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

Everything starts with questions...

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

Everything starts with questions...

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.

Everything starts with questions...

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!

My inspiration for carrying out the research was a workshop conducted by Małgorzata Szymura during the II Congress of Physics Teachers (Kraków, 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

Everything starts with questions...

"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-skarbowi/ulotanka-z-woda-do-gory-dnem/

Everything starts with questions...

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!)

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

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 wlać wodę do szkła?
Czy można wlać wodę gazowaną?

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?

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 matter?

Czy gdy szalka lub naczynie będzie miało przekłute dno to czy zjawisko zadziała tak samo

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

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

Dlaczego kartka nie opada?
Dlaczego kartka nie spada?

Why doesn't the paper sheet fall off?

Dlaczego powietrze nie wydostaje samej kartki?

What forces have an effect on the paper sheet?

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

W jaki sposób woda zmienia się kartka?

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 poziom zbieralności wody w słoiku?

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

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

Jak poziom zbieralności wody od średnicy słoika?

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

Jak użycie wody mineralnej zmieni przebieg doświadczenia?

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

Jak poziom zbieralności wody od średnicy słoiczka?

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

Jak poziom zbieralności wody od rodzaju cieczy?

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

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

Jak zależy zjawisko od grubości kartki?
Jak zależy zjawisko od ilości wody w słoiku?
Jak zależy zjawisko od średnicy słoika?

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?

A co jeśli zamiast wody mineralnej nie gazowanej.

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

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 proces...

Everything starts with questions...

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!

The Pythagorean theorem

METKA KLINC
Vojnik Primary School, Slovenia

By exploring my own practice, I was interested to see whether students would be able to derive the Pythagorean theorem fully independently and apply it to problem situations in everyday life when studying the given problems.
I did this by having the pupils trace squares on the sides of different triangles, calculate the areas of the squares and explore the relationship between the areas of the squares, and then apply this knowledge to everyday life.

WHAT WAS I WONDERING?

1. Will they find the relationship between the areas of the squares over the sides in a right triangle?

2. Will they independently discover examples of Pythagorean triples?

3. Will they be able to apply the Pythagorean theorem to everyday life tasks with complete independence?

GUIDELINES

The work was successful, as the pupils themselves discovered new insights.

They found the first task, making a right-angled triangle out of different shapes, very challenging. They needed to be guided, as they did not observe the individual components carefully.

They quickly derived the Pythagorean theorem and found that it holds only in a right-angled triangle.

When testing the validity of the Pythagorean theorem for an arbitrary choice of side lengths of a right-angled triangle, they were not precise enough in their measurements and problems arose.

They found it very interesting that they could apply the Pythagorean theorem to other figures if they could only find a right-angled triangle inside them.

STEP 1
Making a right triangle with different shapes. Work in groups.

STEP 2
Each group measures the lengths of the sides of the resulting right triangle.They plan the squares over the sides of the different triangles and calculate their areas.

STUDENT ACTIVITIES

STEP 3
Groups reporting calculated data. Discuss the results obtainedand learn about new findings.

STEP 4
They look for applications of the Pythagorean theorem in different characters and solve problems from everyday life.

CONCLUSION

1. The teacher's job was:

- preparing the jigsaw,
- preparing research problems to study,
- naming the concepts in the students' new findings, and guiding them to explore the new problem.

2. The pupils were very motivated to work. They were interested in the research content and found the Pythagorean triples particularly interesting.

3. They were enthusiastic about solving problem situations from everyday life. 4. The research could be extended to the application of the Pythagorean theorem to solids.

LAYING TILES – AREA OF A SHAPE

Vesna Kotnik, prof.
OŠ Vojnik

Of all the topics in mathematics, geometry is the biggest challenge in the 5th grade. In the first part of the school year, we review and reinforce the basic knowledge of shapes and solids. We emphasize the differences, correct the naming of sides, edges, and vertices. We observe concrete objects, trace them, and color them. Then we build upon this knowledge. We can go around a solid, pour something into it, walk around the school playground, and "lay" tiles in the classroom.

I WAS WONDERING:

How successful and accurate will the students be?
What will the transition from perimeter to area be like?

Will they formulate a good research question?
How will they prove their predictions?

How well did they understand the concept of area and the use of non-standard units?

MY IP

Observation of students throughout all stages.
Generated products - squares, animals, proofs.
Self-analysis of students in the form of a worksheet.

WHAT WERE THE STUDENTS DOING?

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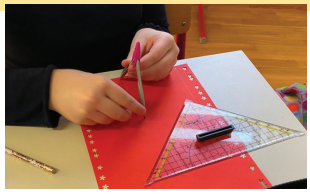
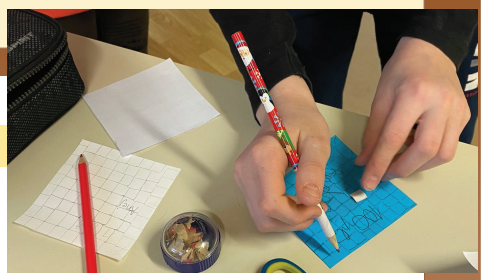
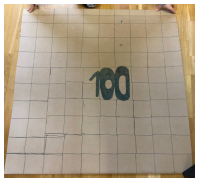
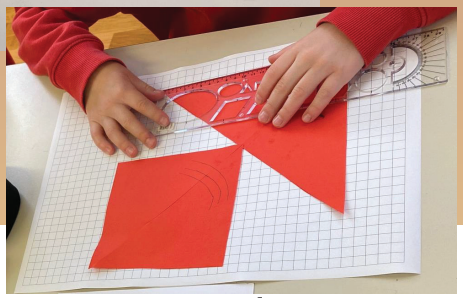


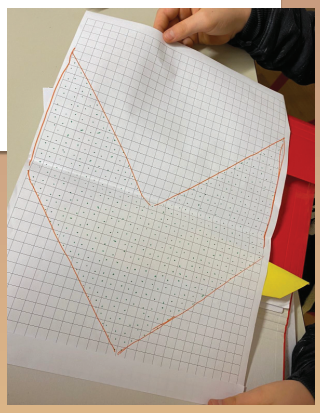




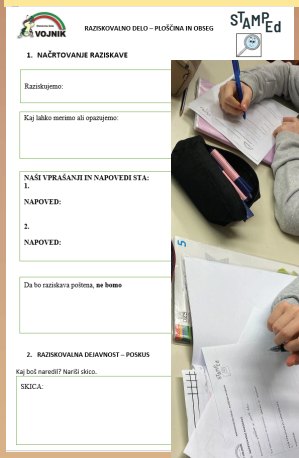
2. LESSON: FROM SQUARE TO ANIMAL ...

3. LESSON: WHAT HAPPENED TO THE PERIMETER AND AREA?





4. SELF-ANALYSIS


VOJNIK RAZISKOVALNO DELO – PLOŠČINA IN OBSEG STAMPED

1. NAČRTOVANJE RAZISKAVE

Raziskujemo:

Kaj lahko merimo ali opazujemo:

NAŠI VPRAŠANJI IN NAPOVEDI STA:
1.
NAPOVED:
2.
NAPOVED:

Da bo raziskava poštena, **ne bomo**

2. RAZISKOVALNA DEJAVNOST – POSKUS

Kaj boš naredil? Nariši skico.

SKICA:

I FOUND OUT ...

... that the students were:

- successful in proving their predictions, demonstrating their prior understanding of determining the perimeter of a shape.
- partially successful in drawing and tracing squares, as they were not very accurate.
- highly successful in formulating research questions.
- successful in selecting the appropriate method for proving their predictions.
- in their self-analysis, they showed a good understanding of the concept of area and the use of non-standard units up to this point.

CONCLUSION:

Through exploring my own practice, I wanted to test how successfully the students would grasp the concept of area using the method of inquiry and to what extent they would connect area with the perimeter of a shape. I found that the previous lessons on geometric figures and solids paid off, as the transfer of knowledge from the 4th grade was very weak. The work was initially partially guided, but the students eventually completed the tasks independently. It became evident that most of them were quite inaccurate. Some struggled without guidance, but their classmates encouraged and supported them.
During the assessment of their knowledge, it was later revealed that the students remembered the activity well and had a better understanding of the concept of area compared to previous years.
During the next meeting of our school's vertical team, I will bring attention to this activity, as I am interested in seeing how they will transfer this knowledge to the higher grade levels.

0. BRAINSTORM

Osnovna šola VOJNIK
Prušnikova 14, 3212 Vojnik
Univerza v Ljubljani Pedagoška fakulteta

GEOMETRIC SOLUTION OF MATHEMATICAL PROBLEMS

Urška Krajnc
Osnovna šola Radlje ob Dravi

During remote learning, students' geometric understanding developed very poorly. After two years of various limitations, I noticed that the majority of seventh-grade students lacked adequate geometric understanding of fractions. Students faced significant difficulties even when solving simpler problems, and not a single student was able to correctly solve more challenging tasks. Therefore, I decided to systematically develop appropriate geometric understanding among students through the geometric solution of various mathematical problems, both easier and more difficult ones.

I WAS INTERESTED IN:

Will students' geometric representations of fractions improve?
Will students be more successful in solving maths problems?
Will students' knowledge improve?

MY RESEARCH PLAN

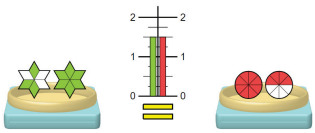
Strengthening fraction representations through the use of models and interactive exercises.
Solving simple word problems in pairs:

- Drawing a picture.
- Writing down the corresponding calculations.
- Presenting the results.

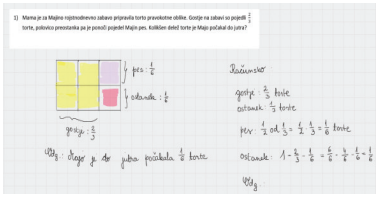
Individually solving various word problems and real-life tasks.
Comparing students' achievements before and after the activity.
Comparing the achievements of students from the experimental and control groups.

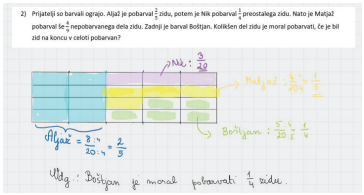
ABOUT THE ACTIVITY

Students initially strengthened their understanding of fractions through the use of models and interactive exercises.



Then, students worked in pairs to solve simple word problems by drawing the appropriate picture of fractional. They also wrote down the corresponding calculations and presented their solutions to their classmates.In continuation, they individually tackled more challenging geometric problems. The activity took place during evry class hour of math, lasting approximately 5-10 minutes, for about 3 weeks.





COLLECTED DATA

With the mentioned activity, students developed their understanding of fractions. They learned geometric problem-solving in word problems, and this strategy was more frequently used by academically weaker students.
Initially, some students struggled with geometric problem-solving as they couldn't draw appropriate pictures. However, with the help of the teacher, all students were successful in this aspect.
Before the activity, most students couldn't solve word problems, but after the activity, they were better in problem-solving.
I found that students' geometric representations of fractions improved, and their understanding of word problems involving fractions also improved.
I compared the achievements of the experimental group (7.a) with the achievements of other students. I found that the experimental group performed 10 % better in solving word problems compared to the other students.

CONCLUSION

I have realized that different strategies for solving word problems significantly impact the understanding of the subject matter and the success of individual students. I found that geometric problem-solving particularly helps academically weaker students achieve better learning outcomes.
Through this research, I have confirmed my hypothesis that geometric problem-solving is a highly effective strategy that aids students in understanding both simpler and more challenging tasks.
I will continue to utilize this approach in my teaching practice in the future.

PLACEMENT OF AN OBJECT IN SPACE USING BISECTORS

Urška Krajnc
Osnovna šola Radlje ob Dravi

Pupils often struggle to understand and relate different mathematical topics to concrete life situations. Knowledge often remains at a theoretical level, as pupils are unable to apply what they have learned to real-life problems. They also have difficulties in transferring their knowledge to other subject areas. This problem is present in all pupils, but is more pronounced in those who are weaker academically. In order to improve understanding and, consequently, knowledge for all pupils, I include a variety of activities in the classroom to help pupils to put themselves in a concrete life situation.

I WAS INTERESTED IN:

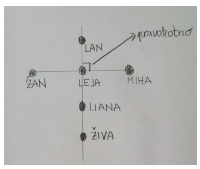
How successful will students be in solving a concrete problem from everyday life?
How successful will pupils be in transferring knowledge to other subject areas?
Will pupils' understanding improve?
Will pupils' knowledge improve?

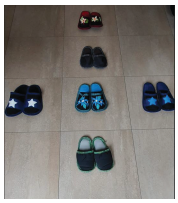
MY RESEARCH PLAN

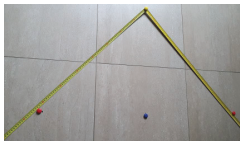
Group problem-solving in everyday life.
Individual verification of correctness of findings by measurement.
Drawing a sketch, recording findings.
Constructing the symmetry of a line.
Individual problem solving in everyday life and other subject areas.
Comparison of pupils' achievements in the treatment and control groups.

ABOUT THE ACTIVITY

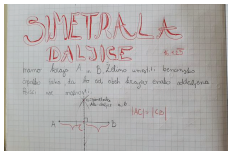
The students had to position themselves in the class so that they were at the same distance from two classmates at the same time. Then they checked the correctness of their layout by measuring and drawing a sketch. They worked in groups to find out the properties of a symmetrical line.







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



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 pupils immediately knew how to position themselves in space so that they were equidistant from two classmates at the same time. The other pupils also quickly worked out how to position themselves correctly. Only after checking by measuring did all the pupils believe that all the points on the symmetry line were equidistant from the two places on the line. The pupils 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.
The pupils 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 pupils solved this problem successfully. The transfer of knowledge to a concrete situation (locating a swing on a map) was not a problem for the pupils.
I also compared the performance of the pupils in the experimental group (7a) with the control group (7c) in solving the task from this content and found that the pupils in the experimental group scored 20% better than the pupils in the control group.

CONCLUSION

I realised that all the pupils are more active and, above all, much more motivated to do their school work. I was surprised that at the beginning only two pupils 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 pupils were very successful in the task of placing the swing in space.
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).

MODELLING ROUND BODIES

Miran Kučer
OŠ Ljudski vrt Ptuj

For my research I was observing the 9th grade students during a lecture on round geometric bodies. My research question was: What role does experiential learning and practical experience have in mathematics? The students were trying to make round bodies based on the net shape they drew in the beginning of the lecture. They gained new knowledge through cooperative work and their active engagement.

My motivation for research

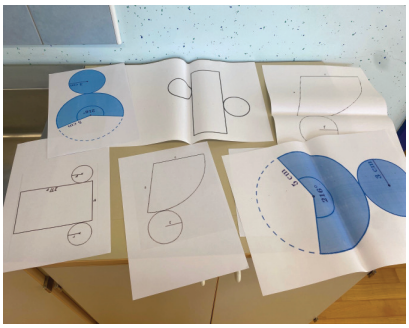
I notice every year that students falsely draw the net of the cone as a triangle instead of a circular segment. I was interested to see if using the method of experiential learning in mathematics will make the abstract knowledge of geometrics easier and more manageable for the students.

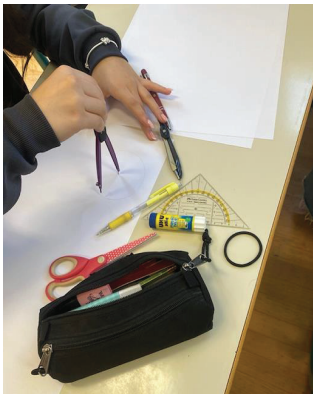
My research plan

I asked the students to draw nets of round geometric bodies. Then I asked the students to make the bodies in groups. I was writing down the troubles they were reporting. Then I gave them some tips and observed how they will use given information. At the end we compared initial sketches of the nets with the correct ones and resolved their cognitive conflict. I concluded that experiential learning is very useful in geometrics and confirmed my hypothesis by also asking the students what they thought of the lecture.

Student activity

The students had the task of sketching the nets of round bodies. Then I gave them materials and asked to make the models of round bodies. They were figuring out what is the correct net shape. They came to their conclusions by trial end error and my help. They reported about their experience and findings in groups by selecting a reporter.





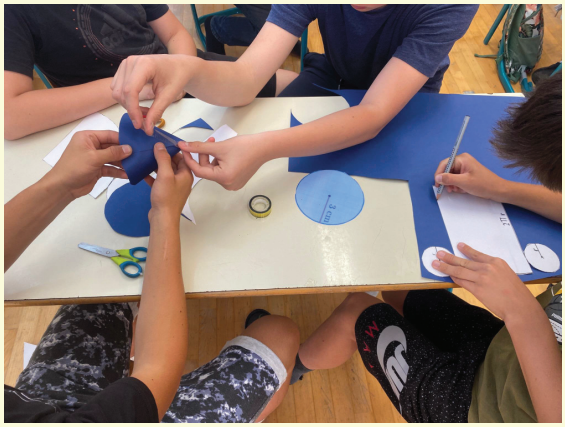
My findings

- The students active role helps them understand the content better.

- Experiential learning helps the students to imagine the abstract geometrical concepts.

- Students are more engaged and motivated when they cooperate with eachother.

- Students gain more wholesome knowledge when we show them how mathemathics is present in their everyday life.



Conclusion

I found that using the methods of experiential learning in mathematics is very useful for students because it allows them to transform abstract knowledge into a more understandable form. My hypothesis is that knowledge acquired in such active way is more permanent. It would be interesting to compare the results of my lecture with a test group that had a lecture on the same topic, but by using a classical ex-cathedra method.

OSNOVNA ŠOLA LJUDSKI VRT PTUJ
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Final conference of the Erasmus+ project Supporting Transitions Across Math and Physics Education (STAMPEd), Ljubljana, June 2023

Univerza v Ljubljani
Pedagoška fakulteta

Where in Asia would you live?

Ana Lavre
Primary School Vojnik

Students researched which part of Asia would be the most livable. I wanted the pupils to have the opportunity to do a short piece of research in a group without much help from the teacher. They were researching on their own, connecting facts they already knew, working in a group, being active, having the opportunity to learn in a slightly different way. During the work I observed the dynamics in the groups, the way they prepared for the work, the workflow and then the preparation for the presentations. In the final presentations, the students themselves came to the conclusion that the choice of an area to live in is very subjective and does not depend only on the factors studied.

1. Motivation: What were my aims?

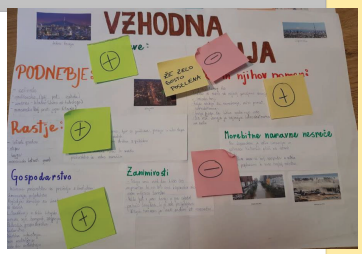
→ to see if students would be able to relate prior knowledge, draw conclusions and then synthesise.

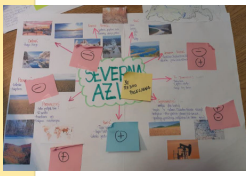
→ If the students will be more active during the lessons.

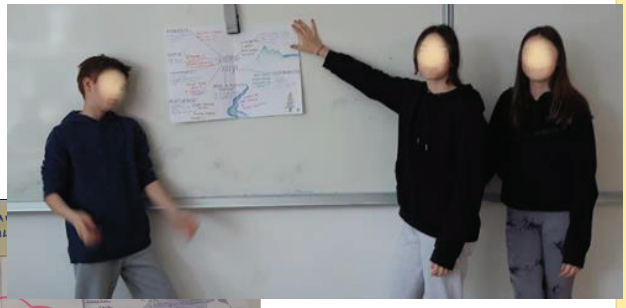
→ how would they work together (finding new data, coordination of work, making a good synthesis).

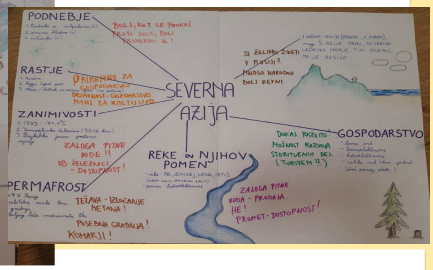
They presented their findings to the rest of their classmates and tried to convince them, that their part of Asia is the best for potential settlement. They were also asked to give reasons why.

2 Pupils' activity









Data and results

NO problems recalling knowledge from previous lessons,
finding correlations between, for example, relief and habitability, or climate and habitability.

DIFFICULTIES finding information outside the notebook and textbook,
what to put into a search engine,
not being satisfied with the first hit on Google,
extracting the relevant content,
being critical.
What to write on posters, what is relevant, how to make a poster.

The findings: if we had known nothing about Asia, we would have chosen North Asia to live in. It was presented as a future destination, with a flat terrain, plenty of clean drinking water, a climate is not an attractive factor, but an area that is currently sparsely populated and offers many opportunities for the development of different economic sectors, recreation, and a peaceful life.

I can conclude that students enjoyed these three lessons, they were very active, reviewed what they had already learned and learned something new. They were also forced to work together, which is proving to be an increasingly difficult task.

I think our survey was a success and I am sure that we will do another one this year, perhaps with a more open topic, where they will be forced to find out more information on their own and with less of the knowledge given to them in the previous lessons.

Osnovna šola VOJNIK
Prušnikova 14, 3212 Vojnik

ANGLES IN A TRIANGLE

Vesna Lindič
Osnovna šola Tončke Čeč Trbovlje

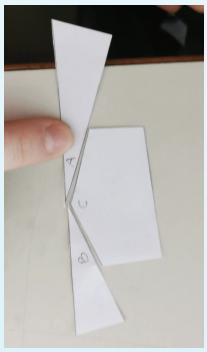
Find the rule for the sum of the interior angles of a triangle by drawing, cuting, tearing or folding.

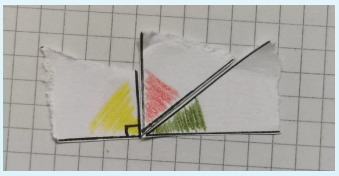
Questions:

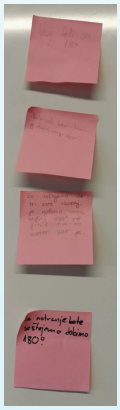
- How successful will the students be in finding the properties?
- How well will students work together?

Activities:

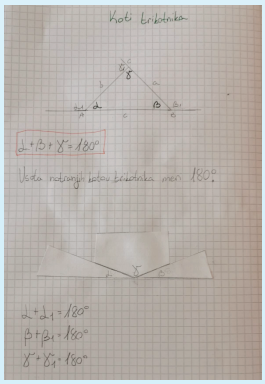
- heterogeneous groups with 4 members,
- each group drew acute triangle, obtuse triangle and right-angled triangle,
- triangles were cut out and folded or thorn, only measuring was forbidden,
- pupils checked that the rule applies to all different triangles,

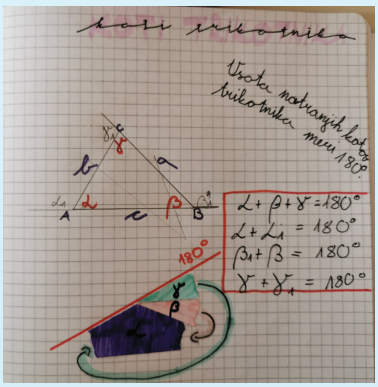






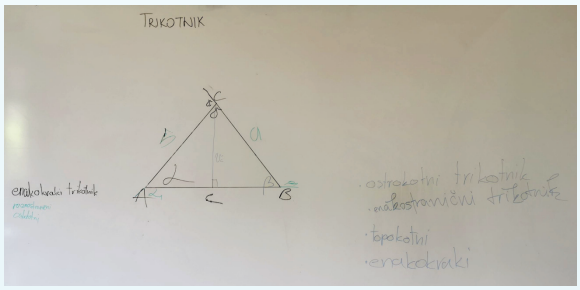
- the rule was written on the sticky note and stuck on the board,
- we formulated the rule in notebook and solved calculation example.





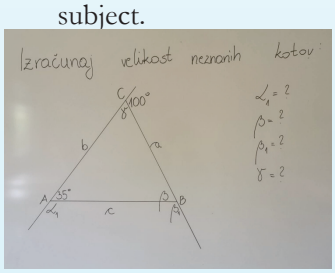
Start of the lesson:

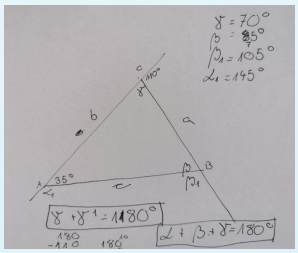
- brainstorming,
- a scale acute triangle drawn on the board,
- pupils wrote everything they alread know.

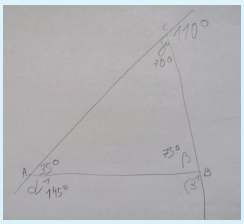


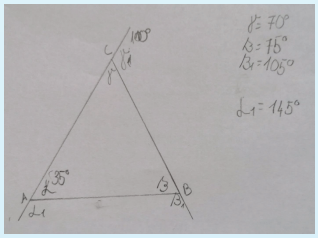
Monitoring pupils' work:

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

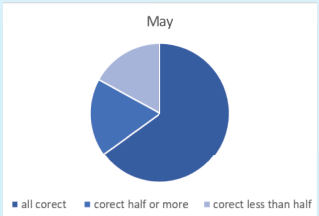


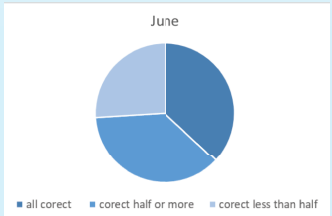






Results:





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.

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

Create lesson plans.

Working with ticking off when students have done something.

Open up a decibel meter on the computer.

Work with attitude points.

Activate pupils to especially work in class so that they don't have to do a lot (or anything) at home.

Question?
Re-read the theory, watch a video, ask for help from each other and only then ask the teacher.

Let similar exercises as the additional ones return on test.

Provide numerical solutions.

Make two tests with a little difference.

On tests, check their lesson plans.

Post videos of the theory on the digital learning platform.

Denis McCarthy
Hazelwood College, Dromcollogher

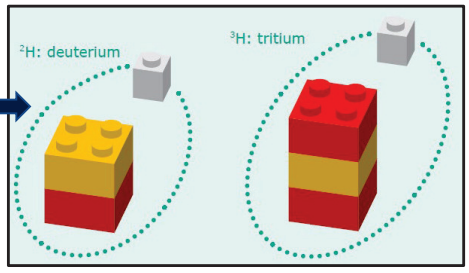
A model-based approach to give a deeper understanding of aspects of atomic and particle physics

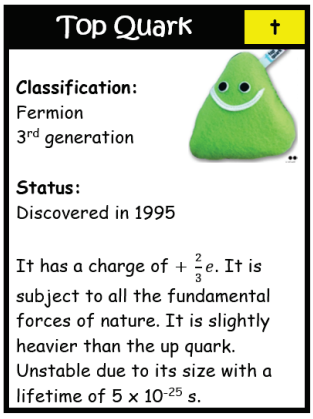
The Challenge

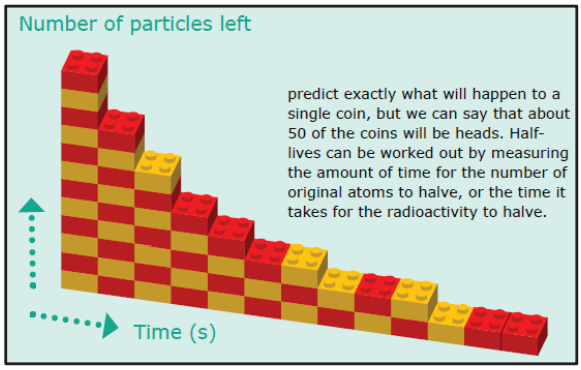
The lack of relevant experimental work in the areas of atomic and particle physics contrasts with other areas of the leaving cert physics course. This approach aims to provide interactive moments for pairs of students to inquire about quite theoretical material

Topics covered

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

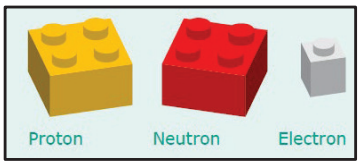


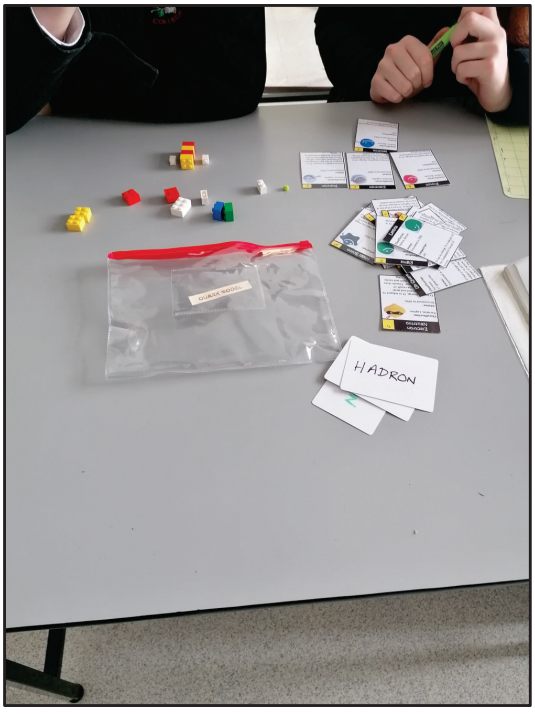




Methodology

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





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

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.

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

Larissa O'Neill
Kildare Town Community School

How does Peer Feedback Effect Higher Academic Achieving Students in Maths?

Hypothesis

Students who are "underachieving" at Maths benefit greatly from feedback but find it difficult to give feedback to "over-achieving" students in Maths, hence limiting the over-achieving students' benefits from Peer Feedback.

Context

Class: 2nd Year (13-15 years) OL Maths
Topics Covered: Financial Maths, Area.
Class Activity: Students were given a task and a feedback sheet, to give peer feedback to another person in their group, three different tasks.

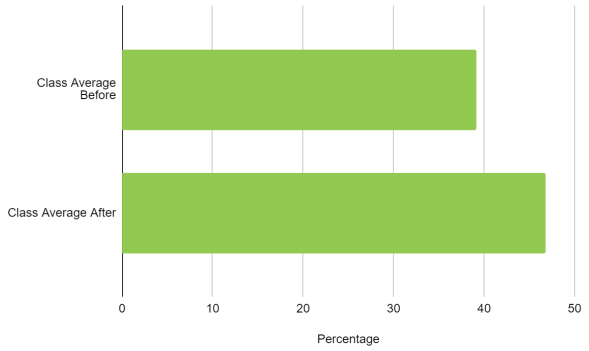
Data Collection

- The average result of each student of 3 tests "pre-feedback" was taken.
- The overall class average "pre- peer feedback" and "post peer-feedback".
- The average result of each student over three tests "post-feedback".

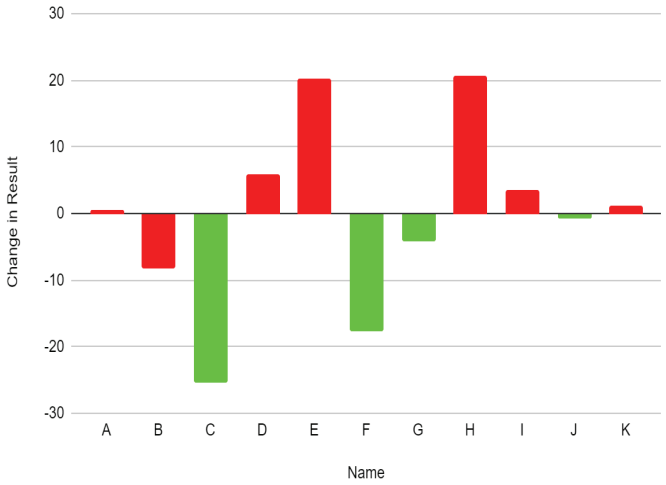
Findings

- Students whose results were previously below 50% benefitted greatly in this class from feedback, with the average gain in percentage being 7.13%.
- The overall class average improved by 7.68%.
- Students whose results were previously above 50%, their result decreased by an average of 9.64%.

Results



Graph showing the increase of the over-all class average percentage "post- feedback".



This graph shows the Change in Average percentage from "Pre-Feedback" Tests to "Post Feedback tests.

Green: Students' average pre-feedback were above 50%.
Red: Students average pre-feedback were below 50%.

Conclusion

Peer feedback is of great benefit to a lot of students, particularly those who find Maths difficult. However, students "under-achieving" in Maths, don't seem to have a deep enough understanding of the topic to give feedback to those who do, hence limiting the over-achieving students' benefits from peer feedback. The tasks also took up a lot of time during class, and some students deemed it "a waste of time". Students' quality of feedback improved during this experiment. This begs the question, if there was a culture of feedback in a school, would peer feedback be more beneficial to **all** students?

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Grant agreement no. 2020-1-IE01-KA201-066069

CIRCUMFERENCE AND AREA

Jasmina Petek Pelcl
OŠ Ljudski vrt Ptuj

With the pupils of the 7th b and 8th a grades, we repeated the circumferences and areas with the help of tangram. The pupils first had to measure the data for the square, parallelogram and triangles. Then they had to calculate the circumference and area of these figures. They had to investigate the circumference and area of characters, if they were assembled from all seven parts of a tangram. They found that the area of all the assembled characters is always the same when all the pieces of the jigsaw are used, but the circumference changes. 8th graders were more successful in identifying this pattern.

WHAT WAS I INTERESTED IN RESEARCH?

How will pupils be successful in solving tasks?

OWN PRACTISE RESEARCH PLANE

- dividing pupils into a heterogeneous group,
- observing pupils when solving task,
- data collection with study sheets,
- examination of study sheets and data analysis

PUPILS ACTIVITY

1. A RESEARCH QUESTION

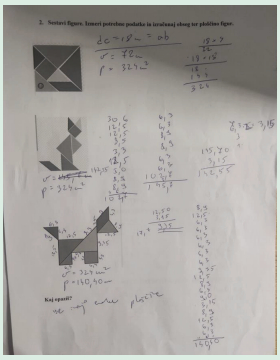
What is the circumference and area of the assembled figures if all 7 pieces of the jigsaw are used?

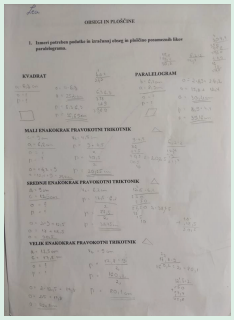
2. PUPILS ACTIVITY

- using a tangram jigsaw
- measurement of the necessary data
- calculation of circumferences and areas

3. REPORTING

Pupils report their solutions in groups.





RESEARCH RESULTS

RESEARCH ACTIVITY	7. B – 26 pupils	8. A – 16 pupils
Measurements	Pupils in the 7th grade had more problems with measuring and writing out data. Learning weak pupils did not know what they had to measure in order to calculate the circumference and area	
Calculating the circumference and area of characters	They knew how to calculate the circumference and area of a square and a parallelogram. 7th grade pupils had problems with triangle and trapezoid. 8th graders had problems calculating the area of a trapezoid.	
Circumference and area of composite characters	7th graders had problems calculating the circumference and area of compound figures. The 8th graders quickly realized that all compound figures have the same area.	

CONCLUSION

Pupils in both classes repeated the circumferences and areas of the characters. The tasks were not too difficult and attracted them to solve them. The pupils liked the way of work very much. It was different and interesting. They found that the area of all the assembled characters is always the same when all the pieces of the jigsaw are used, but the circumference changes. In addition to discovering mathematical laws, the tangram jigsaw allows pupils to develop manual skills, attention, patience and observation.

Literature:
Željko, L., Verbinc, A., Vatovec, M. in Štefančič, M. (2019). Matematika 7: Učbenik za matematiko v 7. razredu osnovne šole. Ljubljana: Mladinska knjiga Založba, d.d.

WHAT WILL THE PYTHAGOREAN THEOREM DO FOR ME?

ŠPELA POVŠE PISTOTNIK
GIMNAZIJA, ELEKTRO IN POMORSKA ŠOLA PIRAN

When planning the activities for the project week "What can the Ancient Greeks teach me?", I wanted to prepare a lesson that would include something that the students had already learnt in primary school, but that still had enough unknown that we could explore together.
The obvious choice was the **Pythagorean theorem**.
The activity had two main aims: to make students aware of the usefulness of the theorem and the importance of proof in mathematics.

WHAT WAS I INTERESTED IN?

- Can students independently represent the geometric meaning of the Pythagorean Theorem?
- How proficient are the students in applying the Pythagorean Theorem?
- Can pupils apply the Pythagorean theorem correctly in problems describing situations in everyday life?
- Can students consider the basic steps of a proof of the Pythagorean Theorem?

RESEARCH PLAN AND OBSERVATION

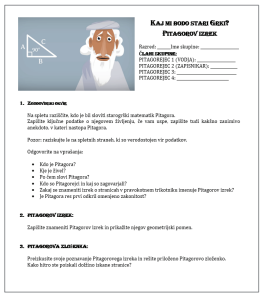
Data acquired with the help of the worksheet:

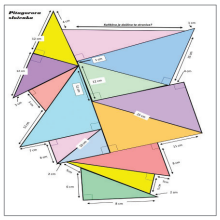
- skills in finding data,
- expressing quantities,
- translating everyday situations into mathematical notation,
- geometric representation of theorems,
- writing conclusions in proofs.

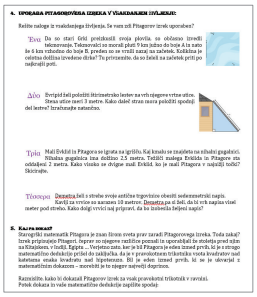
During the lesson itself, I observed students' active participation (independence, engagement, teamwork) using the observation tool.

ABOUT STUDENTS' ACTIVITIES

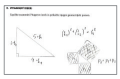
- Students' research question: What will the Pythagorean Theorem do for me?
- Groups of students tried out different activities related to the Pythagorean Theorem. They warmed up by finding interesting facts about Pythagoras, continued by writing down the Pythagorean theorem and presented its geometric meaning. To make it more interesting, they were then faced with a Pythagorean puzzle and the time pressure of who could solve it first. They then tackled problems from everyday life, using the Pythagorean theorem to help them on their way to a solution. Finally, the students tried to prove the theorem.
- The activity was guided by a worksheet on which students wrote down their solutions, conclusions and proof steps.







COLLECTED DATA AND FINDINGS



- Most groups successfully presented the geometric meaning of the theorem.
- The ability to express quantities from the Pythagorean theorem was tested with the Pythagorean folding. Here, for the first time during the lesson, the differences between the groups of students became apparent. The class divided into homogeneous groups had more difficulties than the class with heterogeneous groups. The weaker groups had difficulty getting started on the folding and were outpaced in time by stronger groups.
- When applying the Pythagorean theorem to everyday life problems, the biggest obstacle for students was how to exactly write the situation in mathematical language. Again, there was a big difference in the stronger groups who solved the problems completely independently, while the weaker groups needed some guidance to reach the solution. It also showed that students read the instructions superficially.
- The principle of proof in mathematics is quite alien to first year students. Therefore, the aim of the activity was mainly to discuss the importance of this mathematical principle. Some groups, with the help of the handout (a cut-out square and four right-angled triangles with a hypotenuse of the length of the side of the square), finally managed to carry out the key steps of the (Euclidean) proof.

CONCLUSIONS

During the learning activity students managed to transfer their knowledge of the Pythagorean theorem to the tasks and deepen their understanding of the theorem. Even though most groups of students did not succeed in proving the Pythagorean Theorem, they started to consider the proof which was the point of the planned activity. It turned out that the heterogeneous groups were more successful in the activity than the homogeneous learning groups. In the future, I would like to take more time for the activity carried out, so that there is more room for students' independence and discussion about the importance of proof.

LIGHT AND SHADOWS

Nataša Škorjanc
OŠ Vojnik, Prušnikova 14, 3212 Vojnik

After learning lesson in class of Getting to know environment in third grade about light, we continued our lesson with exploring shadows. Students divided in groups were illuminating different objects and observing their shadows. I was interested in their team work skills, how will they use their knowledge about light and luminaires and how will they all participate in this experiment.

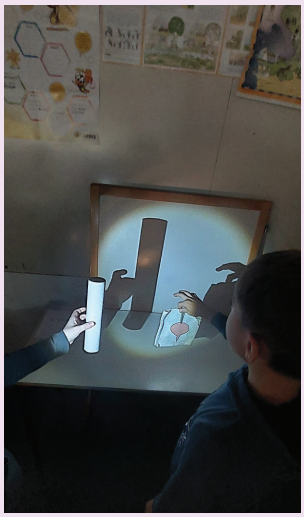
The purpose

How accurate will their answers be with learning through research method used?
What students already know about shadows?
How good are their team work skills?
Will all students be actively involved in research?
How will the "less learning" students follow this?
How will students connect their knowledge to other classes?
How will different roles be assigned in groups?

Own practice research plan:
- observation of students at work
- student guidance
- analysis of findings and conclusions
- insight usefulness

Student activity

List of activities:
- watching shadow show
- answering questionnarie
- analysis of answers
- forming groups and spreading worksheets
- looking for interesting topics that will further on be explored
- creating hypothesis
- choosing neccessary tools
- executing of experiment
- listing conclusions
- reporting and evaluation



Hypothesis:
- Which is the color of shadow?
- What happens if you move light closer to the object?
- Is shadow getting bigger or smaller? How?
- Is shadow behind object the same size as object?

Students were divided in random groups. They were illuminating different objects with flashlights. Objects were made out of different materials and had various shapes. Students were researching on their own and they were writing down their conclusions. At the end of the experiment they had to report.

NEW CHALLENGE: How to make a short shadow show?

Zbrani podatki in ugotovitve

Delo je potekalo v dobrem in aktivnem vzdušju. Izziv jim je bil zelo zanimiv, saj še niso navajeni dela v skupini, pa tudi samostojnega raziskovanja ne. Učenci so samostojno raziskovali. Poslušali so ideje drug drugega in sodelovali. Učenci, ki so učno šibkejši so se odlično vključili. Moj cilj je bil vzpodbuditi učence za samostojno raziskovanje, kar mi je tudi uspelo. Zelo so bili veseli takšnega načina dela.
Ugotovili so, da se senca lahko veča ali manjša, če premikamo svetilo in je predmet pri miru, lahko pa predmet približamo svetilki in se senca tudi spremeni. Ugotovili so, da je oblika sence za predmetom enaka obliki predmeta, lahko je pa večja ali manjša od predmeta.

Zaključek

Zelo sem bila zadovoljna s potekom učne ure in sodelovanjem vseh učencev. Učenci so bili zelo radovedni in zelo aktivni. Navedli so, da si želijo še več takšnih aktivnosti.
Z delom smo nadaljevali tudi pri slovenskem jeziku, kjer so učenci napisali krajšo zgodbico in jo nato uprizorili v senčnem gledališču. Senčne lutke za predstavo so izdelali pri likovni umetnosti.
V prihodnje bom pripravila še več aktivnih ur. Menim, da so učenci pri aktivnih oblikah pouka bolj motivirani za pridobiva nje znanja, izkušenj.

Viri: N.Grošelj, M. Ribič: Učbenik za spoznavanje okolja v tretjem razredu OŠ (Lili in Bine), Rokus Klett 2022
B. Walpole, J. Ferbar: zbirka Veselje z znanostjo SVETLOBA, Pomurska založba 1990