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Version: 1

Status: Final

Preparatory studies for students

Learn to Learn Preliminary Courses

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Summary

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1 Introduction

This Deliverable contains highlights and results of the local iterations from activity PR3-A4 “Preparatory studies for students: Learn to Learn”.

As collectively deliberated during CREAM Transnational Project Meeting in Athens of the 29th of November 2023, the “Learn to Learn” was reconfigured as a mini-CWL activity designed to give students as well as teachers a chance to see what the larger Pilot activities will entail, what kind of problems might emerge, and what king of recommendations could be drawn from these experience to help a smoother running of the Pilot projects.

2 Learn to Learn

Learning can be compared to a path that is steep and leads to the top of a mountain. First of all, we reach the mountain, then we look at it and raise our eyes towards the top, towards our goal. During the journey, we often look back at the valley, and we see where we've been and how far we've come. Sometimes we experience it as something pleasant, sometimes as something painful.

And it's the same with learning. Sometimes we find it very pleasant and rewarding, some other times we struggle to cope with it. But, after all, learning is a human activity, and that every individual will have to learn.

Although sometimes we think that we have already learned everything and that learning is over, the very next moment we realise that we still have so much to discover, and one that our learning journey has just begun.

In a classroom setting, this requires carefully-planned timing and a substantial understanding of the most common learning styles and methods, be the learning intentional or unintentional. This makes school work easier, more interesting and fun. Crucially, students will have more time to dedicate to their own interests and leisure activities.

The official and professional definition of learning is: “Learning is any change in behaviour, information, knowledge, understanding, attitudes, skills or abilities that are permanent and cannot be attributed to physical growth or development of inherited behavioural patterns" (UNESCO 1993). This definition expands the field of the content of learning and demarcates the concept of learning from the concept of physiological growth or development, which is at least in part hereditary. Learning takes place on the basis of experience, during the interaction between a person and his or her physical and social environment.

Factors that affect how humans learn can be broadly categorised as Intrinsic and Extrinsic, each affecting very specific areas and elements (Marentič Požarnik, 1976).

Intrinsic

- physiological: they originate from the student's physical condition, health and well-being. Learning performance is affected by contingent conditions of the organism, for example: excessive hunger, fatigue etc., as well as more permanent ones, like chronic illness.

- psychological: mental abilities, developmental level, structure and developed skills (calculation, verbal, memory...), study habits, skills and learning methods.

Extrinsic

- physical: these are main factors from the environment: lighting, noise, temperature, arrangement of learning aids and equipment of the learning space

- social or social: these originate from the student's narrower and wider social environments: family, school, one’s network of social connections, etc.

We cannot always draw a sharp line between intrinsic and extrinsic factors of successful learning, as they are closely intertwined. Therefore, an effective environment, one that influences the individual’s innate dispositions, development and experience, is important for academic success (Marentič Požarnik, 1976).

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2.1 Motivation

Acquiring knowledge is a challenge, like climbing an awe-inspiring, beautiful and majestic mountain.

We shouldn't tackle anything with a big spoon, and it's the same with learning. That's why it's better to work regularly. All our efforts, desires and goals reflect how motivated we are to achieve them. Motivation helps us to rationally use time and resources for education, to invest the necessary energy and effort in learning. A motivated person is ready to learn in a wide variety of situations, sometimes even in extremely unfavourable conditions.

Unfortunately, many school failures are caused by a lack of motivation. We consider learning motivation to be anything that provides the individual with impetus towards learning, directing and determining its intensity and duration. Learning motivation is the product of the interaction between the relatively permanent personality traits of the students and the characteristics of the learners' learning motivation.

As with any activity, learning also requires a certain level of excitement, tension or alertness in the organism. This should be neither too low nor too high.

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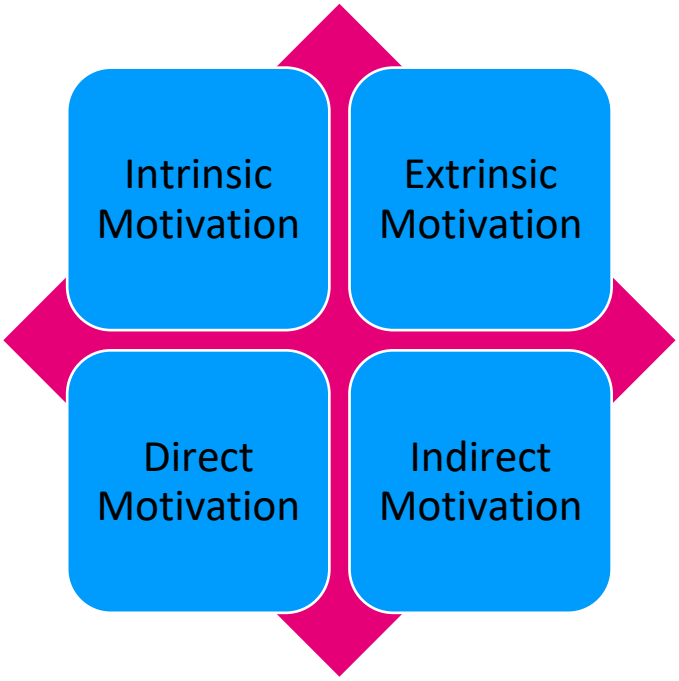
2.2 The building-blocks of Motivation

Motivation can be represented as a matrix of four interacting elements:

- Intrinsic motivational factors
- Extrinsic motivational factors
- Direct motivation
- Indirect motivation



2.2.1 Intrinsic motivational factors

In intrinsic motivation, the goal of the action in the activity itself, and the source of reinforcement is within us. Intrinsic motivation refers to learning for one's own reason, out of curiosity. It is also related to interests. As an indicator of intrinsic motivation, there is a strong immersion in an activity when we lose track of time and what is happening around us. A sign of

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intrinsic motivation is also continuing to engage in the activities that we learned at school after we already finished our formal education.

If we want to increase intrinsic motivation, it is necessary for the teacher to create an environment in which all students will have the opportunity to discover that effort they invested in learning enables them to achieve a sense of success. The amount of time and effort students need to put in to achieve success varies from student to student, but they all need the right approach to achieve success.

2.2.2 Extrinsic motivational factors

They are things, people, events and phenomena in the environment that an individual tries to approach or withdraw from. Such factors are praise and criticism.

Praise is generally more effective than criticism. In some cases, criticism also promotes success. Only highly intelligent individuals and people who are well adapted to the environment are receptive to criticism. However, criticism reduces academic success in above-average students, in students living in disordered home conditions, and especially in emotionally disturbed people. Criticism, when not constructive, can even make a student lose the joy of learning.

2.2.3 Indirect motivation

We talk about indirect motivation when students study to reach external goals, for example, a good grade, a reward promised by parents, a promotion at work, for fear of punishment or other unpleasant consequences, higher income, social prestige, etc.

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2.2.4 Direct motivation

We speak of direct motivation when the students are interested in the learning material. This motivation does not cling to external goals, such as various awards, good grades, standing in front of classmates, etc. Direct motivation is usually more effective and long-lasting.

Lack of interest in certain subjects is therefore the result of lacking knowledge. Initial effort leads to adequate knowledge, and with knowledge comes interest. Students must really delve into the learning material, think about problems, discuss them and, if possible, apply the knowledge in practice.

Learning successes increase commitment to learning, while failures decrease it. When we are struggling, it is always boring, tiring, as if it resisted us. Failures in school often cause severe aversion to learning subjects.

In addition, students should familiarise themselves with the learning outcomes, as knowing what the final results of one's effort will be can be a powerful incentive for learning (Drofenik, 2023).

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2.2 Learning styles

Anyone can learn to learn, even in a fun way, if they get to know themselves and the learning methods that suit them. It is easier to learn if we include more senses, that is, if the learning paths lead to memory through seeing, listening, touching, tasting and smelling (Marentič Požarnik, 2019).

Learning styles can be divided into different types: visual type, auditory and physical-motor type (Drofenik, 2023). Each type can be described via a set of parameters, listed as follows:

- Learning styles
- Reading
- Handwriting
- Memory
- Distraction
- Problem solving
- Inactivity
- New Situations
- Emotionality
- Communication
- Appearance
- Art

2.2.1 Visual type

Learning style: students learn by sight, by watching demonstrations.

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Reading: students like descriptions, sometimes stop reading and stare into the air, daydreaming. Intense concentration. He recognizes words by the shape of the letters, he relies on the shape of the words.

Handwriting: Good, especially if the person is young. Spacing and font size are fine; appearance and external appearance are important.

Memory: Remember faces, forget names; he writes things down, makes notes. Performances: Has live performances; thinks in pictures, visualises down to the details.

Distraction: Generally barely aware of distracting noises; he is distracted by visible clutter or movement.

Problem Solving: Prudent, plans ahead; organises thoughts by writing down; makes lists of problems.

Inactivity: Stare ahead; he draws little things, finds something to observe.

New Situations: Looks around, observes structures.

Emotionality: Kind of reserved, opens eyes when angry; cries easily, glows all over when happy; the expression of his face is a good mirror of his emotions.

Communication: Calm, does not speak for a long time, becomes impatient if it is necessary to listen for a long time; meticulously enters the interlocutor's speech of each word; describes without embellishment, uses words such as: see, look, etc.

Appearance: Groomed, extremely meticulous, loves order: occasionally decides not to change his appearance.

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Art: Music does not please him too much, he prefers visual art, he does not like verbal description of art, and visual stimuli can make a deep impression on him; he looks more at the details than at the whole artwork.

2.2.2 Auditory type

Learning style: Learns with verbal instructions given by others or self-directed.

Reading: Loves dialogues, theatrical plays, avoids long descriptions, does not perceive illustrations, often moves his lips or says what he reads to himself. He often chooses the phonetic approach; words are perceived by the sound they have when we hear them.

Handwriting: Has more problems in the beginning, tends to write easily.

Memory: Remember names, forget faces, remember things by auditory repetition.

Performances: He speaks in his mind, thoughts in noises and voices. Details are less important to him.

Distraction: He is easily distracted by noises.

Solving problems: Says problems, looks for solutions verbally; he talks to himself when solving.

Inactivity: Sings songs, talks to himself or others.

New Situations: Talks about it, Pros and Cons, and what needs to be done.

Emotionality: Screams when happy or when angry, gets verbally fired up, but cools down quickly; expresses his feelings verbally, even with

by changing the cadence, volume and pitch of the voice.

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Communication: Loves to listen, but can't wait to start talking to himself; his descriptions are long and often repetitive; likes to listen to himself and others talk; uses words like: listen, hear, etc.

Appearance: Conformity in dress is not so important, he knows how to justify his choice of clothes.

Art: Prefers music, dislikes visual arts, but is quick to talk about them; omits important details but understands the work as a whole; can develop speech links for all art forms.

2.2.3 Physical-motor type

Learning style: Learns by doing something, in which he is directly involved.

Reading: Prefers stories with fast action; moves when reading, not an avid reader.

Handwriting: Good at first, gets worse as space narrows; he is often weak in spelling, he writes a word to "feel" whether it is spelled correctly.

Memory: He remembers best something that was done and not if he saw or heard it.

Performances: Performances are not as important as images that are associated with movement.

Distraction: Does not pay attention to visual or auditory presentation; so, it seems easy to distract him.

Problem solving: Tackling problems physically; is impulsive; he often opts for solutions that require more activity.

Inactivity: Moves limbs, finds a reason to move, gestures.

New situations: Try things out; he touches them, feels them, uses them.

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Emotionality: Jumps for joy; hugs, tears and pulls when happy;

roars, jumps and kicks when angry, marches away; it is easy to tell his emotions from the expression of his body.

Communication: Likes to gesture when speaking; does not listen carefully; physically stands very close to the interlocutor when speaking or when listening; quickly loses interest in elaborate speech events; uses words like: get, take, etc.

Appearance: Well-kept, but soon becomes crumpled due to the described activities.

Art: Music pleases him through physical movement; he prefers sculptures, touching statues and paintings; at exhibitions, he stops only in front of works that can be physically experienced; he comments very little on each type of art

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	Visual type	Auditory type	Physical-motor type
Learning style	Learn by sight, watch demos	Learns with verbal instructions	Learn by doing, directly involved
Reading	Likes descriptions, intense concentration, recognize words by shape	Loves dialogues, avoids long descriptions, says what's read	Prefers action stories, moves when reading
Handwriting	Good handwriting, attentive to appearance	Initially difficult handwriting, later easy	Good at first, worsens with space narrowing
Memory	Remember faces, forget names, notes	Remember names, forget faces, auditory repetition	Remembers through physical action
Distraction	Distracted by visible clutter, movement	Easily distracted by noises	Not easily distracted by presentation
Problem Solving	Plans ahead, writes lists	Verbally solves problems, talks to self	Tackles problems physically, impulsive
Inactivity	Stares ahead, observes	Sings songs, talks	Moves limbs, gestures
New Situations	Observes structures	Talks about situations, pros/cons	Tries things out, touches
Emotionality	Reflects emotions on face	Expresses feelings verbally	Expresses through body language

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Communication	Describes without embellishment	Long, repetitive descriptions	Gestures when speaking, close proximity
Appearance	Meticulous grooming	Conformity less important	Well-kept but becomes crumpled
Art	Prefers visual art, details	Prefers music, understands whole artwork	Prefers sculptures, physical art

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2.3 Critical thinking

Critical thinking is the ability and willingness to evaluate claims and make objective judgments based on well-supported arguments. The ideal critical thinker is inquisitive, academically well-educated, trusts reason, is open-minded, flexible, honest in evaluation and in dealing with personal mistakes, prudent in judgement, ready to reconsider and precise in dealing with topics. Critical thinking does not mean blind acceptance of all acquired knowledge, but rather their appropriate evaluation. Critical thinking is an ability whose value is often not realised and which has a significant impact on performance in private and business life.

Due to the abundance of data available and easily accessible in the modern world, it is important to be able to distinguish between the essential and the less essential, and not to accept everything as absolute truth. Every piece of information provided must be thought through rationally, evaluated and tried to determine whether it is true. Such an approach is typical of critical thinking. With critical thinking, we consciously solve problems, unlike non-critical thinking, which is routine and follows established habits of thought (Cokan, 2011). The increasing complexity of demands and opportunities in the future will require even more developed critical thinking, which is already and will be even more essential for survival, success and competitiveness in the future.

Critical thinking skills can be taught as well as learned; if people learn these skills and use them appropriately, they become better thinkers. Better critical thinking results in:

A willingness to ask questions and explore

Critical thinkers constantly ask questions and problematise the material they are learning, explore unknown topics and their knowledge.

Definition of concepts and problems

Critical thinkers check the meanings of the terms used in a conversation, harmonise them with the interlocutor and thus avoid possible misunderstandings. They strive for clear and precise use of language and as much precision as possible in defining problems.

Awareness of variables

Critical thinkers are aware that for an individual event or phenomenon, there are various explanations that are more or less verified: many of them, although strongly present and well-established, are empirically unverified, i.e. not necessarily valid. They distinguish between facts and interpretations, beliefs and unfounded beliefs, and empirically based scientific explanations.

Analysis of assumptions and attitudes in individual conclusions

Critical thinkers pay attention to the beliefs that underlie individual conclusions, both their own and those of other people. They investigate and raise awareness of the unspoken, what is usually automatically assumed or which is automatically believed, and thematised, doubted.

Avoiding emotional closure

Critical thinkers distinguish the emotional aspect or commitment to an idea and being attached to it from a rational point of view, or the validity, the reality of the idea.

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Avoiding oversimplification

Critical thinkers are aware of the tendency to oversimplify, i.e. after seeing the world in black and white or generalising based on insufficient or unrepresentative information. They examine the relevance of claims and conclusions, evaluate them, assess their validity and avoid simplifications.

Allowing and considering different interpretations of events and phenomena

Critical thinkers are aware that an individual always interprets events from a certain perspective, based on more or less conscious assumptions. They know that it is possible to look at the same event (phenomenon) from different angles and that its explanation or interpretation is only one of the possible ones. They are aware of relativity and that thinking always takes place within a certain perspective.

Allowing vagueness, openness

To a greater extent, critical thinkers agree with vagueness, openness, ambiguity, complexity. To a greater extent, they accept situations in which there is no final answer at some point. They accept that at some point there is no final, complete explanation for a certain phenomenon (knowledge is never complete, final, absolute).

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Characteristics of Critical Thinking

Willingness to ask questions and explore

Definition of concepts and problems

Awareness of variables

Analysis of assumptions and attitudes in individual conclusions

Avoiding emotional closure

Avoiding oversimplification

Allowing and considering different interpretations of events and phenomena

Allowing vagueness, openness

3 Learn to Learn CWLs

Simply put, the idea of the Learn to Learn mini-CWL is using the CWL method and tools designed during PR2-A3 to set up a small-scale activity containing all the essentials of the aforementioned method. Students and teachers would then run the mini-CWL and use the experience as a training ground in preparation for the larger Pilot activities of Spring 2024.

The Learn to Learn activity also includes the documentation guidelines developed by Viteco in PR4-A1 and delivered earlier than originally planned, as deliberated during Athens' TPM of the 29th of November 2023.

The following pages contain information and insights from the four Learn to Learn mini-CWLs of CREAM, which were run by the following partners:

1. Edumotiva (Greece)
2. IEXs (Italy)
3. GRM Novo Mesto (Slovenia)
4. ZSO (Poland)

3.1 Greece

Between November and December 2023, the mini CWLs were implemented at three pilot schools under the supervision of EDUMOTIVA: the 2nd Primary School of Nea Erythraia, the 8th Primary School of Kifisia, and the 6th Primary School of Nea Filadelfeia. The program involved four classes of 12-year-old students and seven teachers.

3.1.1 Outline

The primary goal of our mini CWL, 'Fashionable Flowers,' was to establish a meaningful intersection between creative writing, environmental education, scientific inquiry, and programming. This STEAM approach motivated students to engage and creatively explore real-world problems, such as pollination, fostering a holistic understanding of diverse subjects. Additionally, the integration of critical thinking skills and computational skills enriched the learning experience, providing students with a well-rounded set of tools for problem-solving and innovation.

By participating in a project that combined creative expression, scientific exploration, and programming, students developed a range of skills, including creativity, critical thinking, technical proficiency, and empathy, preparing them for the complexities of the modern world. This approach aligns with our school's commitment to nurturing environmentally conscious citizens capable of adapting to a rapidly changing world.

The mini CWL was implemented into the national curriculum, as an eTwinning interdisciplinary activity during Skill Labs and Informatics classes, providing students with a collaborative platform to share their creative and scientific insights with peers from different parts of Europe. This cross-cultural exchange further enhances the project's impact, fostering a sense of global citizenship among our students. The initiative aligns with our participation in various European networks and STEM

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initiatives, such as the Eco-Schools, EU CodeWeek, and eTwinning school networks, reinforcing our dedication to fostering interconnected learning experiences.

3.1.2 Execution / Implementation

a) Activity Name: Fashionable flowers

b) Short description:

The teachers created an imaginary mystery story about flowers and bees. In teams, students read the story, answered comprehension questions, and expressed their understanding through creative illustrations. Following this, students formulated their hypotheses to solve the mystery. The teacher then provided accurate articles on the impact of flowers' colours and shapes, encouraging students to follow a scientific approach to support their hypotheses with facts. To assess their newfound knowledge, students participated in a fun online quiz prepared by the teachers. The concluding activity involved a Scratch coding project, where students applied coding and mathematical skills to design a flower garden using a single petal. For additional support, a step-by-step tutorial was made available to students seeking assistance.

c) Objective:

The activity aims to immerse students in an engaging activity, fostering creativity, critical thinking, computational thinking and environmental awareness. Through a series of interconnected tasks, students engage in imaginative storytelling, critical reading, artistic expression, hypothesis formulation, investigation, and Scratch coding.

d) Resources:

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- Worksheets with the story, the questions
- Worksheets to formulate the hypothesis
- Drawing materials
- Internet connection
- Resource articles on the impact of flowers' colours and shapes
- Computers and Tablets for the coding and quiz part
- Online Step-by-step tutorial for Scratch coding

All the resources above have been uploaded to our online collection "Fashionable Flowers": https://wakelet.com/wake/rYpIHLu-8J7WPSXeLbL_4

e) Duration: Four didactic hours

f) Activities:

Session 1:

The students were organised in teams of four to five. The teacher distributed the mystery story, guiding students to read and comprehend the story. After reading, students answered comprehension questions and creatively illustrated the story.

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Session 2:

The teacher explained briefly what hypotheses are and how important it is to investigate them scientifically using critical thinking. The students, in teams, discussed and debated before formulating their hypotheses. Each team presented in the plenary their conclusions.

Session 3:

The teacher presented accurate articles about the impact of flowers' colours and shapes on pollination. Each team investigated their hypotheses, refining them based on the provided information. In plenary, each team presented their new hypothesis and supported it based on the articles. Next, all students used their tablets to assess their knowledge online with a quiz specially created by teachers.

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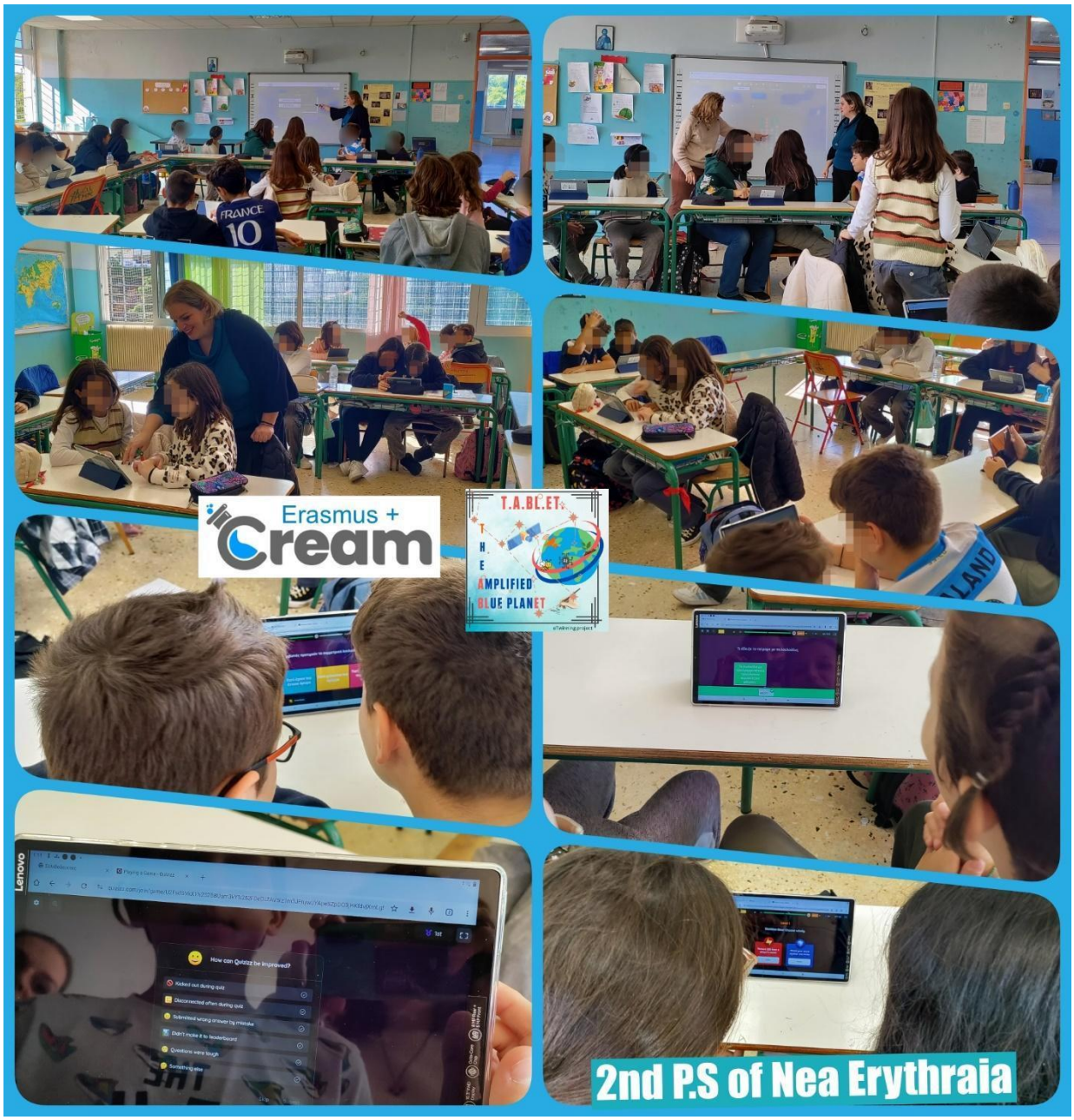

Session 4:

Students applied their coding and mathematical skills to design a flower garden on the Scratch platform. Starting with only a single petal, and using replication, rotation and repetition they created hundreds of flowers of different sizes, shapes, and colours. During the whole activity, students had the opportunity to seek help from the provided step-by-step tutorial.

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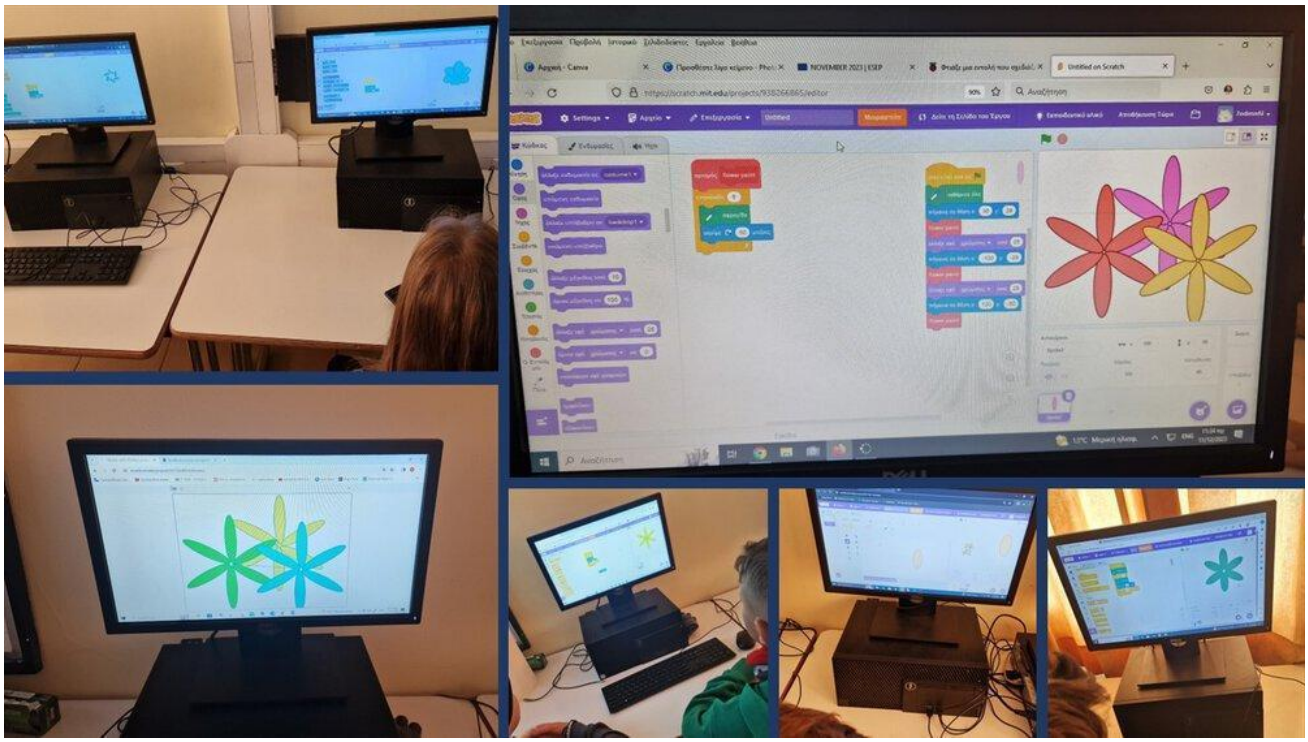

g) Assessment:

Assessment involves the comprehensive evaluation of various aspects throughout the learning process. Formative assessment techniques, such as teacher-led questions and observations, were consistently applied during the entire project. Additionally, the student's understanding was assessed through:

- written comprehension questions and creative illustrations
- the quality of the students' formulated hypotheses and their alignment with research
- an online quiz to test knowledge regarding the impact of flowers' colour and shapes on pollination.
- a Scratch coding project served as a practical demonstration of the application of coding and mathematical concepts.

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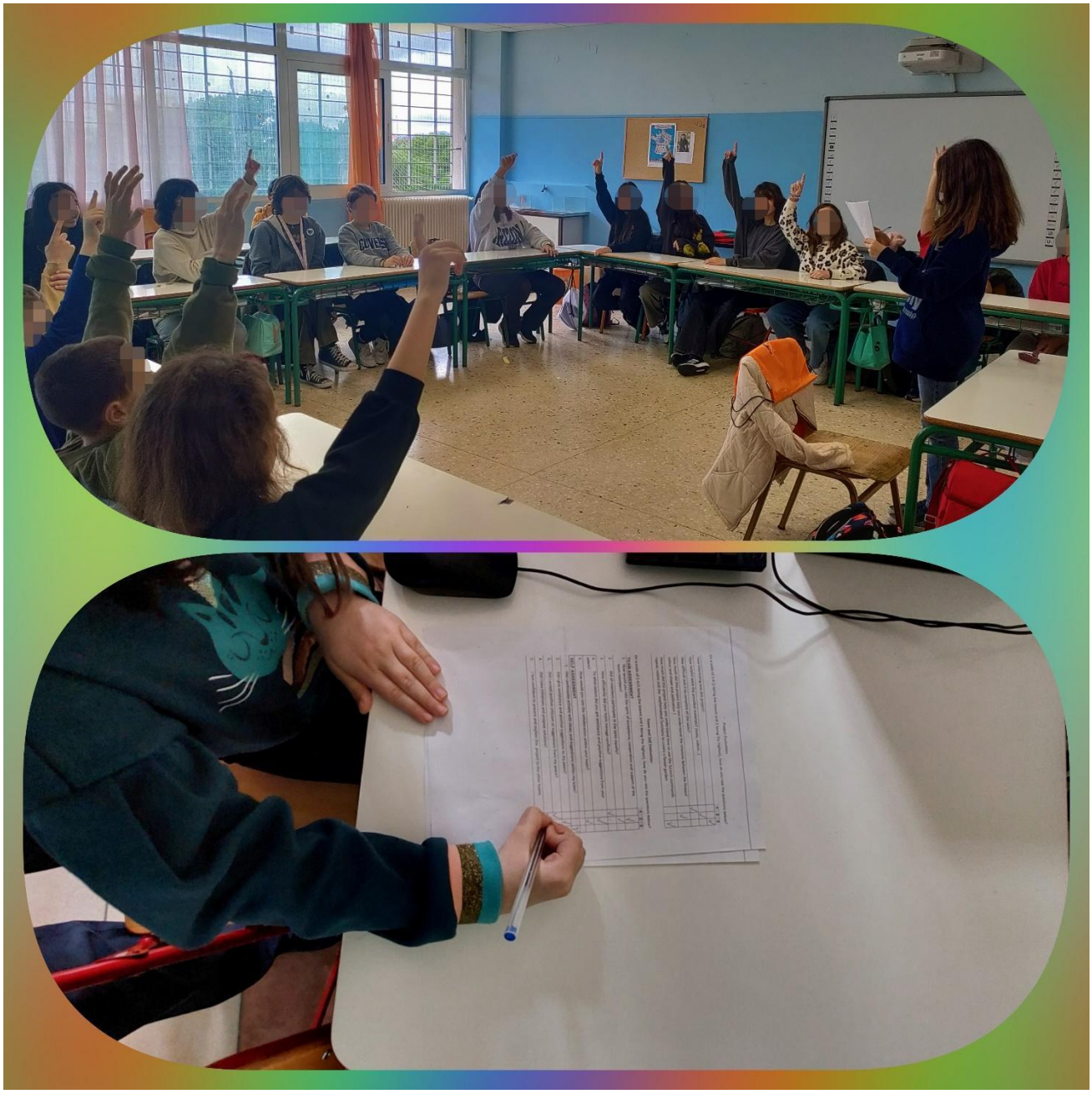
At the end of the mini CWL, the students completed the project assessment, team assessment, and self-assessment rubrics. Additionally, teachers underwent evaluation through a post-survey, providing insights into the effectiveness of the teaching approach and overall learning experience.



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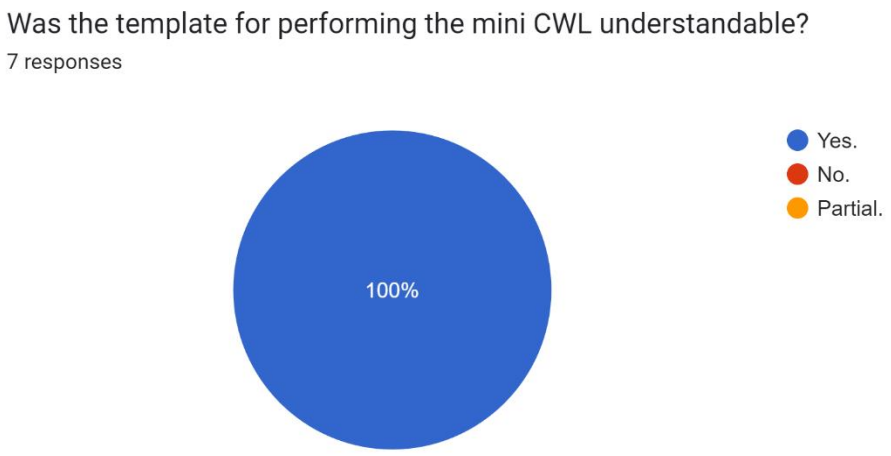
h) Conclusion

This activity offered a dynamic and interdisciplinary approach to learning, blending creativity, critical thinking, and environmental awareness with STEM principles. The sequence of activities allows students to explore, question, and apply their knowledge cohesively and engagingly.

3.1.3 Results

Teachers Survey results:

https://docs.google.com/forms/d/1k78_OR9qCDyurbVXoyZFZ7JUnMjhDZKCoSvL3AzWsqg/viewanalytics



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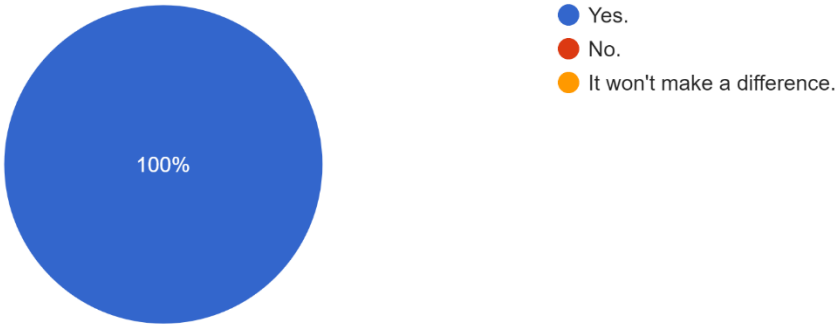
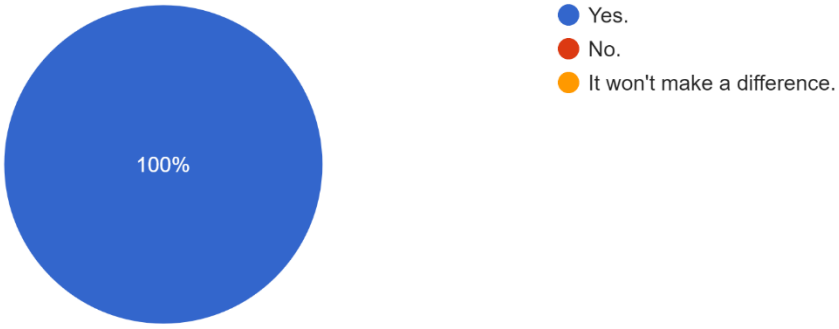
Do you think students will be more motivated in learning by the CWL method?

7 responses



Do you think students will be more active in learning with CWL?

7 responses



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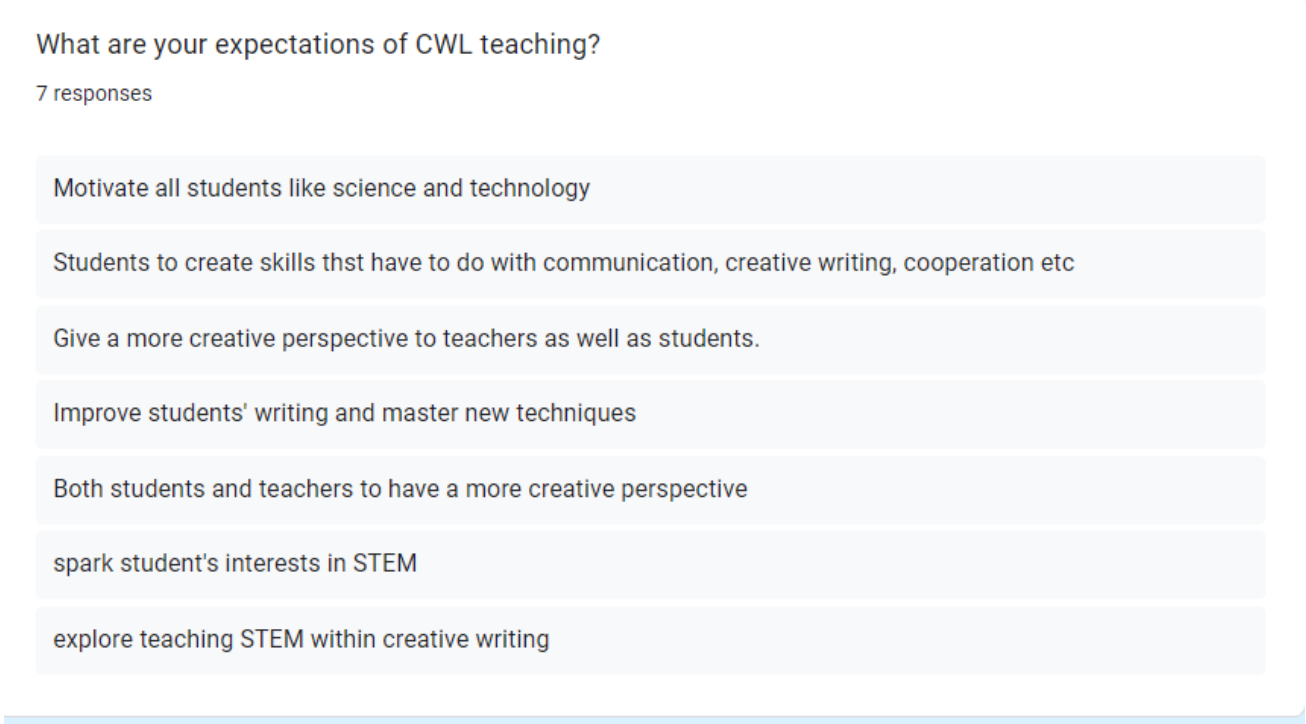

Students' feedback

a) Students' Project Assessment

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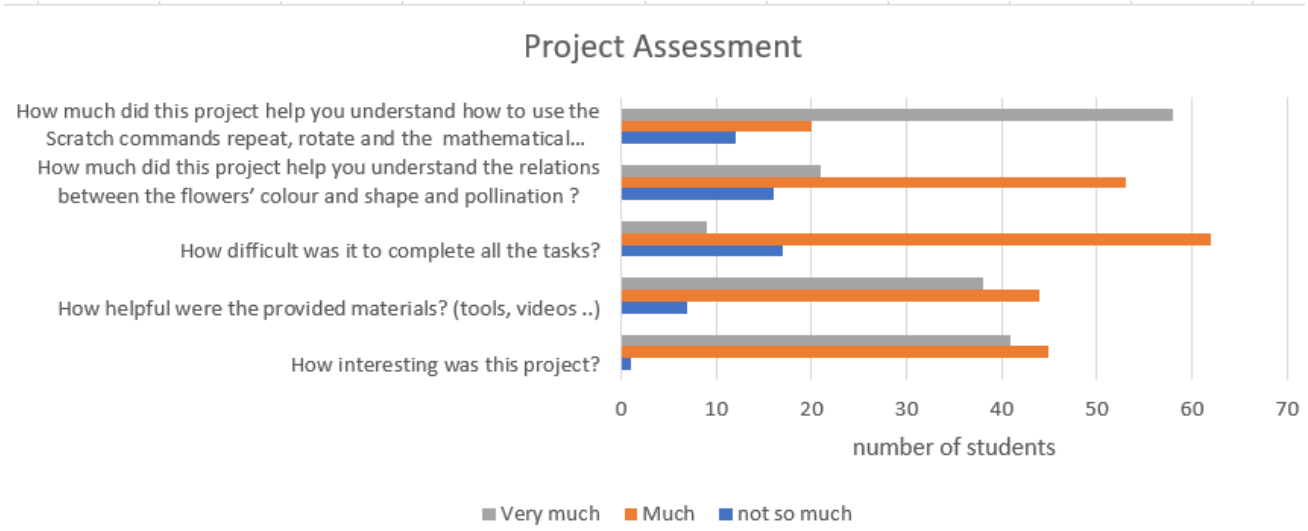

b) Students' team Assessment

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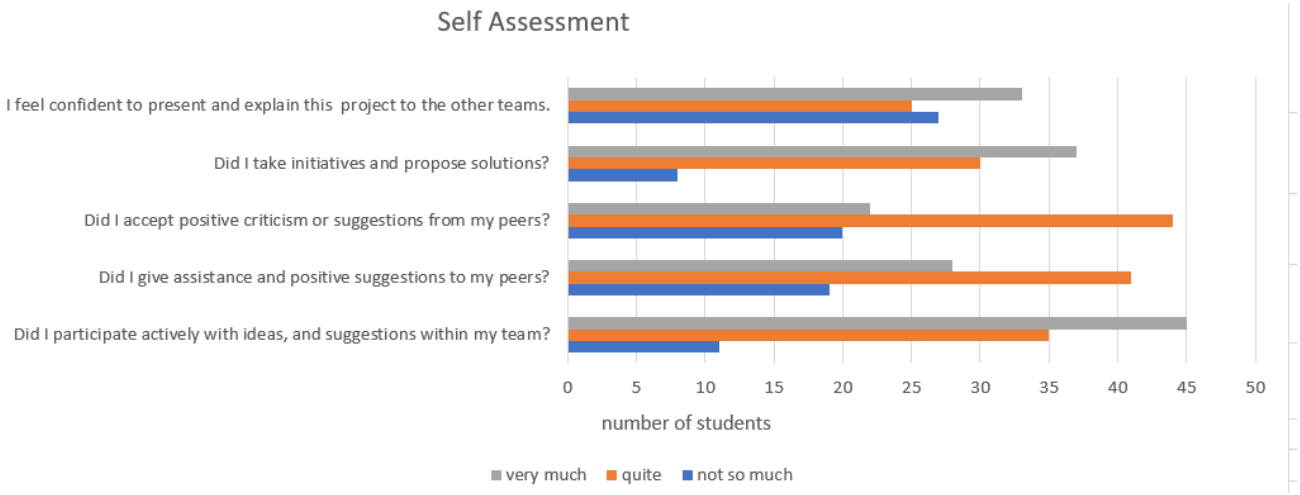
c) Students' self-assessment



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ANNEX

Overview of the project and all the provided materials and resources used for the mini CWL	https://wakelet.com/wake/rYpIHLu-8J7WPSXeLbL_4
Presentation videos of the project	2nd P.S of Nea Erythraia: https://youtu.be/6XAA2CCga7o?si=Ni8tkalMdVjHbbxz 7th PS of Nea Filadelfeia: https://vimeo.com/894004285 8th PS of Kifisia : https://youtu.be/V25kk8_CzHs?si=zJ5cDZB2Eb6DZlDn
European eTwinning mini CWL page	http://tinyurl.com/bdhuxp66
Scratch students' creations	https://scratch.mit.edu/studios/32487040
Teacher's survey results	http://tinyurl.com/y7txt8hj
Students' survey results	http://tinyurl.com/2p8jpe86

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3.2 Italy

In the implementation phase, the Create Writing Laboratory (CWL) model was introduced at IEXS (International Experiential School), targeting students in the 14-15 years age group. The focus areas for implementation included Mathematics, covering topics such as polynomials and the Cartesian plane, and Geography, delving into concepts like topography and scale maps.

To cater to the school's academic structure, the implementation was organised for 1st, 2nd, and 3rd-grade classes. Each class participated in two activities, with a total activity time of 4 hours. Given the 2-hour duration of class periods, the activities were thoughtfully divided into two lessons for each class.

The essence of the implemented activity was to seamlessly integrate creative writing with STEM (Science, Technology, Engineering, Arts, and Mathematics) subjects. The method employed storytelling was a powerful vehicle to explore and comprehend mathematical concepts related to vectors and motion in the plane. This approach aimed to utilise storytelling as a contextual framework, fostering visualisation, imagination, engagement, and overall enjoyment in the learning process.

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At IEXS, these activities were designed to provide a unique and immersive learning experience, aligning with the objectives of the CREAM Project. This initiative sought to engage students in a dynamic educational journey, combining the rigours of STEM subjects with the creativity and narrative depth of creative writing.

3.2.1 Outline

The Mini CWL activity focused on delivering a captivating lesson on vectors and motion in the plane through the innovative storytelling method. The narrative unfolds in a magical kingdom where vectors take on the role of heroes navigating through a two-dimensional world. The journey includes overcoming obstacles like rivers and mountains, requiring the protagonist to employ vector operations to navigate the challenging terrain.

The classroom setting was organised with desks and chairs to facilitate group discussions, individual work, and group presentations. An open area was designated for mapping the journey, providing students with a space to work on visual representations using paper and markers.

Materials:

Materials such as paper and markers were supplied for mapping the journey, along with storytelling aids like slides and visual materials. Handouts or notebooks were provided for individual work, and

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homework assignments related to vector concepts were assigned to reinforce learning.

Problem Statement:

The STEAM-related problem addressed through the activity revolves around the quest to find a hidden treasure using a map and instructions centred on vectors and operations.

Activity Structure:

The organised activities are designed to guide students in solving the problem of finding the hidden treasure.

Visibility:

To make the activities, story, and solutions visible, students were provided with the starting point of a story containing instructions to find a treasure. Their task was to create a map to scale and complete the story, drawing on their linguistic skills by writing the story in both Italian and another chosen language.

Stakeholders:

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Internal stakeholders, including students and teachers, actively participated in this Mini CWL activity. The engagement of these stakeholders enriched the learning experience within the school environment. The school management and the external stakeholders specially parents were also involved by sharing the activity results and the response of the students.

3.2.2 Enactment

This is one of the mini CWL activities to conduct at IEXS. This was a group-based activity for the total time of 04 hours.

I. Subject and topics:

- Physics: Learn what a vector is, how it is used, operation between vectors, scalar product, and motions.
- Maths: polynomials and cartesian plane
- Geography: topography and scale map

II. Presenting the original idea:

The original idea is to deliver a lesson on vectors and motion in the plane using the storytelling method. The narrative unfolds in a magical

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kingdom where vectors are portrayed as heroes navigating through a two-dimensional world.

The narrative incorporates fundamental vector concepts, such as direction and magnitude, and introduces vector operations like addition and subtraction. The journey involves overcoming obstacles like rivers and mountains, where the protagonist employs vector operations to navigate the terrain. The story also integrates the notion of the dot product as a tool for solving challenges along the way.

Ultimately, the objective is to convey abstract mathematical concepts in an engaging manner, allowing students to visualise and understand vectors and motion intuitively. Through the storyline, students are encouraged to apply these concepts to real-world problem-solving.

III. Story Narrative:

The story unfolds with the young mathematician Alex, captivated by the legend of a hidden treasure, embarking on a magical journey. Using a map based on vectors, motions in the plane, and the dot product, Alex overcomes obstacles like forests, rivers, and mountains. Each vector on the map represents a unique direction and length, with the scalar product providing crucial information to navigate challenging terrain. Ultimately, Alex's mathematical prowess leads him to the mountaintop

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where the coveted treasure is discovered, turning him into a hero in his village. The narrative emphasises the practical application of mathematical concepts in solving real-world problems.

IV. DESCRIBE YOUR PROBLEM:

You must find a hidden treasure, using a map and instructions.

V. Organization of the activity:

Please relate your activity/solution around the problem presented below. (remain to the point)

VI. Story related to the activity/problem.

The story follows the young mathematician Alex who, fascinated by the legend of a hidden treasure, embarks on a journey through a magical kingdom. Using a map based on vectors, motions in the plane and the product climb, Alex overcomes obstacles such as forests, rivers, and mountains. Each vector on the map represents a direction and a length, while the scalar product provides crucial information to orient and tackle difficult terrain. Eventually, thanks to his mathematical skill, Alex reaches the top of a mountain and finds the treasure so sought after, becoming a hero in his village. The story emphasises the practical application of mathematical concepts in solving real problems.

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VII. Goals and objectives

VIII. The goals and objectives of the storytelling lesson on vectors and motion in the plane are designed to ensure that students not only grasp the fundamental mathematical concepts but also develop an intuitive understanding of their real-world applications.

IX. Subject and topics

1. Understanding Vector Concepts:

   Goal: Gain a solid understanding of what vectors are, including their direction and magnitude.

   Objectives:

   Define vectors and identify their key characteristics.

   Differentiate between position vectors and displacement vectors.

   Recognize vector operations such as addition and subtraction.

2. Application of Vectors in Motion:

   Goal: Apply vector concepts to describe and analyse motion in a two-dimensional plane.

   Objectives:

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Understand how vectors can represent motion and displacement.

Use vectors to analyse and solve problems related to motion in the plane.

Explore the concept of velocity vectors and their significance in describing motion.

3. Operational Skills with Vectors:

   Goal: Develop proficiency in performing vector operations.

   Objectives:

   Add and subtract vectors using geometric and algebraic methods.

   Understand scalar multiplication of vectors and its impact on magnitude and direction.

   Solve practical problems involving vector operations.

4. Introduction to the Product Scalar:

   Goal: Introduce the concept of the dot product and its applications.

   Objectives:

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Define the dot product of two vectors.

Understand the geometric interpretation of the dot product.

Apply the dot product to solve problems related to vectors and motion.

5. Real-world Problem Solving:

   Goal: Apply vector and motion concepts to solve real-world problems.

   Objectives:

   Utilise vectors to navigate through a hypothetical scenario or journey.

   Solve problems involving obstacles, terrain, and other challenges using vector operations and the dot product.

   Develop problem-solving skills by translating real-world scenarios into mathematical models.

6. Moving on a cartesian plane:

   Goal: Foster a deeper understanding of the mathematical concept of cartesian planes.

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Objectives:

Encourage students to visualise vectors and motions in the plane.

Promote critical thinking by connecting mathematical concepts to practical situations.

Strengthen problem-solving skills through creative and narrative applications.

X. Expected output of the activity

Students must draw a scale map to find the treasure and put the map on a cartesian plane, showing how they're moving on it and the calculus done. They have even to write the very end of the story explaining which treasure (a new physics law) and how to use it.

TIMELINE:

- Introduction (15 minutes)
- Story Introduction (10 minutes)
- Vector Exploration with videos (20 minutes)
- Mapping the Journey (15 minutes)
- Obstacle Course (20 minutes)

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- Exploring the Dot Product (15 minutes)
- Problem-Solving Challenge (25 minutes)
- Writing the story (35 minutes)
- Group Reflection (10 minutes)
- Conclusion and Homework assignment (10 minutes)

XI. Evaluation:

We always give students an evaluation based principally on effort, communication, problem-solving and know-how achieved. The score and evaluation will be depending on the productivity, and it has maximum weightage form the self-evaluation score relatively.

3.2.3 Results

A short survey was conducted to analyse the understanding and interest of the students into mini CWL mode. It highlighted key outcomes and achievements observed during the activities.

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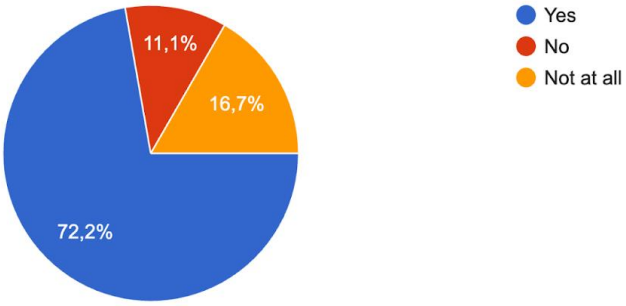
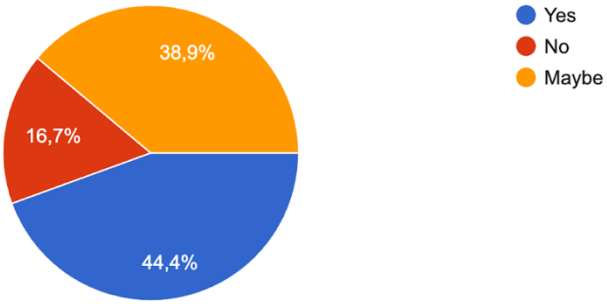
Did you enjoy the storytelling approach in learning about vectors?

18 risposte



Do you feel that the storytelling method helped you better understand the concepts of vectors and motion in the plane?

18 risposte



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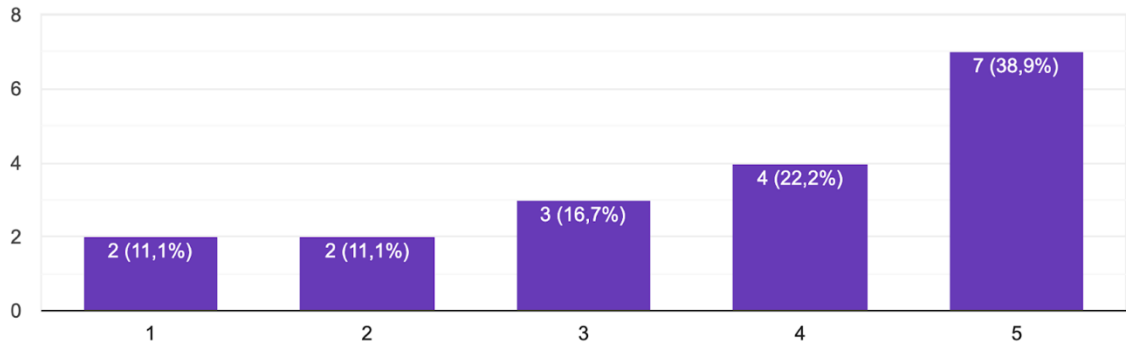
On a scale of 1 to 5, with 1 being not satisfied at all and 5 being very satisfied, how satisfied are you with the overall learning experience?

18 risposte



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3.3 Poland

High School / students' age between 14 and 19 / around 30 students in each class.

3.3.1 Outline

The problem of constantly judging the book by its cover when it comes to assessing other people, especially among teenagers, seems to be crucial. However, it is worth saying that these problems might be overcome at school simply by trying to combine STEM and Non-STEM subjects and carrying out an experiment.

3.3.2 Enactment

The main subject is the theory of probability. Students get a piece of paper where they see the first sentence of a possible story. Their job is to continue the story using the ideas of some probable problematic situations. An example outline of a story is given by the teacher, so that the students could know what is expected from them. Then, the brainstorm commences. Students exchange their ideas about possible different stories and create them in the form of a narrative story, dialogues, graphics, posters, riddles. The students are given a specific amount of time for that, say 45 minutes tops. Then, they change the tasks and carry out the experiment about the Efron's dice which takes them another 45 minutes (a single-class hour). During the next hour the students complete the endings of their stories and compare the results of them to the experiment. They ought to find out that the similarities are obvious. During the next 45-minute class evaluation of the experiment takes place. The presented time needs to be considered roughly, as some groups might need more.

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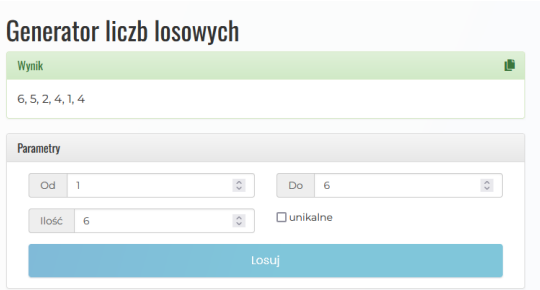
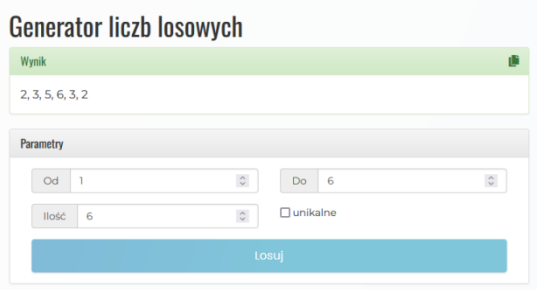
Each student generates with the help of the page https://generujemy.pl/losowa_liczba six random numbers ranging from 1 to 6.

Example Cube layout A:



Example Cube layout B:



Then, the students compare which of the cubes is "stronger".

	1	2	4	5	5	6
2	B		A	A	A	A
2	B		A	A	A	A
3	B	B	A	A	A	A
3	B	B	A	A	A	A
5	B	B	B			A
6	B	B	B	B	B	

In this set of cubes, the A Cube turned out to be stronger.

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Intuition tells us that if Cube A is stronger than Cube B, and Cube B is stronger than Cube C, Cube A is stronger than Cube C.

Students are divided into groups of three. Students draw dice with each other:

Cube A: 3, 3, 3, 3, 3, 6

Cube B: 1, 3, 4, 4, 4, 4

Cube C: 2, 2, 2, 5, 5, 5

They then compare which of the cubes is the strongest.

Cube A and Cube B

	3	3	3	3	3	6
1	A	A	A	A	A	A
3						A
4	B	B	B	B	B	A
4	B	B	B	B	B	A
4	B	B	B	B	B	A
4	B	B	B	B	B	A

Then, the students compare which of the cubes is "stronger".

Then, the students compare which of the cubes is "stronger".

Then, the students compare which of the cubes is "stronger".

Then, the students compare which of the cubes is "stronger".

Cube B is stronger than Cube A

	1	3	4	4	4	4
2	C	B	B	B	B	B
2	C	B	B	B	B	B

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2	C	C	C	C	C	C
5	C	C	C	C	C	C
5	C	C	C	C	C	C
5	C	C	C	C	C	C

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Cube C is stronger than Cube B

	3	3	3	3	3	6
2	A	A	A	A	A	A
2	A	A	A	A	A	A
2	A	A	A	A	A	A
5	C	C	C	C	C	
5	C	C	C	C	C	
5	C	C	C	C	C	

Then, the students compare which of the cubes is "stronger".

Cube A is stronger than Cube C

So what seemed pretty obvious turned out not to be true.

Then the students study the five dice system:

A: 0, 0, 4, 4, 4, 4

B: 3, 3, 3, 3, 3, 3

C: 2, 2, 2, 2, 6, 6,

D: 1, 1, 1, 5, 5, 5

Then, the students compare which of the cubes is "stronger".

Students construct appropriate tables and on their basis determine which cubes are stronger.

Cube A is stronger than Cube B, Cube B is stronger than Cube C, Cube C is stronger than Cube D, and Cube D is stronger than Cube A.

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The relationship of transience, which always seems pretty obvious, turns out to be surprising.

The discoverer of such a system of cubes was the American statistician Bradley Efron, and it was described by another American journalist and popularizer of mathematics Martin Gardner in the journal: "Scientific American".

4.3.3 Results

There have been 3 surveys carried out among the students and teacher, and based on them, it is possible to conclude that the vast majority of the surveyed people were extremely surprised by the outcome of the CWL and the pilot. The question about the importance of the social problem was answered in the way that it is vital to talk about it. Finally, the idea about “the cooperation” between STEM and non-STEM subjects should be implemented into the curriculum.

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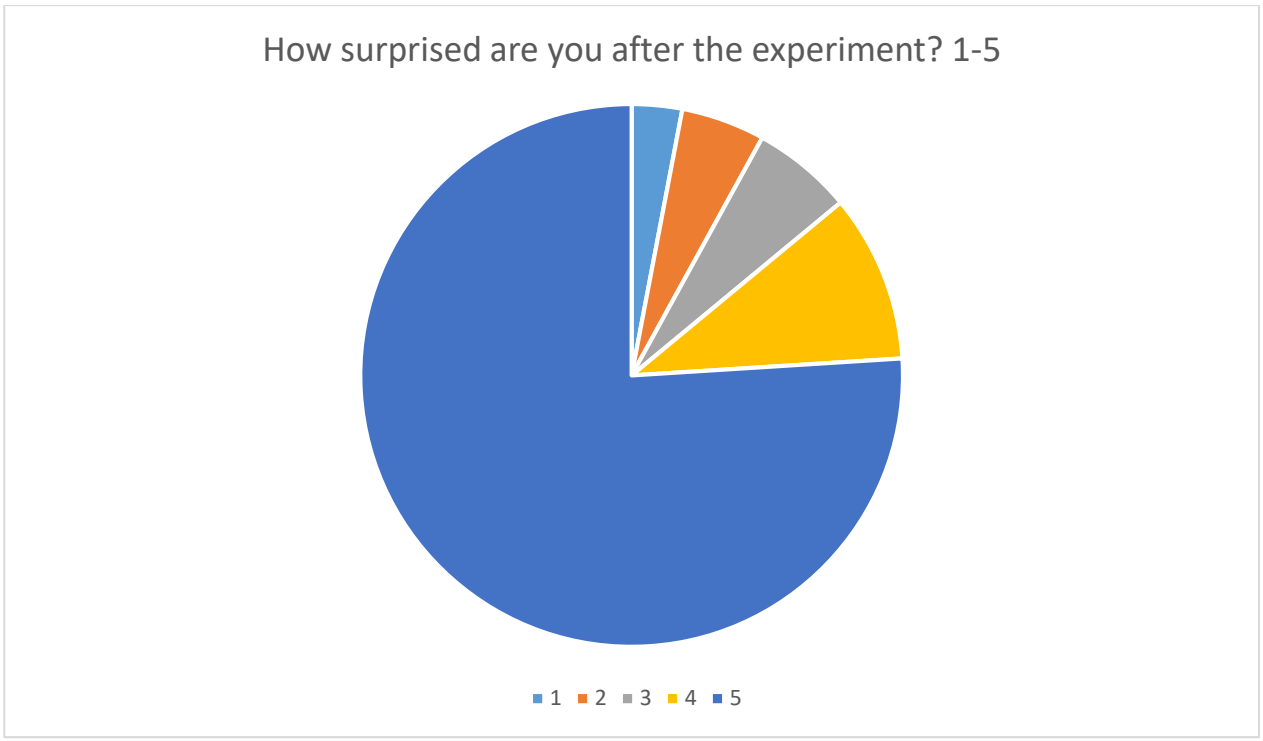

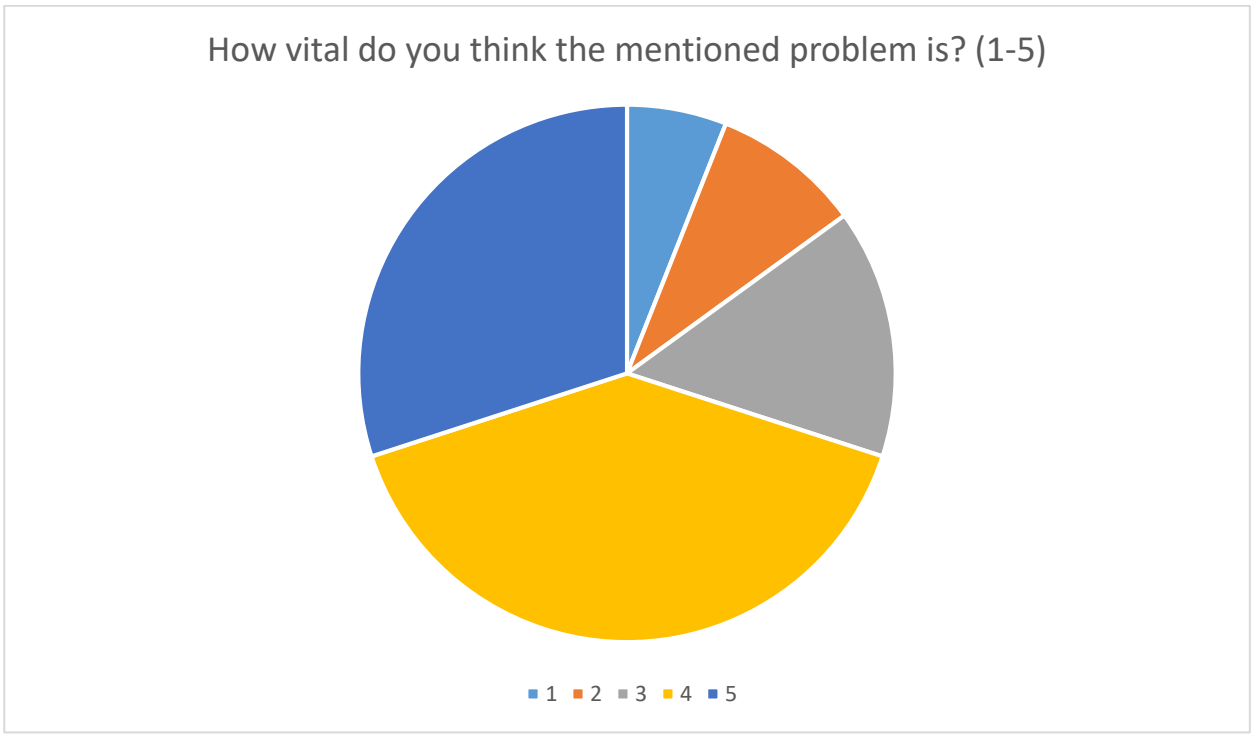

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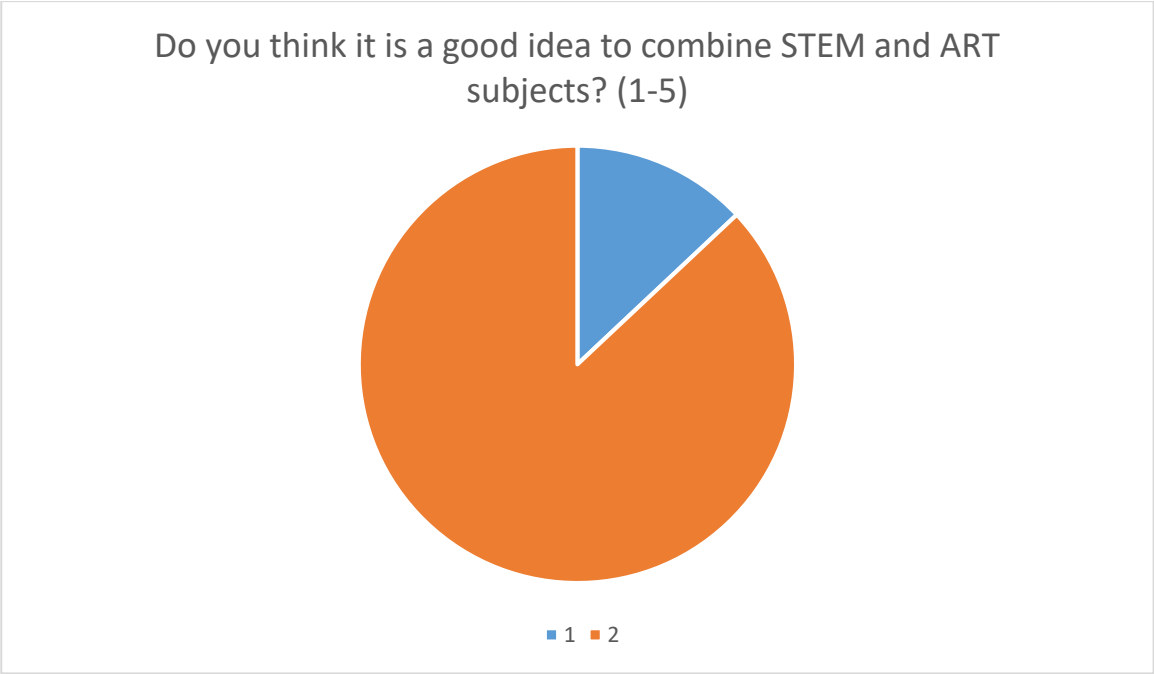

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3.4 Slovenia

Grm Novo mesto - Centre for Biotechnics and Tourism is a school with a venerable tradition of education. It educates for attractive professions in the fields of agriculture, horticulture (gardening and floriculture), food, nature conservation, catering, tourism and in the biotechnical gymnasium programme with a well-equipped laboratory. The Centre has its own 250 ha of land and 50 ha of forest and its own food, catering and tourism facilities. All this is combined in the Inter-enterprise Training Centre. The purpose of the Inter-enterprise Training Centre is to provide practical education and training for pupils, students and adults for all programmes and orientations, and it plays a major role in competence training in production, processing, marketing, tourism, catering, nature conservation, horticulture, environmental protection, recreation and sport. It also plays an important role in the process of lifelong education and training.

Mini CWL was carried out with the students of the 3rd year of the Florist programme, which is a three-year programme. Students are between 17 and 18 years old. There are 16 girls and 1 boy in the class. At the time of the mini CWL was carried out, two students were absent.

4.4.1 Outline

We chose this mini CWL because we are ECO SCHOOL and we tend to make new products from already used materials. Depending on the chosen theme, we planned the activity for the month of November, as it makes sense before the beginning of Advent. At the school, we make different wreaths every year, which are sold at a traditional charity bazaar. Usually wreaths are made of different materials, but this year we also made some of them from old T-shirts we found on the school property.

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In carrying out the activities, we followed the goals defined within the objects of decoration in floristry, mathematics and environmental protection.

3.4.2 Enactment

Before and after the activity, the students evaluated their expectations and well-being with the help of pictorial material (children on a tree).

We planned 7 school hours. The activity was carried out in the flower shop. Materials we needed: found and washed T-shirts, newspaper, wire, scissors, glue, decorating material and meter.

As an external collaborator, a florist (teacher) joined us. She introduced the students to all the stages needed to make a wreath.

The students recorded and photographed the individual stages needed to make wreaths with the help of a camera on their phone. The next day they finished their stories (photos, comics), we did not have enough time to make videos or presentations with photos (e. g. PowerPoint).

The students presented their products and sold them at a charity bazaar, so they proposed a selling price for them.

Criteria for evaluation: precision, production within time frame, attitude to material.

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Worksheet:

Mini CWL – From a T-shirt to a Wreath

1. Read the story titled From a T-shirt to a Wreath.

In the Kingdom of T-shirts, where waste shirts were alive and full of life, there lived a T-shirt named Lacosta. She was a creative and innovative T-shirt who dreamed of adventures outside her realm. One day, Lacosta found a box full of worn-out T-shirts that had been discarded due to stains and holes. She decided to join forces with these waste shirts and breathe new life into them in a different way - by making a wreath. With scissors in hand, an abundance of imagination, and considering that the entrance door to the Kingdom of T-shirts measures 90 cm wide and 220 cm high, Lacosta began to cut and knit, creating beautiful wreaths from recycled T-shirts. So every shirt got a new role, it became part of the wreath. Some t-shirts became colourful ornaments, others formed the basis of the wreath, and all were combined into a festive symphony of coluors. Lacosta and her friends began to create fairy-tale wreaths. One day, when the first snow bleached the Kingdom of T-shirts, it was noticed that some T-shirts were losing their original colour. Together, they investigated why this was happening and found that it was due to a lack of festive spirit. They decided to start making Advent wreaths and spread the joy of Christmas among the people. This is how Lacoste's wreath workshop was created, where people could bring their old t-shirts and turn them into festive wreaths. Wreaths could be shared with those who needed a little Advent charm. T-shirts have come to life again, now as part of the festive decorations, and the community has become even more united in the spirit of festive joy. Lacosta was lucky to be able to create not only wreaths, but also a festive atmosphere that warmed the hearts of all inhabitants of the Kingdom of T-shirts.

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2. **Based on what you read, answer the questions and write down the answers.**

Who were the heroes of the story?
Where did the story take place?
What was the problem with the Kingdom of T-shirts?
How did the Kingdom of T-shirts deal with the problem?

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3. **In the left column of the table, write down the stages needed to make a wreath, and in the right, draw sketches of the individual stages of making a wreath.**

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5. **When making a wreath, keep in mind that it should occupy no more than one third of the width of the door. At the appropriate stage of making the wreath, it is important to also observe the rule of the golden ratio, since the width of the perimeter against the size of the opening should be in a ratio of 1:1.6.**

a) Calculate the diameter of the perimeter and the diameter of the finished wreath for the dimension of the door from the story.

b) Note the calculations in the table below. Note the calculated diameters on the corresponding sketch in the table from task 3.

c) Now that you have calculated the size of the wreath and made it, measure the wreath with a meter and compare the measurements with the calculated values. Write down the results in the table below. Do your calculations match the measurements?

	Calculated (cm)	Measured (cm)
Diameter of the wreath		

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Circumference Diameter		
My findings:		

6. **Continue the story in a way that incorporates the techniques you learned while making the wreath. You can write a story, draw a comic, make a presentation (using ICT tools) or a paper sticker, or record a short video story of making the wreath itself. The choice is yours.** 😊

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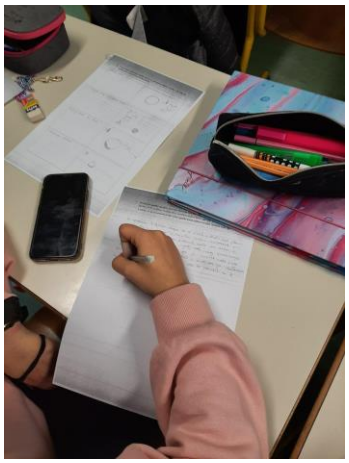
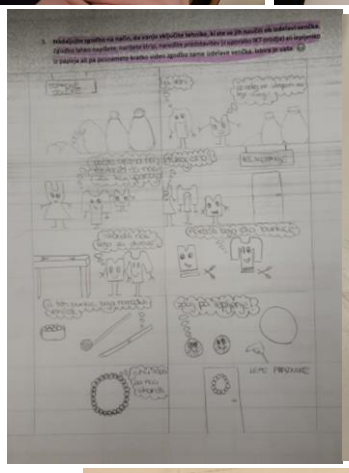
Photos of the activities carried out (the source of all is Grm Novo mesto – Centre of Biotechnology and Tourism).





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3.4.3 Results

Advantages (strong points) of the activities carried out:

The activity is suitable for students of different ages. If students work in groups, collaborative learning and the development of teamwork skills are encouraged.

The use of recycled T-shirts to make wreaths promotes environmental awareness and educates about the possibilities of reusing materials.

The assignment develops reading and understanding of the text, as students had to read the story carefully in order to be able to answer questions and understand the course of events.

The assignment encourages creative thinking as students continue the story in a way that suits them best. Students can show their artistic side by drawing sketches of making a wreath or creating art products related to the story.

By making the wreath itself, motor skills are developed (e. g. cutting, knitting and creating are activities that can improve the motor skills of students).

It is important to plan and allocate time to complete all tasks.

Floriculture was associated with other subjects. With mathematics in mathematical calculations, where we included the principles of geometry, the golden ratio, measurement, etc., with environmental protection in the reuse of waste T-shirts.

Measuring the actual wreath with a measuring tape allows students to gain experience by actually measuring and comparing the results with the calculated values.

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Students can combine theoretical knowledge of the golden ratio rule with actual creation of a wreath, which strengthens the connection between theory and practice.

By selling wreaths at the charity bazaar, students became involved in the local environment/community.

Difficulties (weak points) of the activities carried out:

Limited time. Additional hours would be required to complete some phases.

Problems with mathematical calculations - students had to cope with the comprehension of the text and the recall of the mathematical knowledge needed to solve the tasks.

Recommendations:

Students could create sketches of their wreaths using a computer program, thus including ICT content.

After completing the assignment, students could be encouraged to think more about what they have learned and how they can use this knowledge in the future.

Feedback from students:

	(1) I completely disagree	(2) I disagree	(3) I partially agree	(4) I agree	(5) I completely agree
The activity was interesting.	0 %	0 %	7 %	21 %	71 %
The activity was too demanding.	21 %	57 %	14 %	7 %	0 %

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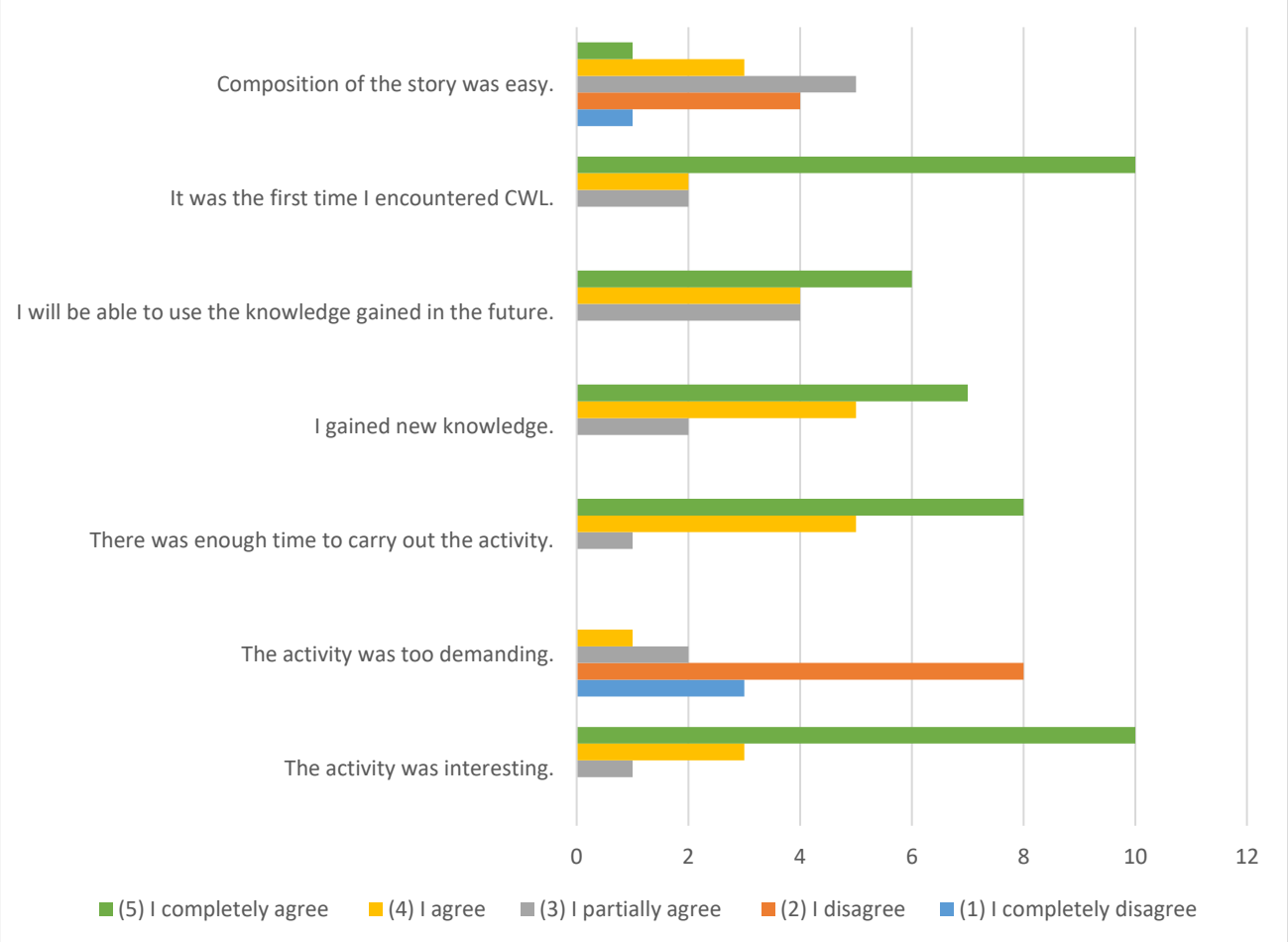
There was enough time to carry out the activity.	0 %	0 %	7 %	36 %	57 %
I gained new knowledge.	0 %	0 %	14 %	36 %	50 %
I will be able to use the knowledge gained in the future.	0 %	0 %	29 %	29 %	43 %
It was the first time I encountered CWL.	0 %	0 %	14 %	14 %	71 %
Composition of the story was easy.	7 %	29 %	36 %	21 %	7 %



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4 Conclusions

Based on the experience derived by the implementation of the Learn to Learn mini-CWL, three types of conclusions can be drawn: strong points, difficulties, and recommendations.

4.1 Strong points

CWL is a great way to actively engage students in the teaching process of STEAM subjects. Students are also developing teamwork skills, critical thinking and time management and allocation. With CWL teachers can relate abstract concepts to everyday life and make otherwise less interesting subjects very interesting. Integration of CWL enhances engagement, stimulating visualisation and emotional connection.

4.2 Difficulties

The limitations that occurred during CWLs were described as lack of team work by some members of the team and lack of ability to connect different school subjects in solving a problem.

4.3 Recommendations

The main problem in education is lack of connection between subjects. With CWL and storytelling teachers could break this barrier and connect school subjects with real life problems, which are requiring a multi-subject approach.

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