FINAL INTERNATIONAL CONFERENCE

Remote Inquiry in Science Education

Part II: TEACHERS' PRESENTATIONS

27. – 28. JUNE 2023

Organised by
UNIVERSITY OF LJUBLJANA
FACULTY OF EDUCATION
SLOVENIA

2020-1-SI01-KA226-SCH-093576

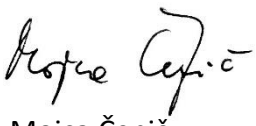
Dear participants of RISE conference

Many, really many teachers were brave enough to jump over the language barrier, to overcome the stress of the audience, to invest the work to inquiry first, to organized data, to draw conclusions, organize everything into the presentation and the poster, and finally come to Ljubljana and present the experience to wider international audience.

The second e-book called “Teachers’ presentations” includes all presentations from the Final conference of the Erasmus+ project Remote Inquiry in Science Education or shortly RISE. The PowerPoints were transformed to PDF handouts with 6 slides per page. Although teachers presented at different time slots, we decided to organize the collection by authors in alphabetic order. Each presentation includes a photo of the presenter. I few cases the photo of presenter does not originate directly from the presentation, as the photo was not taken due to unknown circumstances.

The collection in a PDF form ws compressed as much as possible, but the file is still big, so it may take some time for downloading.

We sincerely hope you will find useful and interesting information in this collection of presentations.



Mojca Čepič
Coordinator of RISE and Chair of RISE conference

Ljubljana, 28th of July 2023

TEACHERS PRESENTATIONS

Getting started with Inquiry – learning to develop hypotheses and plan experiments through common everyday tasks

Kristian Dimitrov
St.David's C.B.S, Dublin, Ireland

Movement with IT

Špela Gec Rožman
Piran Gymnasium, Electrical and Maritime School, Piran, Slovenia

Supporting students to develop hypotheses and plan investigations through the context of learning about factors required for chemical reactions

Gerard Hughes
Ballymakenny College, Ireland

Challenge - Circuits

Irena Jelenko
Primary School Brezno-Podvelka, Podvelka, Slovenia

The use of inquiry based practical work on student's understanding of classifying conductors and insulators

Jennifer Kelly
Scoil Pol Kilfinane, Ireland

Inquiry of soil

Mateja Kelner
Ljudski Vrt Primary School, Ptuj, Slovenia

We learn to ask. How does working on students' questions bring us closer to a well-posed inquiry question?

Roman Klara
Podkarpackie Centrum Edukacji Nauczycieli w Rzeszowie – Oddział w Krośnie, Katolickie Liceum Ogólnokształcące w Krośnie, Poland

Placement of an object in space using bisectors

Urška Krajnc
Radlje ob Dravi Primary School, Radlje ob Dravi, Slovenia

Modelling round bodies

Miran Kučer
Ljudski Vrt Primary School, Ptuj, Slovenia

How to keep a large, busy class motivated for maths?

Blomme Maes
OLVP Bornem, Belgium

A model based approach to give a deeper understanding of aspects of atomic and particle physics

Denis McCarthy
Hazelwood College, Ireland

Pressure and my shoes

Alenka Mravljak
Brezno-Podvelka Primary School, Podvelka, Slovenia

How does the IBL method affect on student's knowledge about density at physics in primary school

Primož Podrzavnik
Radlje ob Dravi Primary School, Radlje ob Dravi, Slovenia

An inquiry on the effect of wonder on the motivation of students and their ability to ask questions

Wannes Vande Voorde
Arteveldehogeschool, Gent, Belgium

How can you ensure that students work independently in class and remain motivated?

Femke Vandenbroecke
Imacolata, Ieper, Belgium

Discount-price increase or price increase-discount

Simona Verdinek Špenger
Brezno-Podvelka Primary School, Podvelka, Slovenia

How can you evaluate an out of school engineering academy?

Ruben Visser
Arteveldehogeschool, Gent, Belgium

Getting started with Inquiry – learning to develop hypotheses and plan experiments through common everyday tasks

Kristian Dimitrov
St.David's C.B.S, Dublin, Ireland

Introducing Inquiry-Based Learning (IBL) to students

By Kristian Dimitrov
St. David's CBS

1

What is IBL?

- Inquiry-based learning is a type of active learning that encourages students to ask questions, conduct research, and explore new ideas (Brame 2016).

2

Irish Context

- The lesson took place in a 2nd year class (14-15 year)
- The lesson was guided by the Junior Certificate Key Skills

3

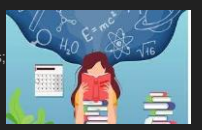
IBL explored

- Aim: Introduce IBL to students and to have students become more independent when performing experiments
- Why: Very often the experiments end up being a "copy and paste" extract from the book.
- I wanted students to take the experiment into their own hands and to become scientists in class.
- Length: 3 classes (3 hours):
  - Preparation
  - Experimentation
  - Results analysis

4

Implementation Day 1: Preparation

1. Students are split in groups;
2. Experiment: *What happens to pasta as we boil it?*
3. How can we demonstrate these properties?
4. Have students come up with a Title and Hypothesis;
5. Have students come up with a list of equipment;
6. Have students come up with method;
7. Have students come up with a way to record their results;



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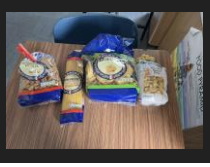
Implementation Day 2: Experimentation

- Students start the experiment as the preparatory work is complete;
- As the students are performing the experiment, monitor and guide the students;
- Highlight the importance of health and safety;
- Tidy up the lab;



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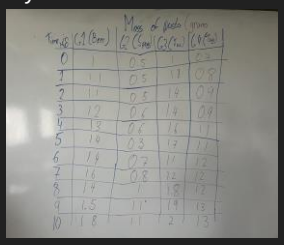
Implementation Day 3: Results

- Students graph their results;
- Students share their results;
- Discussion of the results;
- Students come up with a conclusion;
- Time to reflect!



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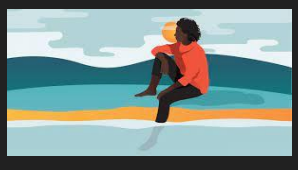
Reflection on the Benefits of IBL

- It is student-centered;
- It is adaptable & expandable;
- I does not have to be complicated;



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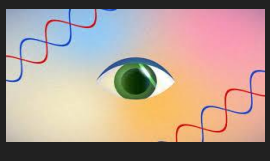
Conclusion

- I recommend every teacher experiment with IBL activities because
  - IBL is interactive
  - Helps students develop an appreciation of science
  - IBL encourages students to develop a sense of the scientific method;



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Movement with IT

Špela Gec Rožman
Piran Gymnasium, Electrical and Maritime School, Piran, Slovenia

GEPŠ
Gimnazija, elektro in pomorska šola Piran
Academic, Electronic and Maritime High School Piran

Erasmus+

RISE

Movement with ICT

Špela Gec Rožman, prof. fizike
Piran Gymnasium, Electrical and Maritime School

1

I will speak about

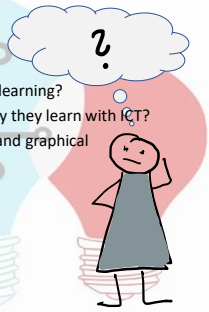
- Lab exercises in physics for 1st year students on the topic of motion, performed with ICT
- student performance in the activities
- Students' performance in solving problems on movement
- Student evaluation of IT laboratory exercises

RISE

2

I was wondering...

- Will coping with ICT overshadow substantive learning?
- How do students themselves evaluate the way they learn with ICT?
- Will learning with ICT make students understand graphical representations of movement better?



RISE

3

Activity 1: Graphs of movement

- Activity objective:
  - To familiarise students with the measuring equipment and software,
  - Students understand the graph of position vs. time
  - Students are able to interpret the graph position vs. time
- Materials used:

  laptop, LabPro interface, Motion detector, wooden board, lab sheet

- Content of the activity:

Students use IT to draw a graph according to the instructions.

They read off the values and determine the displacements, velocities on the individual sections.

RISE

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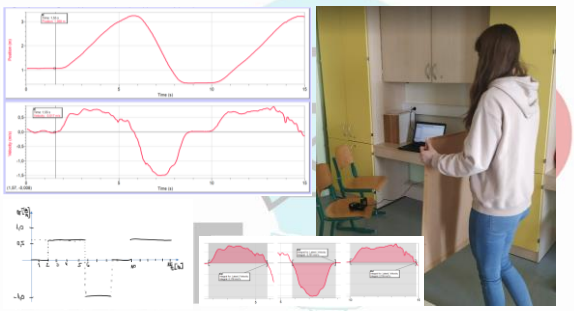

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Activity 2: Free fall

- Activity objective: Students
  - interpret the graph of x(t) for a free fall moving object
  - determine the magnitude of the acceleration due to gravity
- Materials used:
  - laptop, interface, Motion detector, ball

- Content of the activity:

Plot and analyse a graph of position versus time for a ball that first falls freely and then bounces several times on the flor. Use IT to find the most appropriate parabola and determine the gravitational acceleration from its parameters.

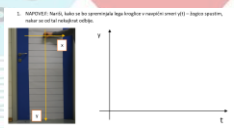
RISE

6

7

Activity 3: Video analysis (free fall)

- Activity objective:
  - introduce video analysis as a tool for motion analysis,
  - self assessment of students' knowledge and understanding of motion graphs.
- Materials used:
  - pre-recorded video of the movement (free fall with rebound, projectile thrown horizontally), laptop + LabPro
- Content of the activity: Students predict the shape of the graph x(t) and v(t), then analyse the video and compare their predictions with the outcome. They critically evaluate their errors and create a record of this.



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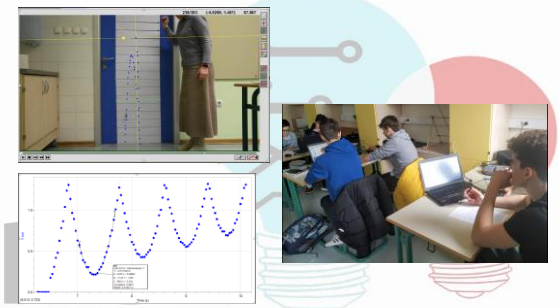

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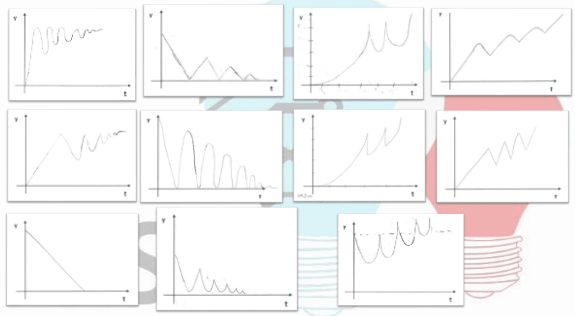

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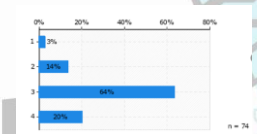
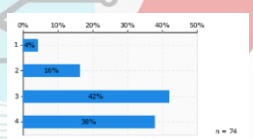
Survey – students evaluation

- The software we use for the exercises is easy to use.



- Computer lab exercises help me better understand the subject matter covered in class.



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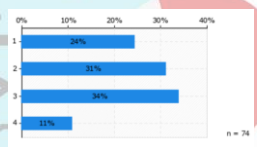
Survey – students evaluation

- When we use computers for laboratory work, I get confused.

(1) (2) (3) (4)



Students reported poor understanding of this question. As (4) meant something positive for all other questions, some perceived (1) as the highest level of confusion and (4) as 'less confused'.

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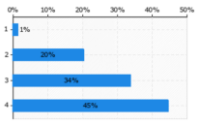
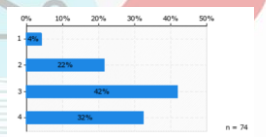
Survey – students evaluation

- I like the ICT lab exercises better than the traditional ones.



- It's easier to understand the physics behind the phenomenon I'm investigating if I collect data using ICT.



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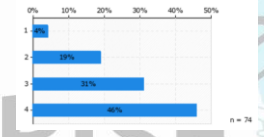
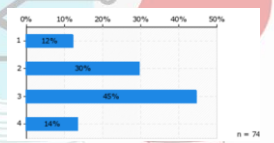
Survey – students evaluation

- I would like to do more lab exercises using ICT.



- I think the software we used for the lab exercises could be useful for studying at home.



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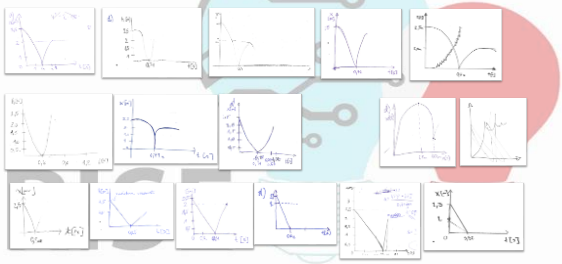
Evaluating underperforming students



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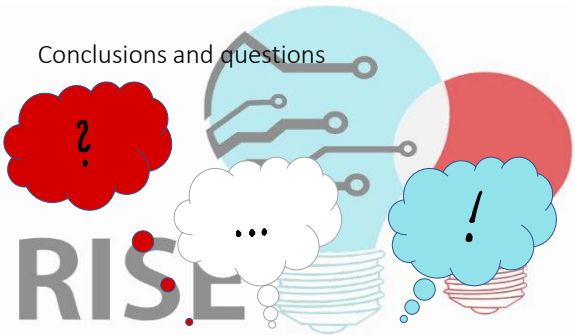
Conclusions and questions



17

Supporting students to develop hypotheses and plan investigations through the context of learning about factors required for chemical reactions

Gerard Hughes
Ballymakenny College, Ireland

CHEMICAL REACTIONS

GERARD HUGHES – BALLYMAKENNY COLLEGE

1

BALLYMAKENNY COLLEGE

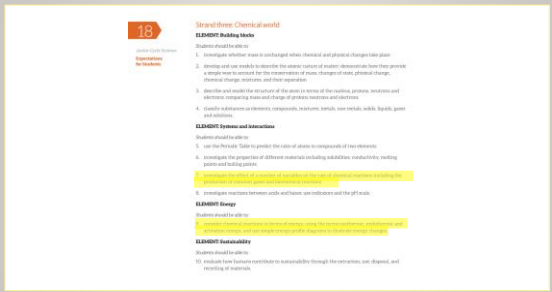
- Educate together school
- Co-educational
- I-pads integrated into classes
- Students are generally well-behaved
- Opened 9 years ago

2

JUNIOR CYCLE SCIENCE

- The development of these key-skills is the common goal shared by all subjects in the junior cycle course.
- Each subject develops different skills.

3



Strand three: Chemical world

ELEMENT: Building blocks

Students should be able to:

1. investigate whether mass is unchanged when chemical and physical changes take place
2. develop and use models to describe the atomic nature of matter; demonstrate how they provide a simple way to account for the conservation of mass; changes of state; physical change; chemical change; mixtures; and their separation
3. describe and model the structure of the atom in terms of the nucleus, protons, neutrons and electrons; comparing mass and charge of protons; neutrons and electrons
4. classify a substance as elements, compounds, mixtures, metals, non-metals, solids, liquids, gases and solutions

ELEMENT: Systems and interactions

Students should be able to:

5. use the Periodic Table to predict the ratio of atoms in compounds of two elements
6. investigate the properties of different materials including solubilities, conductivity, melting points and boiling points
7. investigate the effect of a number of variables on the rate of chemical reactions including the production of gaseous gases and behavioural reactions
8. investigate reactions between acids and bases; use indicators and the pH scale.

ELEMENT: Energy

Students should be able to:

9. investigate chemical changes in terms of energy; using the terms exothermic, endothermic and activation energy; and use simple energy profile diagrams to illustrate energy changes

ELEMENT: Sustainability

Students should be able to:

10. evaluate how humans contribute to sustainability through the extraction, use, disposal, and recycling of materials

4

CHALLENGES

- Understanding factors necessary for reactions to take place
- Visualizing how reactions take place
- Developing a hypothesis
- Designing fair experiments
- Connecting results to the hypothesis

5

MY APPROACH TO TEACHING CHEMICAL REACTIONS

- I previously used the example of baking pancakes to introduce students to experimental design and understand factors for chemical reactions.
- Students had to plan and design how they could make a pancake considering different amounts of ingredients, temperature, time etc. This supported students to develop understanding of chemistry and inquiry skills

6

BENEFITS OF MY APPROACH

- By using baking to teach chemical reactions, we take something microscopic and make it macroscopic. They can see that conditions for their reaction are being met.
- It serves as a useful comparison for future reactions.
- Continuously developing student's inquiry and experimental skills. This is vital for the classroom-based assessments.

7

CONTENT COVERED IN LESSON

- Phase of reactants
- Amounts
- Temperature
- Limiting reagents

- It is possible to introduce more content here, specifically factors affecting rates of reactions. There must be adequate time to discuss these in detail.

8

COMMON GOALS FOR EACH ACTIVITY

- Students state their desired hypothesis.
- Students design a fair test, correctly stating the variable being tested.
- Students perform the experiment.
- Students observe and record their results.
- Students make a conclusion, connecting it back to their hypothesis.

9

PHASE OF REACTANTS

- Students are given powdered milk and low-fat milk.
- Students add the same mass of each to their mixture.
- No reaction occurs in the egg, flour and powdered milk mixture.
- Students can see that there must be an aqueous solution as a medium for the reaction.

10

LIMITING REAGENTS

- Students measure out different masses of flour for their mixture, including 0g of flour.
- The thickness of the mixtures will be examined.
- Students will determine which mixture would make the best pancakes.
- This introduces the idea of limiting reagents.

11

AMOUNT

- After examining limiting reagents, it can be shown that you can double or triple the masses of ingredients used and the mixture will remain consistent.

12

TEMPERATURE

- Using 2 different pans we can compare the affect that temperature has on the reaction.
- This introduces the concept of activation energy.

13

KEY-SKILLS DEVELOPED DURING THIS LESSON

- **Junior Cycle Key-skills:**
- Being numerate-
- Developing a positive disposition towards investigating, reasoning and problem solving.
- Seeing patterns, trends and relationships.
- Being creative-
- Exploring options and alternatives.
- Implementing ideas and taking action.

14

POSSIBLE FOLLOW-UP CLASSES.

- Rates of reactions
- Production of Hydrogen, oxygen and carbon dioxide
- Millard's reactions

15

QUOTE

- It's not about the destination, It's about the journey… But people just want the destination, they want pancakes.

16

THANKS FOR LISTENING

17

Challenge - Circuits

Irena Jelenko
Primary School Brezno-Podvelka, Podvelka, Slovenia

Erasmus+

RISE

CHALLENGE - CIRCUITS

Irena Jelenko (irena.jelenko@os-brezno.si)
Osnovna šola Brezno - Podvelka

Final conference RISE
27th - 28th of June 2023, Ljubljana
Slovenija

1

I'm a professor of mathematics and physics. I have been teaching in primary school for 29 years.

I want to introduce children to the world of maths and physics in as interesting and varied a way as possible.

2

As part of their physics curriculum, ninth-grade students (14 years old) engage in hands-on experiments to explore the concepts of current and voltage within circuits featuring two connected consumers, either in series or in parallel. This practical activity serves as an evaluative knowledge test, conducted at the conclusion of the chapter.

3

I WAS INTERESTED IN:

- how students will apply their knowledge to a novel situation,
- what their expectations will be, and
- what conclusions they will draw.

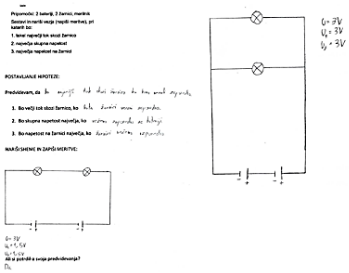
4

ABOUT THE STUDENTS ACTIVITIES

Using two identical batteries, two identical light bulbs, and a meter, the students were tasked with a challenge. They had to assemble circuits and record measurements in order to achieve the following objectives:

1.Find the configuration that allows the maximum current to flow through the bulb.
2.Determine the setup that produces the maximum total voltage.
3.Identify the arrangement that results in the maximum voltage across the bulb.

5



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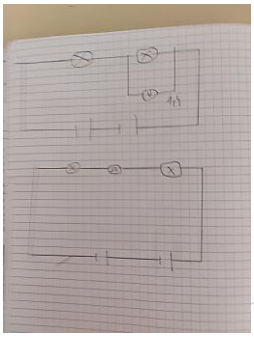

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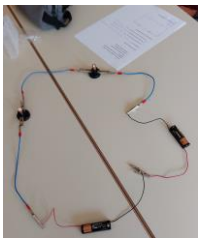

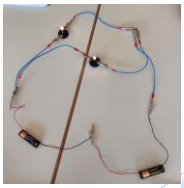

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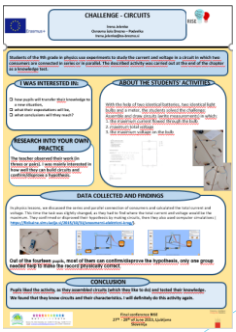

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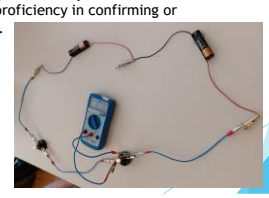
RESEARCH INTO YOUR OWN PRACTICE

The teacher closely observed the students' work, which was conducted in groups of three or pairs. The primary focus was on assessing their ability to construct circuits effectively and their proficiency in confirming or disproving hypotheses.



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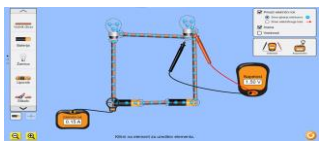
DATA COLLECTED AND FINDINGS

In physics lessons, we discussed the series and parallel connection of consumers and calculated the total current and voltage. This time the task was slightly changed, as they had to find where the total current and voltage would be the maximum.

11

They confirmed or disproved their hypothesis by making circuits, then they also used computer simulations (https://fizikalne.simulacije.si/2015/10/31/enosmerni-elektricni-krog/).



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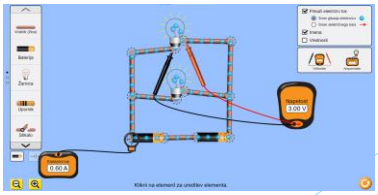
Out of the fourteen pupils, most of them can confirm/disprove the hypothesis, only one group needed help to make the record physically correct.



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CONCLUSION

Students liked the activity, as they assembled circuits and tested their knowledge.

We found that they know circuits and their characteristics.

I will definitely do this activity again.

14

Thank you for your attention.

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Final conference RISE
27th - 28th of June 2023, Ljubljana
Slovenia

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The use of inquiry based practical work on student's understanding of classifying conductors and insulators

Jennifer Kelly
Scoil Pol Kilfinane, Ireland

2021/2022 PS483A Practitioner Inquiry in Physics Education 2

Jeniffer Kelly

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Practitioner Inquiry

Context:

- I chose to complete my practitioner inquiry on the use of inquiry based practical work to develop student understanding.
- As a Science and Chemistry teacher I regularly carry out experiments and investigations with my students.
- I feel practical work can play a key role in the teaching and learning of science/physics.

2

Practitioner Inquiry

My Inquiry Question:

Does the use of inquiry based practical work improve student's understanding of classifying conductors and insulators?

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Practitioner Inquiry

Implementation:

- The inquiry was undertaken by my transition year science class
- The class is of mixed ability (the school is a mixed gender school)
- Students worked in their regular experiment groups (mixed ability & gender)
- The inquiry took place over a two week period
- The inquiry took place over 4 one-hour classes

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Practitioner Inquiry

Class 1:

- Introduction to heat energy
- Investigating the expansion & contraction of solids, liquids and gases

Class 2:

- Movement of heat energy
- Introduction to conductors and insulators (Mind-map)
- Conduction
- Introduction of inquiry

Class 3:

- Student pre-survey on conductors and insulators
- Planning and carrying out of Investigation

Class 4:

- Completion of analysis and conclusion
- Student post-survey on conductors and insulators
- Student reflection on inquiry

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Practitioner Inquiry

Summary of Investigation:

- Each group will be given the same equipment pack which will include; Ingenhausz apparatus, conductivity/insulating rods, thumb tacks, vaseline, boiling water and a timer
- They will have to plan, design and carry out an investigation to investigate the rate of conduction in different materials
- Each group will be given an investigation template on which they will write up their experiment and record their results and findings
- Students will finish their investigation templates by reviewing their results and analysing and interpreting the data to provide an explanation and conclusion

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Practitioner Inquiry

Collection of data:

- Class discussion
- Pair mind-maps
- Individual student pre/post survey
- Teacher observations
- Teacher field notes
- Group journal
- Individual student reflection

Conductors & Insulators

Investigation Template

7

Practitioner Inquiry

Data Observations:

Class discussion:

- The majority of students were able to explain the difference between conductors and insulators in terms of heat transfer (i.e. conductors allow heat to pass through them easily, insulators prevent heat from passing through them)

Mind-maps:

- All pairs completed their mind-maps giving properties of conductors and insulators and included examples of both conductors and insulators

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Practitioner Inquiry

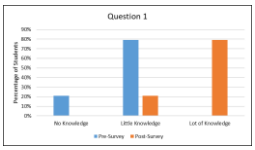
Student Survey: (Question 1)

1. How much do you know about thermal conductors?

a. I know nothing about thermal conductors

b. I know only a little bit about thermal conductors

c. I know a lot about thermal conductors



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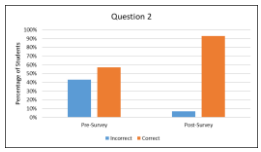
Practitioner Inquiry

Student Survey: (Question 2)

2. Explain how heat travels by conduction?



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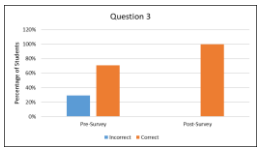
Practitioner Inquiry

Student Survey: (Question 3)

3. Why are most saucepans made of metal? And why do metal saucepans usually have plastic or wooden handles?



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Practitioner Inquiry

Teacher field notes:

Planning phase:

- Lower ability students were slower at beginning to get involved
- Lazier students had to be encouraged to contribute
- Students struggled to begin to plan the experiment until they were physically shown the apparatus
- Once groups figured out where to place the rods in the Ingenhausz apparatus they were very to grasp the concept

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Practitioner Inquiry

Teacher field notes:

Design phase:

- Groups were generally very quick to set up the apparatus
- The lower ability students contributed much more in the design phase
- Groups were encouraged to divide jobs, assertive members in each group divided out a role to each member
- Teacher had to remind groups of the importance of controls in an experiment as one group had not considered adding the same amount of Vaseline to each rod (all the other groups had) and a different group had not considered the length of the rod exposed to the boiling water

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Practitioner Inquiry

Teacher field notes:

Carrying out of experiment:

- Group members worked together to correctly position the rods, Vaseline and tacks
- The boiling was only added by each group after the rods were in position and then all groups started their timers
- All groups successfully recorded the time taken for the tack to fall off each rod
- All results were recorded in tables (some students were idle whilst recorders recorded the results, the majority tidied away equipment during this time)

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Practitioner Inquiry

Teacher field notes:

Tabulating results and analysis:

- Each group completed a table and then ranked the four metals 1-4 with 1 being the rod whose Vaseline melted the quickest and 4 being the rod whose Vaseline melted the slowest
- As students put this into words for their analysis groups discussed what this meant about the four individual metals in terms of their conductance
- Three of the four groups collected the similar results (the order in which the tacks fell off each metal was the same)
- One of the groups third and fourth metals were in reverse order (one and two agreed with the other groups)

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Practitioner Inquiry

Teacher field notes:

Forming conclusions:

- All groups successfully determined that the metal rod whose Vaseline melted the quickest (whose tack fell off first) was the best conductor of heat and the metal rod whose Vaseline melted the slowest (whose tack fell off last) was the worst conductor of heat

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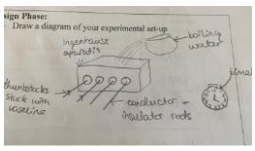
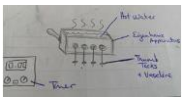
Practitioner Inquiry

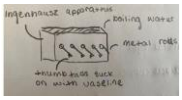
Group journal:

Design phase:

- Labelled diagrams were excellent







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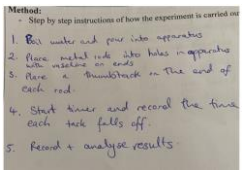
Practitioner Inquiry

Group journal:

Method:

- All groups numbered/bullet pointed the correct procedure
- No group mentioned the needed to add the same amount of Vaseline to each rod but all physically did this when carrying out the experiment
- No groups mentioned the need to have the same length of rod in the boiling water but again all physically did this when carrying out the experiment



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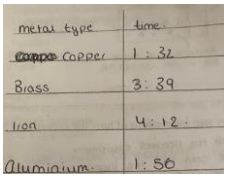
Practitioner Inquiry

Group journal:

Results:

- All groups successfully recorded their results in a table
- Three of the four groups agreed on order



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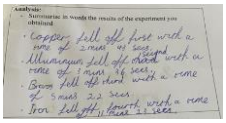
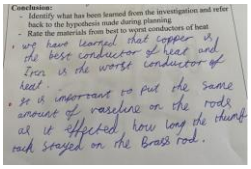
Practitioner Inquiry

Group journal:

Analysis & Conclusion:

- All groups detailed in words the results they collected and successfully concluded what this meant about the conductivity of each metal rod





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Practitioner Inquiry

Student reflection:

The most important thing I learned was…

- "The difference between conductors and insulators"
- "That heat travels at different rates through different metals"
- "Copper is the best conductor of heat"
- "Iron is the worst conductor of heat"

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Practitioner Inquiry

The most interesting part was…

- "Heat travelled through the metals at different rates"
- "How quickly metals conduct heat"
- "Copper is a really good conductor of heat"
- "The thumb tacks fell off all the metals so metals are really good conductors"

A question I still have is…

- "Why does heat travel at different rates through different metals"
- "What makes copper the best conductor and iron the worst conductor"
- "Are all metals conductors"
- "Is there a better conductor than copper"

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Practitioner Inquiry

A skill I used was…

- "Planning an experiment"
- "Considering control variables"
- "Using multiple timers"
- "Drawing labelled diagrams"
- "Drawing tables"
- "Recording results"
- "Drawing conclusions"

I enjoyed/didn't enjoy learning in this way because…

- "I enjoyed learning through experiment"
- "It was fun and gives me a better idea as to how conduction works"
- "I enjoyed seeing how conduction works and not just reading about it"
- "I enjoyed working in a group"

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Practitioner Inquiry

What I found difficult was…

- "Putting the same amount of Vaseline on each rod"
- "Making sure the same length of each rod is in the water"
- "Pouring the boiling water without soiling it"
- "Cleaning up after"

What helped me learn was…

- "Planning the experiment myself"
- "Learning from the others in my group"
- "Recording the results"
- "Comparing the four different metals"

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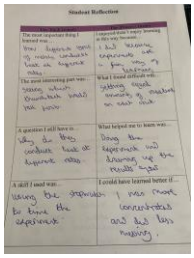
Practitioner Inquiry

I could have learned better if…

- "We didn't spill some of the water at the start"
- "We used the same mass of Vaseline each time"
- "I was in a smaller group"
- "We used more types of metals"
- "I had my own recording booklet"



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Practitioner Inquiry

Challenges to date in analysing data and drawing conclusions:

- As the inquiry took place over a two week period there was only 14 students present for all four class periods this limited the amount of both pre and post surveys completed
- This also resulted in some students being in for the actual investigation but not having done any of the previous lessons on heat, these students were more reluctant to take lead or to complete the investigation template
- Due to time constraints in class 4 not all student reflections were fully completed

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Practitioner Inquiry

Suggested improvements:

- Undertaking inquiry with an exam class as attendance in TY is not as certain
- Ensure there are more sets of equipment so that experiment groups were smaller
- Every student will have their own investigation template to complete, as it was done in groups not all students contributed
- Include a section for controls in the investigation template
- A longer student reflection at the end to ask more in depth questions related to inquiry-based learning
- A lot of students questioned in their surveys why there was different rates of conduction in the different metals, this could be explained/explored further

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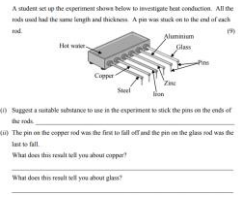
Practitioner Inquiry

TY Summer Exam:

- In the TY Summer exam every single student who participated in the Inquiry correctly answered the followed question based on the experiment they carried out
- All questions clearly distinguished the difference between a conductor and an insulator


A student set up the experiment shown below to investigate heat conduction. All the rods used had the same length and thickness. A pin was stuck on to the end of each rod. (9)

(i) Suggest a suitable substance to use in the experiment to stick the pins on the ends of the rods.

(ii) The pin on the copper rod was the first to fall off and the pin on the glass rod was the last to fall.
What does this result tell you about copper?

What does this result tell you about glass?

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Inquiry of soil

Mateja Kelner
Ljudski Vrt Primary School, Ptuj, Slovenia

Erasmus+ 2020-1-SI01-KA226-SCH-093576

RISE

RESEARCH OF SOIL

Mateja Kelner, OŠ Ljudski vrt Ptuj
Primary school, 5th grade (10,11 years)
Ljubljana, June 2023

1

Erasmus+ 2020-1-SI01-KA226-SCH-093576

RISE

Preparation of the workspace

2

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RISE

Brainstorming

3

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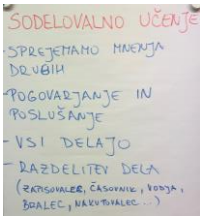
RISE



COLLABORATIVE LEARNING

- we accept the opinions of others,
- we listen to each other,
- all group members work,
- division of labor (manager, reader, writer, timekeeper, shopper)

4

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RISE

Presentation of the material

- measuring cup with scale mark plastic and glass,
- plastic tray,
- spoons,
- phones for time measurement,
- soil,
- water,

5

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RISE

A different types soil

1 – clay soil
2 – terra rossa soil
3 – garden soil
4 – cactus soil
5 – mole hill soil

6

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RISE

Research planning

7

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RISE

8

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RISE

What would the students like to research?

What happens if soil is mixed with water and purified through a filter?	Wich soil is the heaviest?	If water and soil separate through filter paper?	Which soil will purify the water more?	In which soil will the plant grow first?

9

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RISE

What are we interested in? What will we research?	Hypothesis:	Assembling
In which soil will the plant grow first?	The plant will grow earlier in the purchased land.	We were right. The soil that we bought has something in it.
Which soil has thicker mud?	We think that number 3 will be the most dense and number 1 will be the least dense.	We were right about no. 3.
Will the water be purified in all pots?	We assume that the water will be more purified in some soils than in others.	We found out, that the watter was filtered, only the color remained.

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RISE

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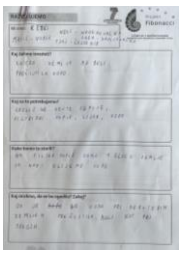
RISE



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Each group presented:

- their research question,
- how they set up the experiment,
- what they observed,
- what they found and
- how they worked together as a group.

18

19

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RISE

In school, we often do experiments and research with the pupils.

This time they noticed a difference in their work, as they themselves participated in planning the experiment, posed the research question and hypothesis themselves.

In summing up, I praised them all for their great ideas, collaborative learning, just performing experiments and enthusiasm for work.

I believe that learning through experiments, the knowledge is more permanent and easier to upgrade.

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We learn to ask. How does working on students' questions bring us closer to a well-posed inquiry question?

Roman Klara
Podkarpackie Centrum Edukacji Nauczycieli w Rzeszowie – Oddział w Krośnie, Katolickie Liceum Ogólnokształcące w Krośnie, Poland

The Supporting Transitions Across Mathematics and Physics Education (STAMPEd), Lublana, 26-28 June 2023

We learn to ask. How does working on students' questions bring us closer to a well-posed inquiry question?

With the support of the Erasmus+ Programme of the European Union

Roman Klara - Podkarpackie Teacher Education Center in Rzeszów – Branch in Krosno, Catholic High School in Krosno

1

Everythingstartswithquestions..

My inspiration... ;-)

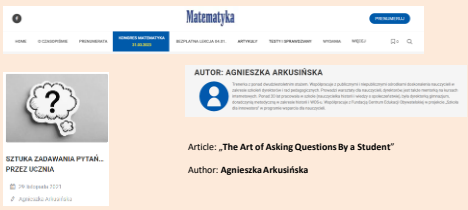
My inspiration for carrying out the research was a workshop conducted by Małgorzata Szymura during the II Congress of Physics Teachers (Krakow, 2-4 September 2022). The title of this workshop was "Inverted Glass". I decided to conduct a similar one at the school where I teach.

Workshop: **How to Ask to Get an Answer?**
Magister **Małgorzata Szymura**,
School Complex in Czerwionka-Leszczyny,
Primary School in Stanowice

2

Everythingstartswithquestions..

My inspiration... ;-)



Article: **„The Art of Asking Questions By a Student"**

Author: **Agnieszka Arkusińska**

3

Everything starts with questions...

4

School is based on „questioning", and it should be based on questions asked by the students (student questions)!

5

Everythingstartswithquestions..

We, the teachers...
– know we ask too many questions;
– we treat frequent asking of questions as the most important element of teaching.

According to many research findings, most of "teachers questions" demands from students to provide facts or mental operations on low cognitive level.

The nature, type of questions asked by the teacher is information/clue for the student about the teacher's expected (student) mindset.

6

Everythingstartswithquestions..

Four categories of questions asked by students according to E. Paula Torrance:

- Questions concerning the procedure („Can I?", "When?", "How?");
- Questions concerning completing the task ("Is the margin necessary?", "When do we take the test?";
- Questions concerning obtaining a particular information;
- Questions concerning the exaplanation.

These categories of questions occur at every stage of education, but in different proportions.

„Interrogative thinking. Theory of education"
Krzysztof J. Szmidt, Elżbieta Płóciennik, University of Łódź

7

Everythingstartswithquestions..

The teacher more wants to check what the student knows, rather than discover what he is interested in – this is the functioning model of school teaching.

We, teachers...
... discover the potential power of questions;
... more and more turn attention to how we ask, what questions we ask, not only what we ask for.

8

Everythingstartswithquestions..

By asking too many questions, teachers do not give students "time and space, to ask them questions themselves. Students have no time to learn how to formulate "good questions".

Let's create opportunities to ask inquiry questions!
Thanks to the atmosphere of inquisitiveness, students will not lose their natural curiosity about the world!

9

Everythingstartswithquestions..

Let's move on to our (my) „experiment"...

Source: https://poszukiwacze-skarbow.pl/szklanka-z-woda-do-gory-dnem/

10

Everythingstartswithquestions..

"Inverted Glass"

...

Materials:
- jar/glass;
- bowl;
- water;
- sheet of paper/cardboard;
- polystyrene or cardboard plate.

Course of the experiment:
- fill the jar to quarter of its height.
- cover the jar with a sheet of paper.
- cover both the jar and the paper sheet with a plate, press it to the jar.
- pressing the plate to the jar, turn the jar upside down.
- carefully move the plate away.

1) Observe „what you see". Surely something surprised you, interested you. Try asking about it.
2) What would you like to investigate further to better understand "what you see". Try to formulate this problem in the form of a question.

Source: https://poszukiwacze-skarbow.pl/szklanka-z-woda-do-gory-dnem/

11

Everythingstartswithquestions..

What do you observe?

What surprised You?

Water does not pour out of the jar.

The page stuck to the water.

Who (what) holds the page?

First reactions of students (most common!)

12

Everythingstartswithquestions..

The process of finding well-formed inquiry questions took place by asking questions, discussing already asked questions, and refining the questions asked previously.

13

First student questions!

Closed questions prevail, questions beginning with „Will/Would/Does/Is..."

Questions beginning with „ Will/Would/Does/Is..."(possible answers: Yes/No)

Working on questions – sample answers, attempts of modification, discussion…

Czy można wodzić to z colą?
Czy można użyć wody gazowanej?

Is it possible to do with Cola?
Is it possible to use carbonated water?

Czy wielkość kartki ma znaczenie?

Does the size of the sheet matter?

14

Czy kartka klei się do wody?

Does the sheet stick to the water?

Czy słoik może być pełen wody?

Can the jar be full of water?

Czy waga kartki ma znaczenie?

Does the weight of the paper sheet matters?

Czy gdy szalka lub naczynie będzie lekko przedziurawione to czy zjawisko zadziała tak samo

If the jar or the dish was slightly pierced, will the reaction work the same?

15

Chciałbym zbadać inne grubości kartki, inne wielkie szkła lub słoiki, inną ilość wody i inną temperaturę wody i czy zamiast kartki można wykorzystać inne przedmioty. I czy można zrobić to z inną substancją zamiast wody

I would like to investigate different thickness of papersheet, different sizes of glass or jar, different amount of water and different water temperature, and use of different objects instead of papersheet. And if it's possible to do with another substance instead of water.

16

Moving on to questions of type "Why..."

Dlaczego kartka nie wypada?

Why doesn't the paper sheet fall off?

Dlaczego kartka nie spada?

Dlaczego powietrze nie utrzymuje samej kartki?

Why doesn't the air hold the paper sheet itself?

17

Moving on to questions of type "How...", "In what way..."

W jaki sposób woda oddziałuje na kartkę?

In what way does the water affect the paper sheet?

Jakie siły działają na kartkę?

What forces have an effect on the paper sheet?

Jak poniższy doświadczenie zależy od ilości wody w słoiku?

How is the course of the experiment dependent on the amount of water in the jar?

18

Moving on to questions of type "How...", "In what way..."

How is the course of the experiment dependent on the diameter of the jar?

How will the use of mineral water change the course of the experiment?

How is the course of experiment dependent on the diameter of the vessel?

How is the course of the experiment dependent on the type of liquid (used)?

19

Moving on to questions of type "How...", "In what way..."

What will change when we take a bigger papersheet, the diameter of the jar will be bigger, the amount of water in the jar, thickness of papersheet, will the experiment work if we put something different instead of papersheet.

Would it be possible to do in bigger bottle of water with greater amount of water. Instead of water put, for example, oil, some carbonated drink Cola.

20

Moving on to questions of type "How...", "In what way..."

How does the course of the experiment depends on the quantity and type of liquid?

How is it dependend on the type of liquid?

21

Moving on to questions of type "How...", "In what way..."

How does the phenomenon depend on the thickness of the papersheet?
How does the phenomenon depend on the amount of water in the jar?
How does the phenomenon depend on the diameter of the jar?

What if we replace (mineral) water with sparkling water?

22

Everythingstartswithquestions..

By formulating and writing down 'on paper' better and better questions the students got closer to well-formulated inquiry questions.

It is not an easy process...

23

Everythingstartswithquestions..

Teachers asking too many questions do not give students "time and space" to ask questions themselves. Students do not have time to learn how to formulate "good questions".

Let's create an opportunity to ask inquiry questions!

Asking of inquiry questions can/must be learned!

24

Thank You for attention

Roman Klara - Podkarpackie Teacher Education Center in Rzeszów – Branch in Krosno, Catholic High School in Krosno

25

Placement of an object in space using bisectors

Urška Krajnc
Radlje ob Dravi Primary School, Radlje ob Dravi, Slovenia

Co-funded by the Erasmus+ Programme of the European Union
Grant agreement no. 2020-1-IE01-KA201-066069

PLACEMENT OF AN OBJECT IN SPACE USING BISECTORS

Urška Krajnc
Osnovna šola Radlje ob Dravi

1

- Students often struggle to understand and relate different mathematical topics to concrete life situations. Knowledge often remains at a theoretical level, as students are unable to apply what they have learned to real-life problems. They also have difficulties in transferring their knowledge to other subject areas.

2

This problem is present in all students, but is more pronounced in those who are weaker academically. In order to improve understanding and, consequently, knowledge for all students, I include many activities in the classroom to help students to put themselves in a concrete life situation.

3

I WAS INTERESTED IN:

- How successful will students be in solving a concrete problem from everyday life?
- How successful will students be in transferring knowledge to other subject areas?
- Will students' understanding improve?
- Will students' knowledge improve?

4

MY RESEARCH PLAN

- Group problem-solving in everyday life.
- Individual verification of correctness of findings by measurement.
- Drawing a sketch, recording findings.
- Constructing the symmetry of a line.

5

MY RESEARCH PLAN

- Individual problem solving in everyday life and other subject areas.
- Comparison of students' achievements in the treatment and control groups.

6

ABOUT THE ACTIVITY

- The students had to position themselves in the class so that they were at the same distance from two classmates at the same time.
- Then th… measur… groups … line.

RISE

7

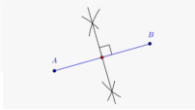
ABOUT THE ACTIVITY

RISE

8

THE ACTIVITY

- The discussion was followed by learning how to construct the symmetry of a line with a geometric tool. The students then worked in pairs to solve concrete tasks from everyday life (placing an ATM and a swing in space).

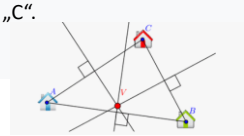


RISE

9

THE ACTIVITY

Example 1 of solving the task:
We would like to place ATM „V“ so that it is at the same distance from the shop „A“, the restaurant „B“ and the flower shop „C“.



RISE

10

THE ACTIVITY

Example 2 (
Place a swi… …quidistant
Miha's hom…

RISE

11

COLLECTED DATA

- Students learnt to construct the symmetry of a line and to determine the point equidistant from three different points in the plane. In the initial task, only two students immediately knew how to position themselves in space so that they were equidistant from two classmates at the same time. The other students also quickly worked out how to position themselves correctly.

RISE

12

COLLECTED DATA

- Only after checking by measuring did all the students believe that all the points on the symmetry line were equidistant from the two places on the line. The students had no difficulty in drawing the sketch, and they quickly realised that the symmetry line of the line of distance bisects the line of distance at right angles.

13

COLLECTED DATA

- The students had some difficulty with the problem where they had to identify a point that is equidistant from three points at the same time. With the teacher's help, all students solved this problem successfully. The transfer of knowledge to a concrete situation (locating a swing on a map) was not a problem for the students.

14

COLLECTED DATA

- I also compared the performance of the students in the experimental group (7a) with the control group (7c) in solving the task from this content and found that the students in the experimental group scored 20% better than the students in the control group.

15

CONCLUSION

- I realised that all the students are more active and, above all, much more motivated to do their school work. I was surprised that at the beginning only two students were able to position themselves correctly so that they were equidistant from two of their classmates at the same time. I was also surprised that the students were very successful in the task of placing the swing in space.

16

CONCLUSION

- The comparison of the results showed that learning by exploring has a significant impact on better understanding and the quality of the knowledge acquired. Exploratory learning also helps weaker students and students with learning deficits to achieve better learning results (in the treatment group, only one student (5%) was unable to solve a task in the subject matter in the assessment, compared to 6 (27%) in the control group).

17

18

Modelling round bodies

Miran Kučer
Ljudski Vrt Primary School, Ptuj, Slovenia

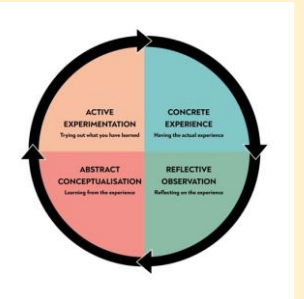
MODELLING ROUND BODIES

MIRAN KUČER

OSNOVNA ŠOLA LJUDSKI VRT PTUJ

1

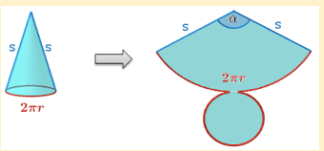
1. What is experiential learning and why is it important?



Kolb's learning cycle

2

2. MOTIVATION FOR RESEARCH



Hypothesis 1: Students will initially draw the net of the cone falsely.

Hypothesis 2: After completing some practical tasks they will learn (by doing) what the net of the cone consists of.

Hypothesis 3: That knowledge will be more long lasting because it was gained by their active experience.

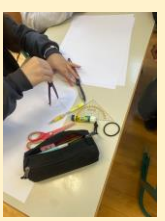
3

3. My research plan

- **Research population:** 9th grade students (N=21).
- **Research question:** What role does experiential learning and practical experience have in mathematics?
- **Activity:** Students were trying to make round bodies.
- **Operational goal:** To gain new and more permanent knowledge through cooperative work and their active engagement.
- **Methodology**: observation, surveying.

4

4. Presentation of the executed lecture



5

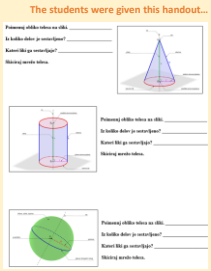
4.1. Motivation for the students and testing their prior knowledge

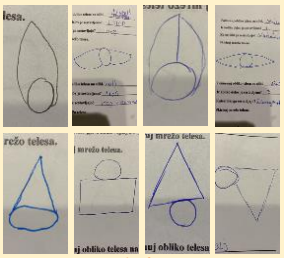
Handout 1: The students had the task of naming the objects on pictures.

6

4.2. Task: Sketch the nets using reflection

The students were given this handout...





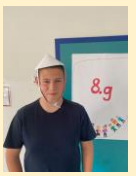
Examples of wrong answers...

7

4.3. Group work and construction of the bodies

They couldn't make a cone out of their initial sketch...

...and that led to the cognitive conflict between their pre-existing ideas and new information.

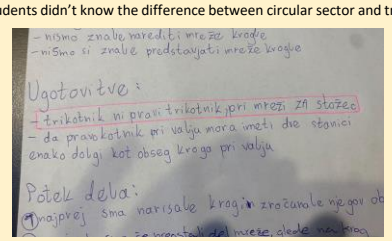


But when they tried to make themselves a hat they got it!

8

4.4. Reporting about their findings

The students didn't know the difference between circular sector and triangle.



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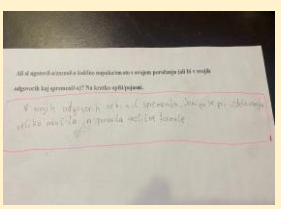
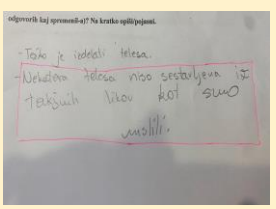
4.5. Reflection, synthesis and evaluation of the lecture





10

5. Conclusion

5.1. My findings

- Students like experiential learning and wish to have similar lectures more often.
- Their knowledge is more long lasting when they construct it themselves.
- Students are more engaged and motivated when they cooperate with each other.

11

5.2. Suggestions for improving my teaching practice and ideas for further research

- Experiential learning takes more time to plan and execute.
- By letting the students ask the questions I noticed the weak spots in their prior knowledge.
- I will give my students more practical examples during my lectures.
- It was really positive to give them a chance to express their creativity in mathematics.

12

Thank you for listening!



13

Angles in a triangle

Vesna Lindič
Tončke Čeč Primary School, Trbovlje, Slovenia

ANGLES IN A TRIANGLE

Vesna Lindič

Osnovna šola Tončke Čeč Trbovlje

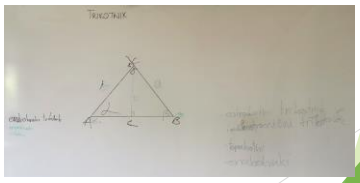
1

Find the rule for the sum of the interior angles of a triangle by drawing, cutting, tearing or folding.

2

Start of the lesson:

- brainstorming,
- a scale acute triangle drawn on the board,
- pupils wrote everything they already knew.



3

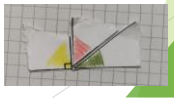
The research question

WHAT IS THE SUM OF THE INTERIOR ANGLES IN A TRIANGLE?

4

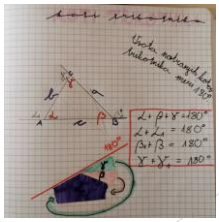
Activities:

- heterogeneous groups with 4 members,
- each group drew acute triangle, obtuse triangle and right-angled triangle,
- triangles were cut out and folded or thorn, only measuring was forbidden,
- pupils checked that the rule applies to all different triangles,



5

- the rule was written on the sticky note and stuck on the board,
- we formulated the rule in notebook and solved calculation example.



6

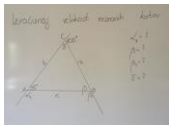
PI questions:

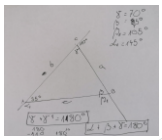
- How successful will the students be in finding the properties?
- How well will students work together?
- In June: Does IBL help them to remember what they have learned in school?

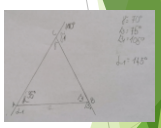
7

Monitoring pupils` work:

- by observing students as they worked,
- in written assessment in May,
- in June with one assignment related to the same subject.







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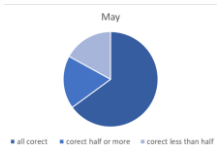
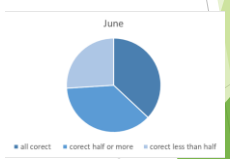
Results:





9

I found out that more pupils were motivated by IBL. They were more connected, more cooperative and helped each other.
All grups were successful in finding the sum of interior angles rule and pupils remembered the rule more quickly.
I think that IBL has positive impact on memorisation and I will try to integrate it into regular work more often.

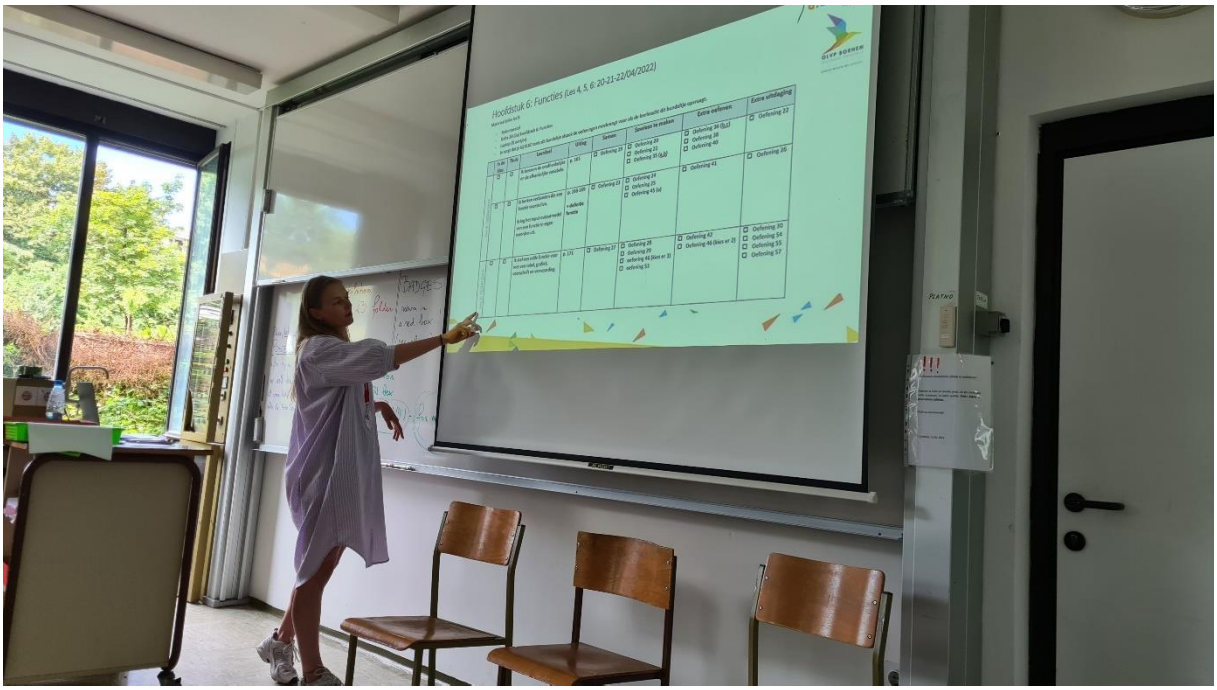
10

THANK YOU FOR YOUR ATTENTION.

11

How to keep a large, busy class motivated for maths?

Blomme Maes
OLVP Bornem, Belgium



Short introduction

- Blomme Maes
- Teacher Mathematics & Physics
- 1 year teaching experience
  - OLVP Bornem
- Student Technology
  - Arteveldehogeschool

artevelde hogeschool
denk. doe. word.

1

The situation in the first trimester

- Teacher Mathematics
- 3M&W1 (study programme: Society and Welfare)
- 3 hours/week
- Septembre – Decembre → 21 students
  - Very busy
  - Chatting a lot
  - Fiddling
  - Doing other things than maths
  - Sitting in a classroom that was far too small
  - Bad grades
    - Difficult classgroup (conclusion of all teachers)

2

The situation in the second trimester

- January – June → 30 students
  - Even more busy
  - Even more chatting
  - Even more fiddling
  - Still doing other things than maths
  - A bigger classroom (but too small for 30 students)
  - Worse grades
- Too much energy, exhausting, no teaching anymore
- Grades dropped dramatically

3

What did I do?

- Crying
- Appointment with educational tutor in mathematics
  - Searching for solutions

4

5

Hoofdstuk 6: Functies (Les 4, 5, 6: 20-21-22/04/2022)

Materiaal (elke les!):

- Rekentoestel
- Delta 3B (3u) hoofdstuk 6: Functies
- Laptop (& oortjes)
- Je zorgt dat je bij ELKE toets dit bundeltje alsook de oefeningen meebrengt voor als de leerkracht dit bundeltje opvraagt.

	In de klas	Thuis	Leerdoel	Uitleg	Samen	Sowieso te maken	Extra oefenen	Extra uitdaging
Les 4: 20/04/2022	☐	☐	Ik benoem de onafhankelijke en de afhankelijke variabele.	p. 165	☐ Oefening 19	☐ Oefening 20 ☐ Oefening 21 ☐ Oefening 35 (a,b)	☐ Oefening 36 (b,c) ☐ Oefening 38 ☐ Oefening 40	☐ Oefening 22
	☐	☐	Ik herken verbanden die een functie voorstellen. Ik leg het input-outputmodel van een functie in eigen woorden uit.	p. 168-169 + definitie functie	☐ Oefening 23	☐ Oefening 24 ☐ Oefening 25 ☐ Oefening 45 (a)	☐ Oefening 41	☐ Oefening 26
Les 5: 21/04/2022	☐	☐	Ik stel een reële functie voor met een tabel, grafiek, voorschrift en verwoording.	p. 171	☐ Oefening 27	☐ Oefening 28 ☐ Oefening 29 ☐ oefening 46 (kies er 3) ☐ oefening 53	☐ Oefening 42 ☐ Oefening 46 (kies er 2)	☐ Oefening 30 ☐ Oefening 54 ☐ Oefening 55 ☐ Oefening 57

6

Naam: _____

Les 4: 20/04/2022	☐	☐ Ik bepaal invoerwaarden en functiewaarden vanuit het voorschrift, de tabel en de grafiek.	p. 173-174	☐ Oefening 31	☐ Oefening 32 ☐ Oefening 33 ☐ Oefening 44 ☐ Oefening 45 (b,c) ☐ Oefening 48 ☐ Oefening 50	☐ Oefening 35 (c) ☐ Oefening 37 ☐ Oefening 39 ☐ Oefening 43 ☐ Oefening 47 ☐ Oefening 49 ☐ Oefening 51 ☐ Oefening 52	☐ Oefening 34 ☐ Oefening 56

TER CONTROLE (THUIS) BIJ HET STUDEREN

☐	Ik benoem de onafhankelijke en de afhankelijke variabele.	p. 165	Wat heb ik geleerd? ☐ Oefening 1
☐	Ik stel een reële functie voor met een tabel, een grafiek, een voorschrift en een verwoording.	p. 171	Wat heb ik geleerd? ☐ Oefening 1
☐	Ik herken verbanden die een functie voorstellen.	p. 168-169	Wat heb ik geleerd? ☐ Oefening 1
☐	Ik bepaal invoerwaarden en functiewaarden vanuit het voorschrift, de tabel en de grafiek.	p. 173-174	Wat heb ik geleerd? ☐ Oefening 2

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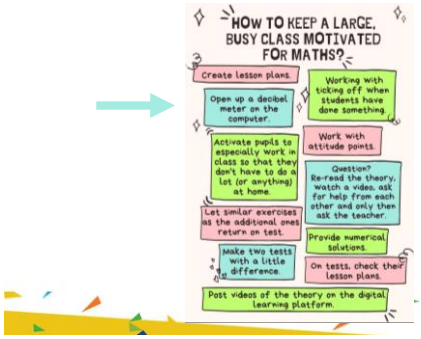

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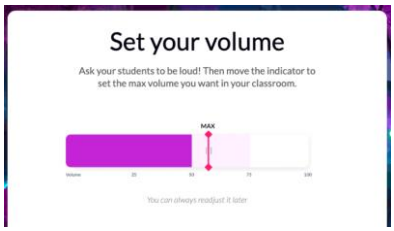

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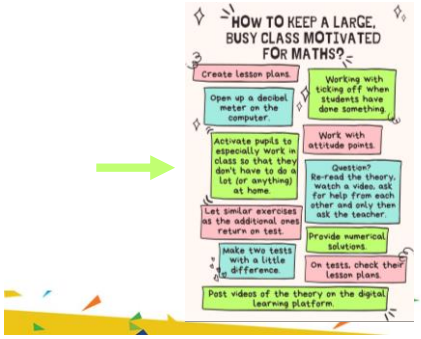

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Hoofdstuk 6: Functies (Les 4, 5, 6: 20-21-22/04/2022)

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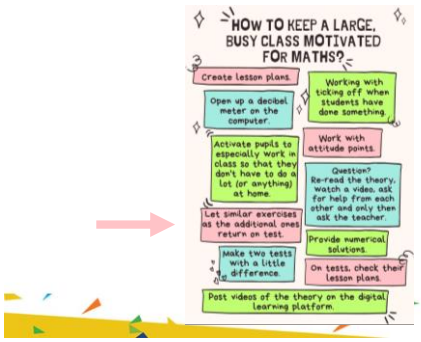

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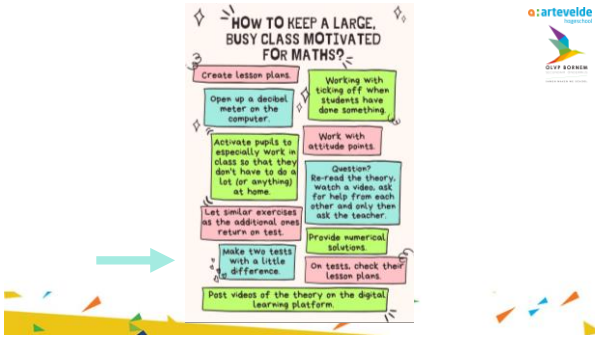

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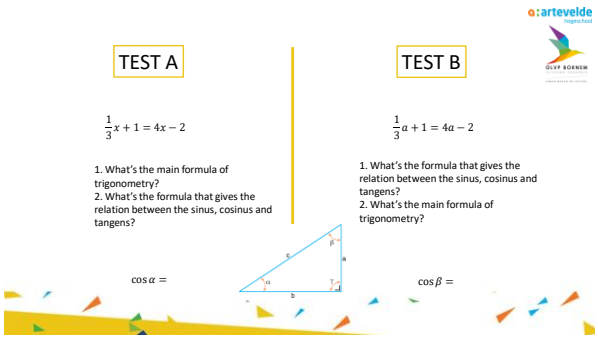

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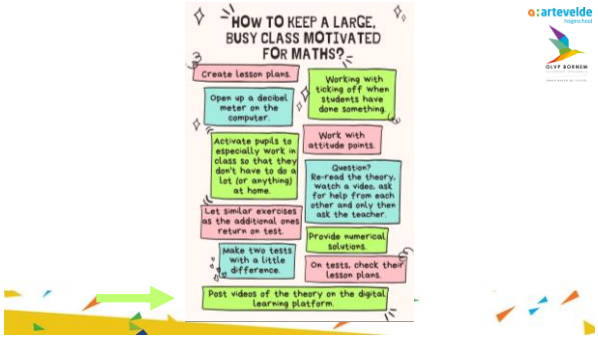

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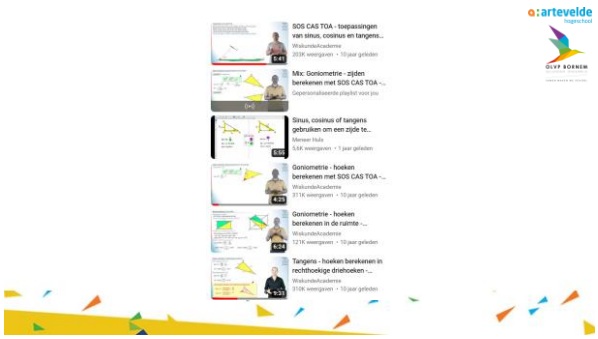

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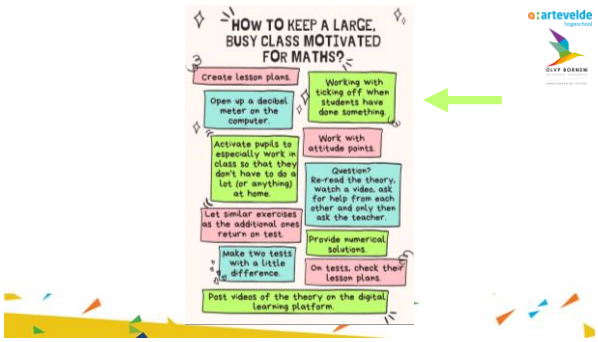

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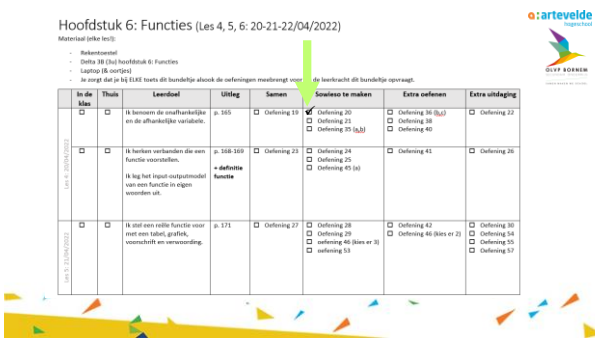

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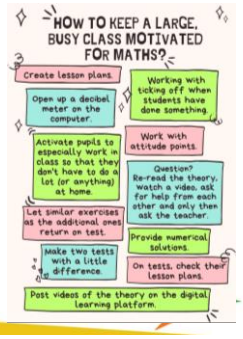
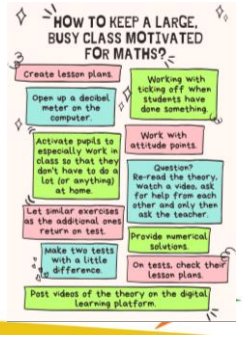


19

5/5
−1 (they forgot to complete their exercises at home)
4/5
−1 (they forgot their workbook, calculator or something else needed for class)
3/5
−1 (they disturb class too much)
2/5
...

20



21

Hoofdstuk 6: Functies (Les 4, [illegible] 6: 20-21-22/04/2022)

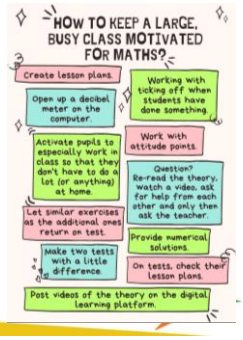
Materiaal (elke les!):

- Rekentoestel
- Delta 3B (3u) hoofdstuk 6: Functies
- Laptop (& oortjes)
- Je zorgt dat je bij ELKE toets dit bundeltje alsook de [illegible]eningen meebrengt voor als de leerkracht dit bundeltje opvraagt.

	In de klas	Thuis	Leerdoel	Uitleg	Samen	Soweso te maken	Extra oefenen	Extra uitdaging
Les 4: 20/04/2022	☐	☐	Ik benoem de onafhankelijke en de afhankelijke variabele.	p. 165 + video on SmS	☐ Oefening 19	☐ Oefening 20 ☐ Oefening 21 ☐ Oefening 35 (a,b)	☐ Oefening 36 (b,c) ☐ Oefening 38 ☐ Oefening 40	☐ Oefening 22
	☐	☐	Ik herken verbanden die een functie voorstellen. Ik leg het input-outputmodel van een functie in eigen woorden uit.	p. 168-169 + definitie functie	☐ Oefening 23	☐ Oefening 24 ☐ Oefening 25 ☐ Oefening 45 (a)	☐ Oefening 41	☐ Oefening 26
Les 5: 21/04/2022	☐	☐	Ik stel een reële functie voor met een tabel, grafiek, voorschrift en verwoording.	p. 171	☐ Oefening 27	☐ Oefening 28 ☐ Oefening 29 ☐ oefening 46 (kies er 3) ☐ oefening 53	☐ Oefening 42 ☐ Oefening 46 (kies er 2)	☐ Oefening 30 ☐ Oefening 54 ☐ Oefening 55 ☐ Oefening 57

22

23



24

Numerieke oplossingen H4 (Les 3 en 4)

Oefening 6

$4x - 5 = 7$	$x = 3$
$-3x - 2 = 5x + 6$ $6x + 3 = 0$	$x = \frac{1}{2}$
$\frac{x}{2} = 5$	$x = -10$
$-11 + x = -7$	$x = 4$
$3,5x - 0,4 = 7,3x$	$x = -0,1$
$9x + 6 = -5x - 4$	$x = -\frac{5}{7}$
$-5x - 13 = -6x - 13$ $8x + 2(3x + 4) = 0$	$x = \mathbb{R}$ $x = -\frac{4}{7}$

Oefening 7

A	$x = 0$
B	$x = 2$
C	$x = 3$
D	$x = -\frac{6}{5}$
E	$x = -\sigma$
F	$x = \frac{26}{5}$
G	$A = 4,52$
H	$x = 1,73$

Oefening 8

A	$t = \frac{11}{4}$
B	$x \approx 4,43$
C	$b = \frac{6\sigma}{5}$
D	$w \approx -7,82$

Oefening 10

A	Vermindert met 8
B	Deel door 8
C	Deel door -1
D	Vermeerder eerst met 12 en deel daarna door -3

Oefening 19

A	$x = 3$
B	$x = 2$
C	$t = -4$
D	$x = \frac{18}{7}$
E	$r = 0$
F	$p = 5$

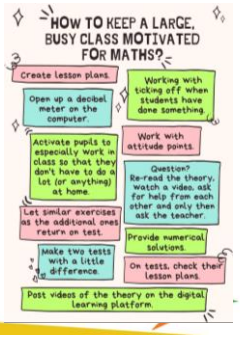
Oefening 20

A	$x = 10$
B	$g = 5$
C	$x = \frac{16}{5}$
D	$m = 7$
E	$b = \frac{19}{5}$
F	$x = \frac{10}{7}$

Oefening 28

$5(x - 2) - 19 = -4$	$x = 5$
$1 + 2x = 3 + 2x$	→ moeten jullie niet kunnen (mag je overslaan)
$\sqrt{27} = -\sqrt{g}$	$g = -3$
$5ax + 7x = a(2x - 3)$	10 $x = -\frac{3}{3}$

25



26

Hoofdstuk 6: Functies (Les 4, 5, 6: 20-21-22/04/2022)

Materiaal (elke les!):

- Rekentoestel
- Delta 3B (3a) hoofdstuk 6: Functies
- Laptop (& oortjes)
- Je zorgt dat je bij ELKE toets dit bundeltje alsook de oefeningen meebrengt voor de leerkracht dit bundeltje verzaagt.

	In de klas	Thuis	Leerdoel	Uitleg	Samen	Sowieso te maken	Extra oefenen	Extra uitdaging
Les 4: 20/04/2022	☐	☐	Ik benoem de onafhankelijke en de afhankelijke variabele.	p. 165	☐ Oefening 19	✔ Oefening 20 ✔ Oefening 21 ✔ Oefening 35 (a,b)	☐ Oefening 36 (b,c) ✔ Oefening 38 ☐ Oefening 40	☐ Oefening 22
	☐	☐	Ik herken verbanden die een functie voorstellen. Ik leg het input-outputmodel van een functie in eigen woorden uit.	p. 168-169 **+ definitie functie**	☐ Oefening 23	✔ Oefening 24 ✔ Oefening 25 ✔ Oefening 45 (a)	✔ Oefening 41	✔ Oefening 26
Les 5: 21/04/2022	☐	☐	Ik stel een reële functie voor met een tabel, grafiek, voorschrift en verwoording.	p. 171	☐ Oefening 27	✔ Oefening 28 ✔ Oefening 29 ✔ oefening 46 (kies er 3) ✔ oefening 53	☐ Oefening 42 ☐ Oefening 46 (kies er 2)	☐ Oefening 30 ☐ Oefening 54 ☐ Oefening 55 ☐ Oefening 57

27

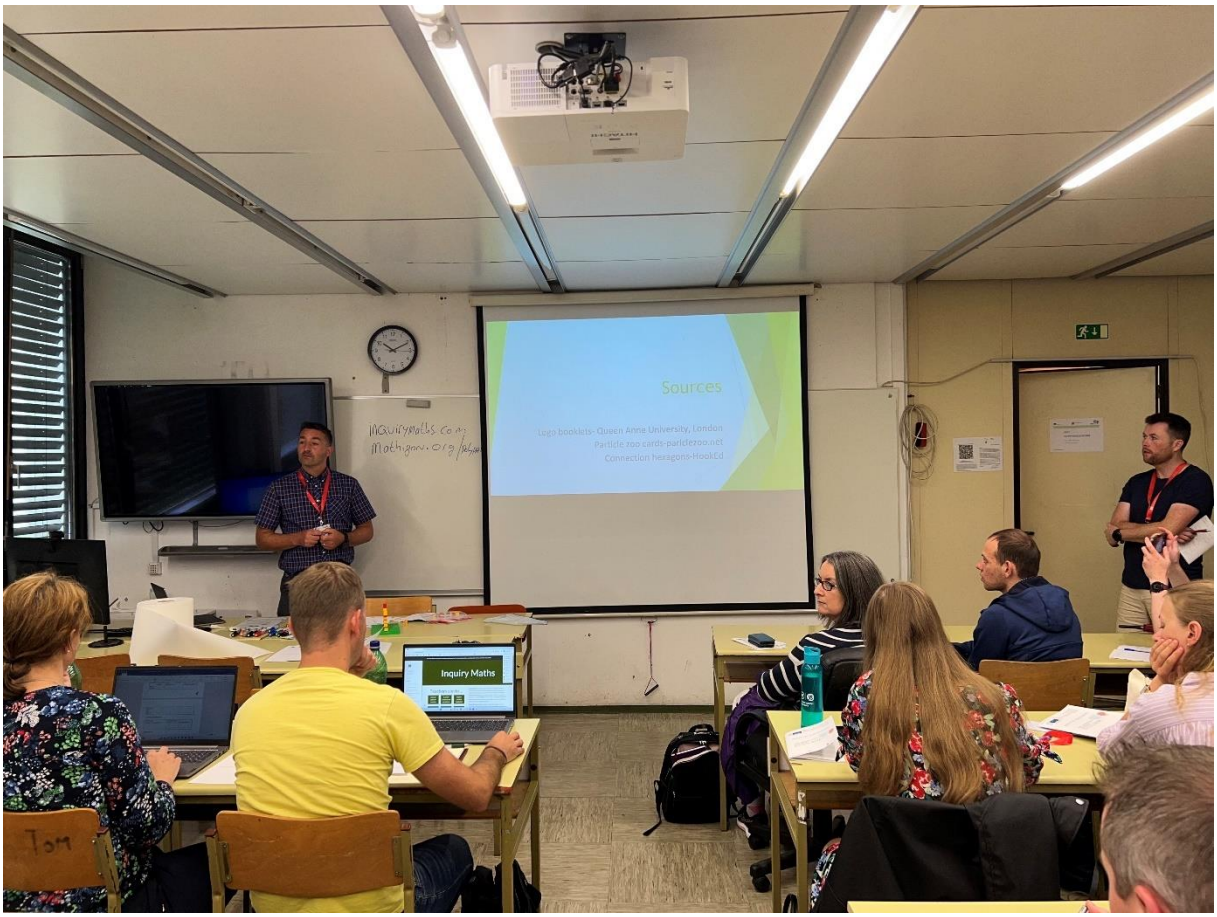
The situation in the third trimester

- January – June → 30 students
- Students who did their best or followed the new system got better (or even good) results

28

A model based approach to give a deeper understanding of aspects of atomic and particle physics

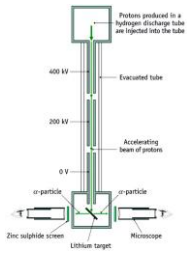
Denis McCarthy
Hazelwood College, Ireland



A model-based approach to give a deeper understanding of aspects of atomic and particle physics

Denis McCarthy
Hazelwood College,
Dromcollogher

1



Challenge

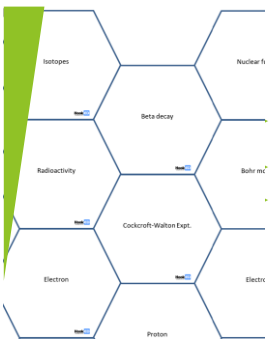
- The lack of relevant experimental work in atomic, particle physics section of course
- Need for interactive class moments between students

2

Approach

- Students work in pairs with kit to model topics to be revised or introduced to
- Any disagreement or misconceptions noted on mini whiteboard

3



Approach

Keywords , info cards and groups are associated with models

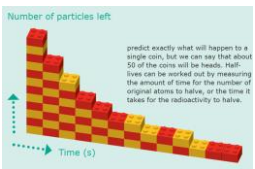
A connections exercise is used as a formative assessment

A narrative overview is presented when all topics covered

4

Topics covered

- Atomic structure
- Quark model
- Beta decay
- Nuclear fission/fusion
- Radioactivity



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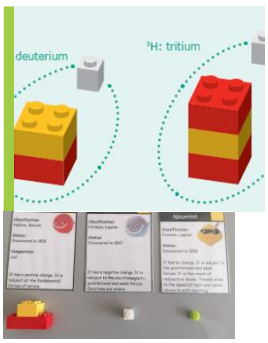


Samples

6

Samples

Hexagons	Connection Explained

7

Observations

- Students readily share ideas or misconceptions when using models
- The use of correct terminology happens very naturally between pairs of students during discussions
- An assessment based on connections encourages effective discussion between students

8

Conclusions

- Modelling proved a more effective strategy than using videos or simulations alone for teaching these topics.
- Adopting a narrative approach encouraged connections between topics to be more readily expressed.
- The timeline of discoveries and the scientists involved became more relevant.

9

Sources

Lego booklets- Queen Anne University, London
Particle zoo cards-pariclezoo.net
Connection hexagons-HoodEd

10

Thank you for your attention

11

Pressure and my shoes

Alenka Mravljak
Brezno-Podvelka Primary School, Podvelka, Slovenia

Pressure and my shoes

Alenka Mravljak
OŠ Brezno-Podvelka

1

What I've been working on

Students love to research, especially when the problem is related to daily life. They approached the given research question, 'How does my choice of footwear affect the pressure under my shoes?' with interest.

The topic of pressure is always addressed in 8th grade towards the end of the school year, when students' motivation to work and learn has already dropped significantly. Therefore, I wanted to make the lesson a little different.
I started with a simple equation for pressure and listed the variables on which it depends.

Students then made hypotheses that they successfully confirmed as they worked.

2

What I wanted to know...

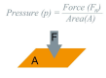
- How will students think?
- How will their exploration take place?
- What hypothesis will they make?
- How will they record their work?
- What conclusions will the students reach?

3

What the students did...

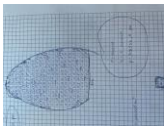
- I conducted the activity in grade 8 at my school. The activity lasted two school hours.
- I started with a simple equation for pressure and listed the variables on which it depends.

- I brought my three different shoes and underneath the shoes we were looking for the pressure.



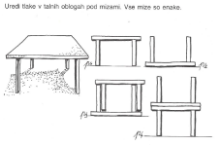
4

- Their first investigation focused on the area of three different shoes.
- In Year 8, we learn how to approximate the area of irregular figures and here we had the opportunity to consolidate this knowledge.
- We have computationally proven our hypothesis that the pressure is higher at a smaller plane.

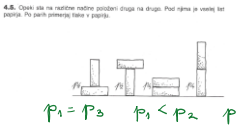


5

- I tested knowledge with two interesting tasks. The students had no problems with the sizing of the pressure



$p_2 < p_3 < p_1 < p_4$



$p_1 = p_3$ $p_1 < p_2$ $p_2 > p_3$
$p_2 = p_4$ $p_1 < p_4$ $p_3 < p_4$

6

Conclusions

- Students think very well. Difficulties arise when writing down their ideas, thoughts or conclusions.
- Students think very well and incorporate knowledge from previous years and from everyday life (We can't go into the meadow or the field with high heels because it digs into the ground)
- What is lacking in the work is the discipline to write down the research design and to formulate the findings or the answer to the question posed. And I need to improve on the latter in the years to come.

7

How does the IBL method affect on student's knowledge about density at physics in primary school

Primož Podrzavnik
Radlje ob Dravi Primary School, Radlje ob Dravi, Slovenia

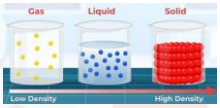
HOW DOES THE IBL METHOD AFFECT ON STUDENT´S KNOWLEDGE ABOUT DENSITY AT PHYSICS IN PRIMARY SCHOOL

Primož Podrzavnik
Radlje ob Dravi Primary School/ teacher of physics and math


[1]

1

By teaching physics it is important to recognize different approaches to delivering content that allow students their active cooperation and their own researching.



[2]

My research focused on comparing two teaching approaches for teaching ***DENSITY*** in elementary school:

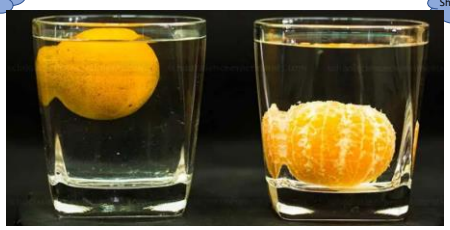
- **delivering content through teacher explanation**
- **students engaging in their own exploration**


2

Motivation

DENSITY EXPERIMENT WITH AN ORANGE

Showed picture



Why does unpeeled orange float on water?

Why does peeled orange sink in water?

3

WOOD	ALUMINIUM	IRON
$V = 1\ dm^3$	$V = 1\ dm^3$	$V = 1\ dm^3$
$m = 0{,}55\ kg$	$m = 2{,}70\ kg$	$m = 7{,}80\ kg$

4

What floats, what sinks (in the water) ?

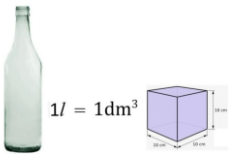
[1]

Which substances else do you know that floats / sinks? Oil, cork, wood,...

[3]

5

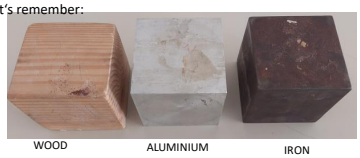
What is the mass of water with the same volume as the cubes?

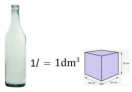



[1]

6

Let's remember:





WOOD	ALUMINIUM	IRON	WATER
$V = 1\ dm^3$	$V = 1\ dm^3$	$V = 1\ dm^3$	$V = 1\ dm^3$
$m = 0{,}55\ kg$	$m = 2{,}70\ kg$	$m = 7{,}80\ kg$	$m = 1\ kg$
$\frac{m}{V} = ?$	$\frac{m}{V} = ?$	$\frac{m}{V} = ?$	$\frac{m}{V} = ?$

...DENSITY...

7

Snov (Substance)	Gostota kg/m³ (Density)
zrak	1.3
smrekov les	500 (Spruce wood)
bukov les	700
etanol	790
olje	800
voda	1000
apnenec	2700 (Limestone)
aluminij	2700 (Al)
železo	7800 (Fe)
svinec	11 400
živo srebro	13 590
zlato	19 300
osmij*	22 600

[5]

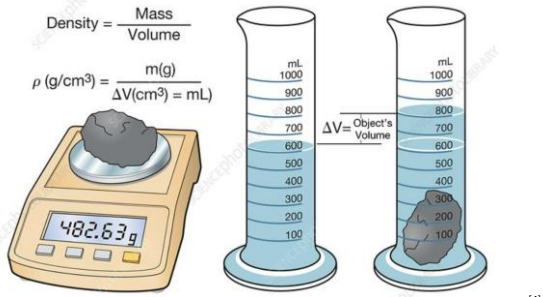
Where is the **water**?

[3]

8

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\rho\ (g/cm^3) = \frac{m(g)}{\Delta V(cm^3) = mL)}$$



[4]

9

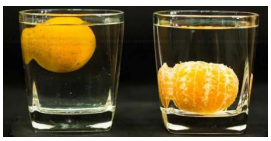
WHAT DID I GET FOR THE GIFT???

10

Back to the motivation...

DENSITY EXPERIMENT WITH AN ORANGE

Demonstration



Why does unpeeled orange float on water ?

Because its density is lower then of water.
There is a lot of **air** space inside orange that makes orange's shape like boat.
As a result its upthrust is exerted.
Which in result makes orange float on water.

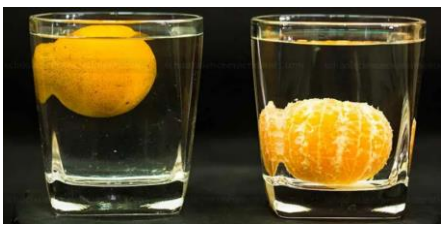
Why does peeled orange sink in water ?

When we put an orange inside the water it sinks.
Air bubbles comes out from orange.
Here water's density is lower then of orange's.
As a result an orange sinks in water.

11

IBL method

Active learning: Students were actively involved in the learning process; instead of passively receiving information from the teacher, students experimented, investigated on their own.



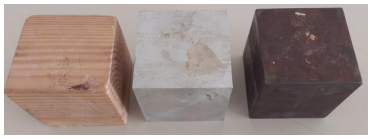
12

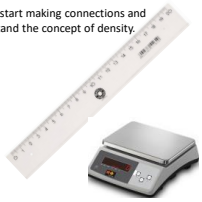
IBL method

Exploration and discovery: Students are encouraged to explore and discover concepts on their own rather than being told the answers directly.
When it comes to density, students may be given various objects of different materials and sizes and asked to compare their weights and volumes.

$m, \ldots V \ldots \frac{m}{V} \ldots = ?$

Through this exploration, students can start making connections and observations that lead them to understand the concept of density.





13

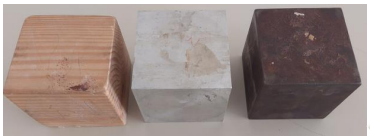
IBL method

Critical thinking skills: Students are encouraged to ask questions, make hypotheses, analyze data, and draw conclusions.

When students investigated density through IBL, they analyzed the relationship between mass and volume, considered different materials, and thought critically about the results they obtained.

$m, \ldots V \ldots \frac{m}{V} \ldots = ?$

This process improves their critical thinking abilities and helps them build a strong basic knowledge in physics.



14

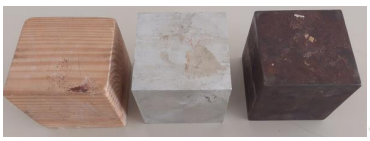
IBL method

Collaborative learning: Students worked together in groups to solve problems and share their findings.

When students engaged in collaborative activities related to density, they could discuss their observations, exchanged ideas, and learned from each other's perspectives.

$m, \ldots V \ldots \frac{m}{V} \ldots = ?$

Collaborative learning not only strengthens their understanding of density but also improves their communication and teamwork skills.

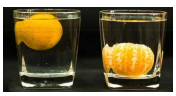


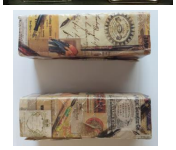
15

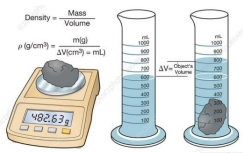
IBL method

Long-term retention: By actively exploring and discovering concepts through IBL, students retained the knowledge in the long term.

Instead of memorizing facts temporarily, they developed a deeper understanding of density that can be applied in different contexts.







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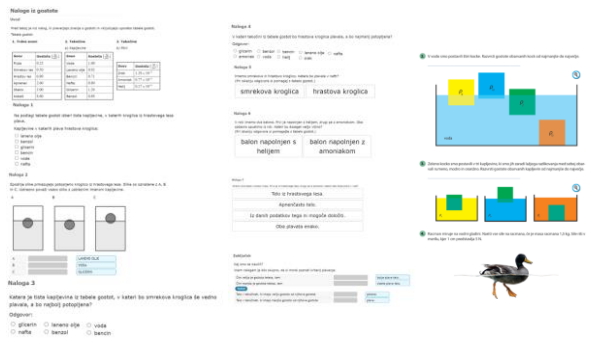


17

Erasmus+

RISE

I compared the achievements of the experimental group with the achievements of other students.
I found that the experimental group performed 15 % better in solving new problems, related to density, compared to the other students.

The study provided insights into the effectivness of two different approaches in teaching density in elementary school. It was found that delivering content through teacher explanation enables faster acquisition of basic knowledge, while student's own exploration promotes a deeper understanding of concepts and connection with the real world. I prefer to combine both approaches when teaching density to allow for a balanced learning experience and the development of various competencies.

18

Sources:

[1]: https://wiki.anton-paar.com/at-de/dichte-und-dichtemessungen/
[2]: https://www.geeksforgeeks.org/density/
[3]: https://www.thoughtco.com/how-to-calculate-density-609604
[4]: https://www.sciencephoto.com/media/981021/view/measuring-the-density-of-an-object-illustration
[5]: https://folio.rokus-klett.si/?credit=MI_MPF1UC&pages=120-121

19

An inquiry on the effect of wonder on the motivation of students and their ability to ask questions

Wannes Vande Voorde

Arteveldehogeschool, Gent, Belgium

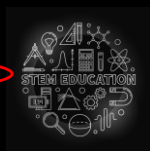
SPACE

A STEM PERSPECTIVE FOR ASTRONOMY AND CLIMATE EDUCATION

1

GOALS OF THIS PROJECT/ THINGS I WANTED TO ACHIEVE

- Real connection between disciplines, not a fragmentend approach
- Using systems thinking to make sense of the world and it's complexity
- Focus on climate and the universe: research
- Motivating students to ask questions through a sense of wonder



2

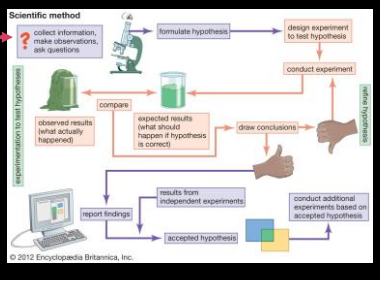
THE IMPORTANCE OF WONDER

- Wonder is at the origin of reality-based consciousness, thus of learning
- Wonderment leads to asking questions.
- It's not the same as curiosity or awe!
- Wonderment, motivation and a broad interest in the world are all linked
- Without wonder the act of learning gets dull and stale
- Wonderment contrast with our everyday experience
- …

3

THE IMPORTANCE OF WONDER

Wonder



4

THE IMPORTANCE OF WONDER

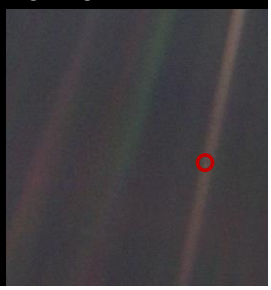
Need for meaningful, wonderful contexts

Need for stories (a story of the universe, example: atoms and stars)

5

WONDERING ABOUT SPACE

A PALE BLUE DOT



6

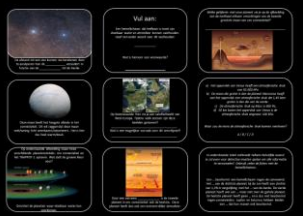
WORKSHOP: INTRO

- Scale of the universe
- Fragility and uniqueness of our planet

7

WORKSHOP: WHAT MAKES A PLANET OR MOON (UN)LIVABLE?

- 11 STEM-investigations with household items
- That are all connected through one summary
- Through which students can classify moons and planets by habitability



8

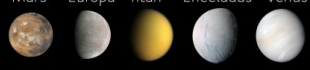
CRITERIA

- Goldilocks zone
- Mass and size
- Magnetic field
- Atmosphere
- Radiation and absorption
- Climate and weather
- Water(cycle)
- Rotation (around the sun) and speed
- Influence of humanity
- Type of star + distance to other stars

9

PLANETS AND MOONS

Mars - Europa -Titan - Enceladus -Venus



niet: Saturnus en Mercurius

10

WORKSHOP: OUTRO

- Focus on questions!
- Is there a second Earth somewhere?
- What about the distance?
- Is there other life in the universe?
- …

esa
www.spacetelescope.org

Goal: More questions after the workshop then answers!

11

CONCLUSIONS

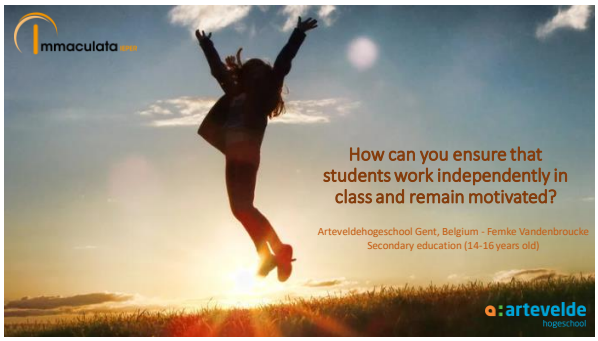
- A lot of questions, most of them deep and meaningful
- Students were motivated to complete all the investigations
- Systems thinking was stimulated, they saw Earth as one system

But more research and tests necessary because of the scope of the project!

12

How can you ensure that students work independently in class and remain motivated?

Femke Vanden Broecke
Imacolata, Ieper, Belgium



1

Situation

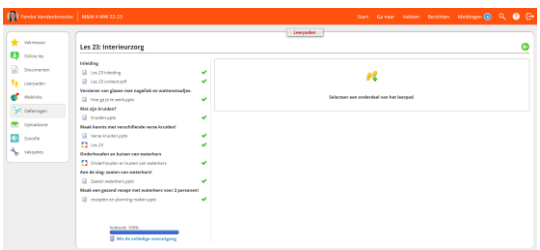
Large class: 20-30 students
I couldn't help everyone

↓

Result: running out of energy

2

Learning paths



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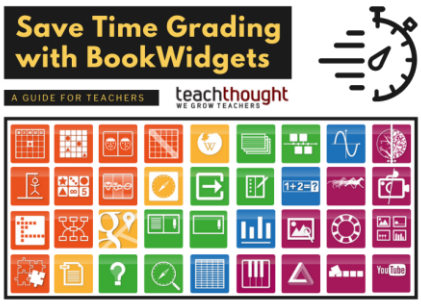

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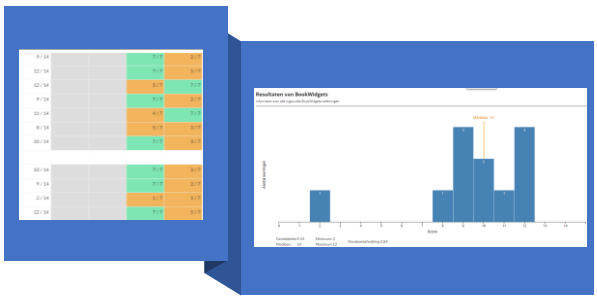


6

7

Pro & cons: learning paths

Positive students:

- Can listen to music during the learning paths
- Same structure every lesson
- Can work in silence

Positive teacher:

- Can provide targeted help and observation
- No need to explain the assignment 100 times
- They know evaluation criteria for the assignment
- You make your own material therefore you don't have to buy a workbook and blindly follow it.

8

Pro & contra: learning paths

Negative student:

- Not create a learning path every lesson
- Not always working alone, sometimes in group

Negative teacher:

- The preparation work to make up the learning path.

9

How can you ensure that students work independently in class while remaining motivated?

10

11

Discount-price increase or price increase-discount

Simona Verdinek Špenger
Brezno-Podvelka Primary School, Podvelka, Slovenia

Erasmus+
2020-1-SI01-KA226-SCH-093576

FINAL INTERNATIONAL CONFERENCE
Remote Inquiry in Science Education
RISE

26th - 28th of June 2023, Ljubljana, Slovenia

University of Ljubljana

DISCOUNT-PRICE INCREASE - OR PRICE INCREASE-DISCOUNT

SIMONA VERDINEK ŠPENGER
OŠ BREZNO-PODVELKA
simona.verdinek@os-brezno.si

1

MOTIVATION

When is a purchase more favourable: if an item is first discounted and then increased by the same percentage, or vice versa, if it is first increased and then discounted by the same percentage?

We encounter such and similar questions in everyday life, so it is important to equip students with knowledge that they will be able to effectively apply in various new situations. To achieve this, we need to use different approaches and activities and connect the subject matter with examples from everyday life.

2

WHAT I WAS INTERESTED IN?

In the research, I was interested in

- **how students will transfer what they have already learnt knowledge to a new situation,**
- **what their expectations will be,**
- **how they will justify their predictions and answers,**
- **what conclusions will they reach?**

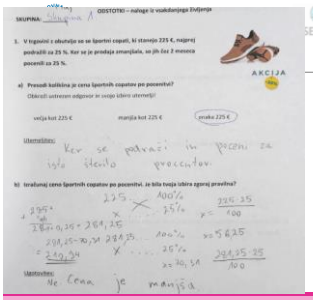
3

THE COURSE OF THE RESEARCH

The researche was divided into two parts. In the first part, the students divided themselves into four heterogeneous groups, while in the second part, they solved the tasks individually.

The study was conducted in a guided manner, using a worksheet.

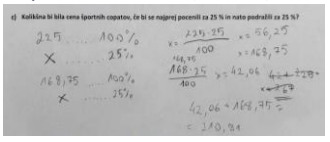
4



The students first investigated what happens to the price of sports shoes when the shoes are first increased by 25% and then later discounted by 25%. Their task was to predict whether the new price would be lower, equal to, or higher than the original price. They had to justify their choice and then solve a specific task, transferring the acquired knowledge to a new situation.

5

And than, they investigated what happens to the price of shoes when they are first discounted by 25% and then increased by 25%. They compared the obtained results and justified their findings.
They had access to a calculator, a link cube, and a worksheet.



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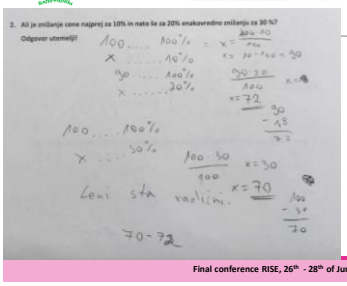
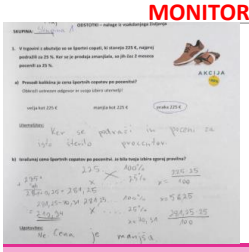


In the second part, they individually determined whether a price reduction of 10% followed by an additional reduction of 20% is equivalent to a total reduction of 30%.

7

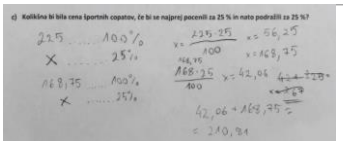
MONITORING STUDENT WORK



Three groups predicted that the price of sports shoes would be the same (because the percentage of increase and discount was the same), while one group predicted that the price would be higher. **So no group made the correct prediction.**

After solving the task, they all correctly wrote down their findings.

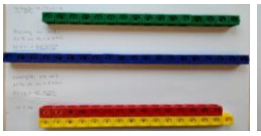
8



They found that it doesn't matter whether the shoes are first increased and then decreased by 25%, or first decreased and then increased by 25%. The final price in both cases is the same and is lower than the original price.

9

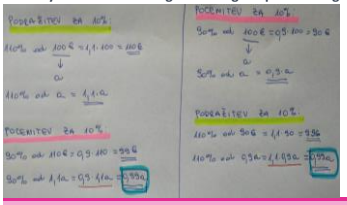
They proved their findings using linking cubes (they needed some hints and assistance).



They had 16 link cubes available. In the first case, they initially increased the number of cubes by 25 percent and then decreased it by 25 percent. In the second case, they initially decreased the number of cubes by 25 percent and then increased it by 25 percent. They found that the final number of cubes in both cases was 15, therefore the same.

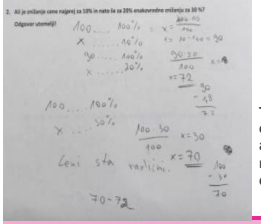
10

They had difficulties in generalizing the proof for a general price *a*, so we did it together.



We have proven that if we first increase something by 10 percent and then decrease it by 10 percent, the new price is equal to 99 percent of the original price.
We obtain the same result if we first decrease something by 10 percent and then increase it by 10 percent.

11



In the second part, the students individually determined whether a price reduction of 10% followed by an additional reduction of 20% is equivalent to a total reduction of 30%.

They solved the task individually. The majority of students remembered the conducted activity and correctly predicted that the reduction is not equivalent, as the base for calculating the percentages is different.

12

MY FINDINGS

The majority of students, even after a two-month period, remembered the conducted activity and successfully applied the acquired knowledge to new situations. The tasks related to percentages were also well solved during knowledge assessments.

For better understanding, students need "hands-on experience." They should be allowed to make mistakes, find them on their own, and correct them. This way, their knowledge will be of higher quality and more long-lasting.

THANK YOU FOR YOUR ATTENTION

How can you evaluate an out of school engineering academy?

Ruben Visser
Arteveldehogeschool, Gent, Belgium

How to evaluate an out of school engineering academy?

Ruben Visser

1

Engineering academy

- 10-12 year old kids
- Stimulate interest for technical professions
- Design-thinking and design skills
- Our theme: Recycling

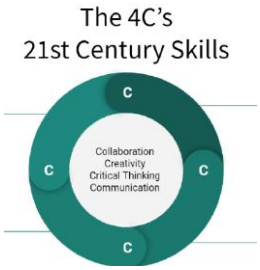
TECHNIEK academie

2

The 4 C's

- 21st century skills

- Critical thinking
- Collaboration
- Communication
- Creativity



3

Example of projects

- Garbage man
- Artwork
- Awards

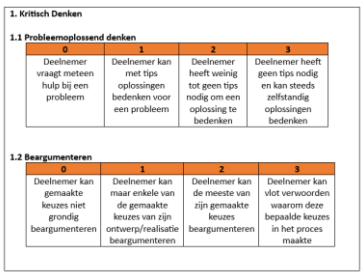
4

Criteria

- Critical thinking: Problemsolving, explaining choices, questioning information
- Collaboration: Helping others, accepting help, being respectful
- Communication: Presenting project, reading others, listening, body-language
- Creativity: Coming up with ideas, realising ideas, innovative techniques

5

Rubric



1. Kritisch Denken

1.1 Probleemoplossend denken

0	1	2	3
Deelnemer vraagt meteen hulp bij een probleem	Deelnemer kan met tips oplossingen bedenken voor een probleem	Deelnemer heeft weinig tot geen tips nodig om een oplossing te bedenken	Deelnemer heeft geen tips nodig en kan steeds zelfstandig oplossingen bedenken

1.2 Beargumenteren

0	1	2	3
Deelnemer kan gemaakte keuzes niet grondig beargumenteren	Deelnemer kan maar enkele van de gemaakte keuzes van zijn ontwerp/realisatie beargumenteren	Deelnemer kan de meeste van zijn gemaakte keuzes beargumenteren	Deelnemer kan vlot verwoorden waarom deze bepaalde keuzes in het proces maakte

6

Evaluation form 1

+1 per keer 1 v.d. 4 C's aan bod komt	Sessie 1
Kritisch Denken (1-5)	3 – Leerlingen deden even aan kritisch denken bij de uitleg van DOKANO (Hoe een flesje platdrukken, wat ligt er in het water, hoe komt het in het water), tijdens het varen zelf weinig, enkel over het sorteren van afval moest nagedacht worden.
Verbale Communicatie (1-3)	3 – Er moest heel veel gecommuniceerd worden tijdens het kano'en, zodat de juiste richting werd gepeddeld, ook het overleggen tussen de leerlingen waar bepaalde stukken afval in moesten.
Non-verbale Communicatie (1-3)	
Samenwerken LK-LL (1-3)	3 - Elke LK begeleidde 1 groep, de leerlingen deden zeer goed mee, luisterden naar de leerkracht en deden wat gevraagd werd.
Samenwerken LL-LL (1-3)	3 – De leerlingen vonden dit zeer leuk, ze hielpen elkaar met het afval rapen. In het begin van de sessie werd er gevoetbald met de leerlingen die vroeger aanwezig waren. Dit verliep ook zeer gemoedelijk.
Divergerende creativiteit (1-3)	2 – De leerlingen beginnen spontaan te brainstormen over het gebruiken van de gevonden voorwerpen in hun projectjes later.
Convergerende creativiteit (1-3)	1 – Leerlingen zochten creatieve manieren om zoveel mogelijk afval te rapen, zoals een tak gebruiken om iets verder weg te kunnen pakken.
Materiaal en Techniek (0-1)	1 – De leerlingen kozen zelf welk materiaal ze willen gebruiken voor de volgende lessen. Techniek: (Het sturen met een kano, het peddelen met de stokken)

7

Evaluation form 2

	Observatie sessies (Foto's)	Voorbereiding (Instructies/Organisatievorm)	Score 0-3	Reflectie begeleider
Creativiteit	Foto 1: Deelnemers komen aan en beginnen spontaan iets te bouwen met wat op tafel ligt Foto 5-6: "Je mag je blad in 4 delen en in 1 ervan een ontwerp tekenen", "In de andere 3 vakken teken je hetzelfde object, maar het moet er volledig anders uitzien" Foto 9: Deelnemers krijgen 3x 1 minuut de tijd om een ontwerp te maken dat anders is dan de anderen Foto 11: Deelnemer leggen ontwerpen samen om tot 1 eindontwerp te komen Foto 13: Deelnemers kiezen zelf de onderdelen voor hun ontwerpen en moeten nadenken welk afval ze	Foto 1: niet voorbereid, …	3	- Oplossingen bedenken om kunstwerken zonder lijm te maken - Meerdere ontwerpen maken van de kunstwerken - Verschillende namen bedenken voor awards - Voorbereidingen bedenken voor laatste sessie

8

Evaluation form 3

Foto	Type	Observatie sessies	Voorbereiding	Score (0-3)	Reflectie begeleider
	KD	Deelnemers stellen gerichte vragen over de opstelling in de klas elektriciteit	Er was een rondleiding op de school voorzien.	1	Er werden een paar vragen gesteld maar niet heel veel.
	CREA	Deelnemers proberen zelf podiumlichten te bedienen	Niet voorzien, een leerkracht die in het lokaal bezig was liet de deelnemers spontaan iets uitproberen.	2	De deelnemers leken oprecht geïnteresseerd en mochten alle knopjes uitproberen.
	CREA	Deelnemers zetten zelf het voetstuk voor hun award in elkaar	Het voetstuk was op voorhand gemaakt met de lasercutter van de school.	1	Ze hadden een stappenplan om het in elkaar te steken en moesten zelf niet creatief denken.
	SMN	Deelnemer vraagt hulp aan begeleider om koperdraad aan elkaar vast te maken	Deelnemers worden verwacht zelfstandig te werken maar krijgen hulp wanneer ze dit vragen.	3	B. kan aangeven dat ze hulp nodig heeft. Ze heeft ook nog extra ideeën gekregen van Reinout.
	SMN COMM	Deelnemer vraagt hulp aan begeleider om een gat te boren in de voet van hun award	Deelnemers worden verwacht zelfstandig te werken maar krijgen	2	Deelnemers kunnen aangeven dat ze hulp nodig hebben.

9

Conclusion

- Creativity: Easiest to incorporate
- Communication and collaboration: very individual qualities, some kids score low, others high
- Critical thinking: Hard to work on, mostly down to preparation

10