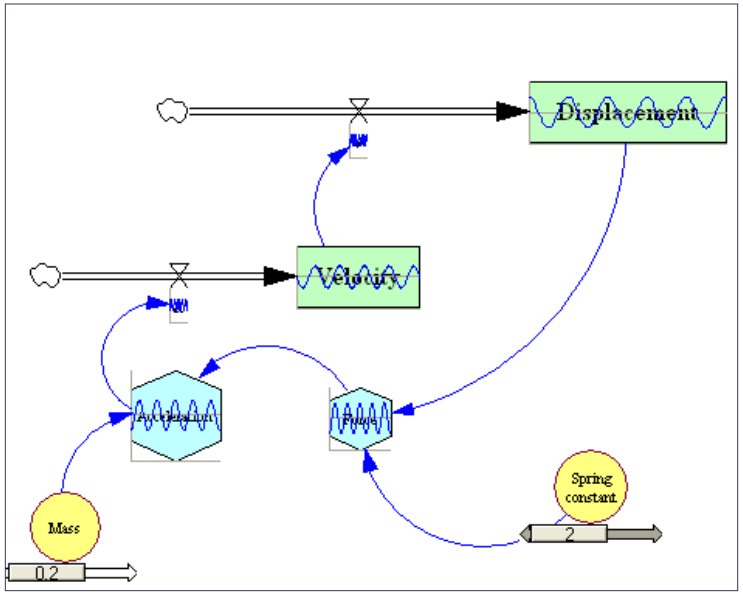
only the value for the mass

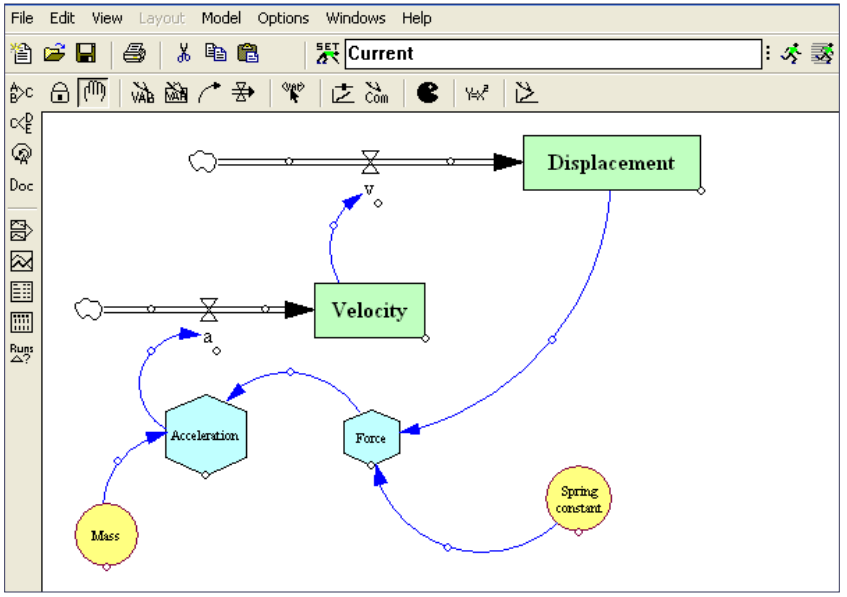
Explore

Can you find a relationship between mass m and period T?

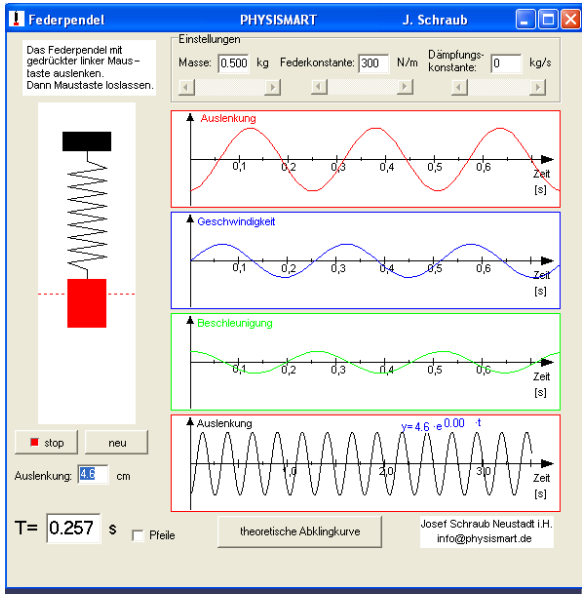
Modelling with VENSIM

From learning by **using** models to learning by **making** models



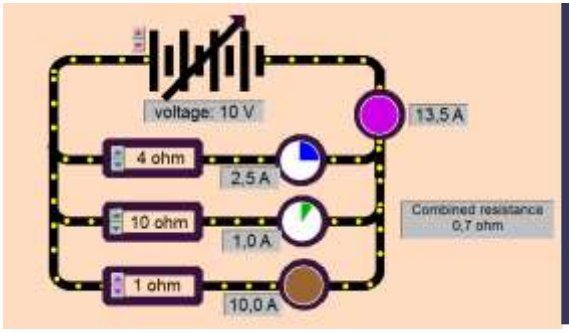


Experiencing with exploratory environments



Find a relationship between mass m and period T.

Associate the motion you observe with the forces acting on the bycicle.



Deduce rules for the combined resistance of resistors in parallel.

Results

Course A / Prospective physics teachers

- Goals and value beliefs for the course have a positive impact on the self-reported evolution of TPCK
- Self-reported knowledge gains in TPCK are in agreement with external assessment of lesson plan designs
- Course materials and the design of the course stimulate teachers to think about useful technology integration
- Prospective teachers are looking forward to implement their lesson plans in their future classrooms

Results

Course B / Practicing physics teachers

- Less than 50% of the teachers participate extensively in the online – course
- Only two thirds of the teachers fill the questionnaires and only 50% write short reflection journals
- Only two teachers are willing to show their lesson plans
- However, two thirds of the teachers report about …
  - a development of their TPCK
  - stimulation to use technology in the classroom
  - useful materials in the ICTforIST pack and well prepared, but time consuming student activities

Conclusions & Implications

- Important differences between the two not comparable groups
- Reasons for differences seem to be obvious

Challenges

- Identify and evaluate obstacles to effective technology integration
- In any case, anchor educational technology in pre-service education
- Publish examples of good practice to convince practicing teachers
- Need for further research on effective technology integration

Thank you for your attention!

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