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Report

PR3-A5 Implementation of pilots of Creative Writing Laboratories

Post Pilots Report

By Edumotiva

EDUMOTIVA EUROPEAN LAB for EDUCATIONAL TECHNOLOGY

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1. Introduction

The Erasmus+ "CREAtive writing labs to foster STEAM learning" (CREAM) Pilots were conducted from February to May 2024 across Greece, Slovenia, Italy, and Poland. These pilots aimed to enhance student engagement and understanding of STEAM (Science, Technology, Engineering, Arts, and Mathematics) disciplines by integrating the Creative Writing Laboratories (CWL) model into STEM education. Targeting students aged 12 to 18, the initiative developed innovative teaching models that connected STEAM learning to real-world challenges, fostering collaboration, critical thinking, and problem-solving skills.

The CREAM initiative utilizes the CWL model to challenge students to address real-world issues through creativity, while building a strong foundation in STEAM concepts. This report provides an overview of the implementation process, focusing on student engagement, learning outcomes, and the overall impact of the CWL framework on both students and educators

In Greece, the EDUMOTIVA organization coordinated the project in collaboration with three primary schools in Athens: the 2nd Primary School of Nea Erythraia, the 8th Primary School of Kifisia, and the 7th Primary School of Nea Filadelfia. Similarly, in Slovenia, the project was implemented at Grm Novo mesto – Centre of Biotechnics and Tourism, while in Italy, the International Experiential School (IEXS) in Reggio Emilia

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served as the host institution. In Poland, the Zespol Szkol Ogolnoksztalcacych im. Stefana Zeromskiego w Ilawie (ZSO) also participated in the initiative.

The project targeted students aged 12 to 18 from various schools. Seventy (70) 12-year-olds from primary schools in Athens, twenty-two (22)

17- to 18-year-olds from Slovenia, fifty (50) 14- to 15-year-olds from Italy, and 14- to 18-year-olds from Poland participated in the pilots.

2. CREAM pilots, Aims and Objectives

The goal of the CREAM pilots was to spark school students' interest in STEAM disciplines by developing and testing the "Creative Writing Laboratory" (CWL), an innovative teaching model. This model presents real-world problems that require creative thinking and a solid understanding of STEAM concepts for resolution.

The objectives of the pilots were to:

- Explore the effectiveness of integrating Creative Writing Labs (CWL) into STEM education to enhance student engagement and understanding of STEM concepts.
- Develop an integrative and collaborative approach through Creative Writing Laboratories (CWLs) to connect STEAM education to real-life problems. This approach aims to enhance collaboration between formal, non-formal, and informal science education providers,

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enterprises, and civil society, thereby promoting the concept of open schooling.

- Cultivate 21st-century skills, including collaboration, communication, critical thinking, and problem-solving, within a STEM context.
- Provide professional development opportunities for teachers to support them in implementing innovative and engaging teaching methodologies, such as the CWL model, STEAM education, and project- and problem-based learning approaches that actively engage students.
- Expand opportunities for promoting learning activities focused on STEAM disciplines, encouraging students to learn through experimentation, trial and error, and problem-solving.
- Facilitate the acquisition of scientific knowledge and foster active participation in the innovation processes within local communities.

3. Implementation Process

3.1 Pilots Description

The implementation of the CWL framework varied by country, with each pilot project tailored to its specific educational context and curriculum. Below is a summary of the pilot projects from each participating country.

At **EDUMOTIVA, Greece,** the "***Biodiversity and Pollinators Project***" (*Annexes 13.3 Implementation Strategies: Plans, Learning Scenarios, and Success Stories*) engaged 70 students in exploring biodiversity, the role of

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pollinators, and climate change. Students were engaged through a mystery captivating video to investigate the role of pollinators and biodiversity loss. Students used machine learning to monitor bee health, created 3D bee hives and models, and developed interactive games and digital materials. This project integrated Science, Technology, Engineering, and Mathematics (STEM) with creative writing, aiming to enhance students' critical thinking, problem-solving, and communication skills. To showcase their work they created comics, posters, presentations, and infographics. This approach not only helped them understand STEM concepts better but also empowered them to share their knowledge in engaging ways.

At **Grm Novo mesto, Slovenia, t**he "***CWL Alter Cup***" project focused on developing bioplastic alternatives to traditional plastic cups. Students researched plastic waste, explored polymerization and chemical reactions, conducted laboratory experiments and fieldwork, and used creative writing to present their findings through posters, presentations, and a short movie. The project combined chemistry, biology, technology, and art, promoting sustainable practices and a deeper understanding of waste management and highlights how creative writing can be a powerful tool for communicating complex scientific research in an accessible and engaging way.

At **IEXS, Reggio Emilia, Italy** the "***Quest for Balance***" project (*Annexes 13.3 Implementation Strategies: Plans, Learning Scenarios, and Success Stories*) taught physics principles like balance and leverage through martial arts. There were more than 50 students who took part in CWL pilot implementation between 14-16 years. Students embarked on a

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unique learning journey by developing a narrative around a martial arts journey that incorporated physics principles.They learned about concepts like balance, leverage, and dynamics through hands-on judo sessions. To reinforce their understanding and express their learning, students created a kamishibai theater performance. They developed the narrative, designed the scenes, and wrote the script, weaving in their understanding of physics within the storyline. This project exemplifies how creative writing can transform abstract scientific principles into a tangible and captivating experience.

At **ZSO, Poland,** the project "Efron's cubes" (*Annexes 13.3 Implementation Strategies: Plans, Learning Scenarios, and Success Stories*) explored non-transitive relationships using Efron's dice. Students engaged with real-life scenarios to challenge conventional mathematical assumptions, fostering a deeper understanding of probability and uncertainty. The project incorporated Math and Computer Science and encouraged students to consider diverse perspectives and social issues.

3.2 The "Creative Writing Labs (CWL) " framework in practice

The **Creative Writing Labs (CWL) model** blends **narrative** and **storytelling** with **STEM** education to make learning more engaging and relatable. This approach fosters creativity and active participation by integrating STEM subjects with creative writing. The CWL framework involves generating original ideas or problems related to STEM topics, designing activities around these concepts, crafting narratives with plot

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elements, and ensuring the project's visibility through narration and conclusion. Effective planning aligns STEM subjects with these ideas, designs related activities, and addresses the identified problems directly.

The four pilot projects highlighted the integration of STEM principles to develop **students' 21st-century skills**. For instance, in Greece, the "Biodiversity and Pollinators Project" engaged students in using machine learning to monitor bee health, setting up sensors, coding interactive games, and creating beehives. In Slovenia, the "Bioplastic Alternatives Project" involved students exploring polymerization and chemical reactions through practical lab work and field research to develop bioplastic alternatives. In Italy, "The Quest for Balance" Project used martial arts to teach physics principles such as balance and leverage, making STEM concepts more engaging through interactive lessons and practical judo sessions.

Project-based learning was central to these projects, with students collaborating to address real-world problems and achieve tangible outcomes. In Greece, students developed technology-based solutions and digital materials to raise awareness about biodiversity. In Slovenia, students researched plastic waste, conducted experiments, and presented their findings through various media. Italian students in "The Quest for Balance" created a kamishibai theater performance, crafting a storyline and characters to illustrate their understanding of physics principles.

Experiential education played a crucial role, with hands-on activities allowing students to apply their learning in practical contexts. For example, Slovenian students conducted lab work and field research, while

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Greek students created 3D models of beehives and trained a machine learning model to recognize pollen-carrying bees.

The principle of "**learning by doing**" was central across all projects. Students engaged in practical tasks such as designing experiments, building beehives, creating digital materials, and performing in theatre. This approach promoted active learning and skill development by immersing students directly in their learning experiences.

The implementation of the CWL framework in schools created engaging learning experiences by incorporating the following teaching approaches:

Spark Interest: all schools sparked student **interest** by presenting them with real-world problems connected to their curriculum. In Greece a mystery movie was used to pique students' curiosity about biodiversity and the role of pollinators. In Slovenia, the challenge involved creating a bioplastic alternative to traditional plastic cups, prompting students to research and propose solutions to plastic waste. Similarly, in Italy, the students engaged with a narrative-driven project called "The Quest for Balance," where they explored physics principles through the lens of martial arts.

Research and investigation: Each school facilitated **research and investigation**, allowing students to explore potential solutions. Students in Greece investigated questions related to biodiversity loss and pollinators using worksheets and various resources like documentaries, interactive games, quizzes and were encouraged to make hypotheses. In Slovenia, students conducted self-directed research on topics like polymerization and biopolymers, while in Italy the students researched physics concepts like balance, barycenter, and leverage.

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Proposing Solutions: Students in all schools **proposed solutions** to the problems presented. In Greece, the students proposed technology-based solutions to address biodiversity loss and raise awareness about pollinators. In Slovenia the students showcased developing and presenting their own bioplastic "alter pots". In Italy, the students applied their understanding of physics to create and perform a kamishibai theater presentation, showcasing their solutions within the narrative.

Creative writing played a key role in presenting these solutions. Students in Greece used creative writing to communicate their findings through mediums like comics, posters, presentations, and infographics. In Slovenia, students employed creative writing to design posters, PowerPoint presentations, and even a short movie about their bioplastic alternatives. Students in Italy developed characters, storylines, and dialogue for their kamishibai theater performance, integrating their understanding of physics into a creative narrative.

Hands-on experiments and fieldwork were incorporated to provide practical experience. In Greece students created 3D Bee Hives and 3D bee models to experiment with sensors and Machine Learning models to monitor bee health and hive conditions. In Slovenia, students participated in laboratory experiments to create bioplastic and engaged in fieldwork related to their research. Meanwhile, students from Italy participated in judo sessions, applying their knowledge of physics principles to physical movements and techniques.

Collaborative teamwork: all schools emphasized **collaborative teamwork** throughout their projects. In Greece students collaborated in teams to develop solutions and create materials for raising awareness

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about biodiversity and pollinators. Students from Slovenia worked together in groups, dividing tasks, and conducting experiments to develop their bioplastic alternatives. Similarly, students from Italy collaborated on scriptwriting, theatre construction, and judo practice, fostering teamwork and communication skills throughout the project.

Tailoring to Specific Curricula: Each participating school tailored the CWL model to their curriculum and context, selecting different themes and integrating various STEM and non-STEM subjects.

4. Student Engagement and Participation

The CWL pilot projects utilized a diverse range of methods for documentation and data collection. Student pre- and post-questionnaires were crucial in assessing their understanding of STEM concepts before and after the projects, as well as capturing their overall experience and perceived learning gains.

Teachers contributed by completing questionnaires and reflections, which offered insights into their experiences with the CWL model, including the challenges faced, assessment strategies used, and the project's impact on students and their own professional development.

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Student worksheets and assignments (*Annexes 13.1 Implementation Strategies: Plans, Learning Scenarios, and Success Stories*) served as concrete evidence of learning and progress, allowing teachers to evaluate students' grasp of STEM concepts, creative writing abilities, and integration of these areas. Photographs and video recordings documented key moments and activities, providing a visual record of the project's implementation. Observation notes from both students and teachers, though less detailed, likely played a role in capturing informal observations and evidence of learning and progress.

In total, seven teachers and sixty-eight students from Greece, four teachers and six students from Italy, and two teachers and seven students from Slovenia participated in the post-implementation surveys conducted using Google Forms (*Annexes 13.2 POST PILOT QUESTIONNAIRES: ANALYSIS & RESULTS*). The lower participation rates can be attributed to the fact that, in some countries, the pilots coincided with exam periods or the end of the school year, which occurred one month earlier in certain regions.

Using both quantitative data from surveys *(13.2 POST PILOT QUESTIONNAIRES: ANALYSIS & RESULTS)* and qualitative observations *(13.1 POST PILOT NATIONAL REPORTS)* from teachers, student engagement in the pilots was highly satisfying.

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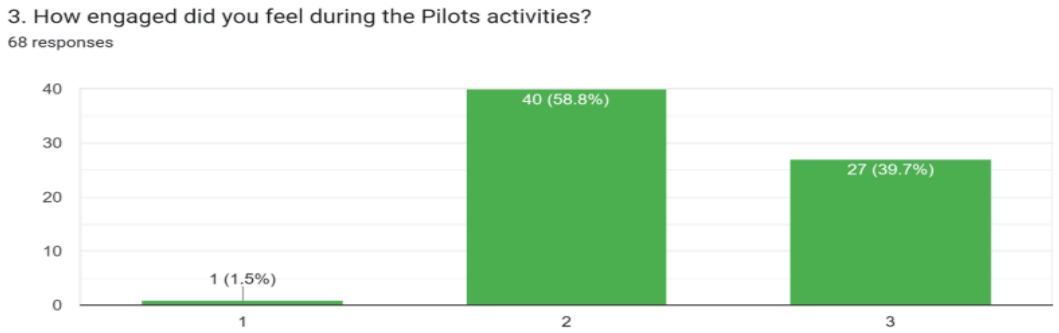
4.1 Quantitative Data:

According to the data, 98.5% of students from Greek schools, 87.5% of students from Slovenia, and 100% of students from Italy reported feeling engaged to very engaged with the project.

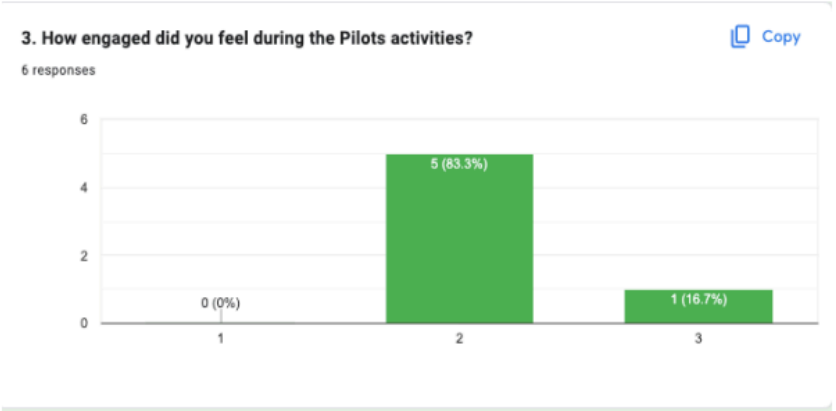
Question 3: Engagement in Pilots Activities

Most respondents felt engaged, with 58.8% giving a rating of 2 (engaged) and 39.7% a rating of 3 (very engaged), indicating a positive reception of the activities. This shows that the activities were generally well-received and engaging.



Engagement: Results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)

Engagement During Activities: The students had mixed levels of engagement during the pilot activities. Some students rated their engagement as high, while others felt moderately engaged, indicating that while the project was generally well-received, there is room for increasing student involvement.



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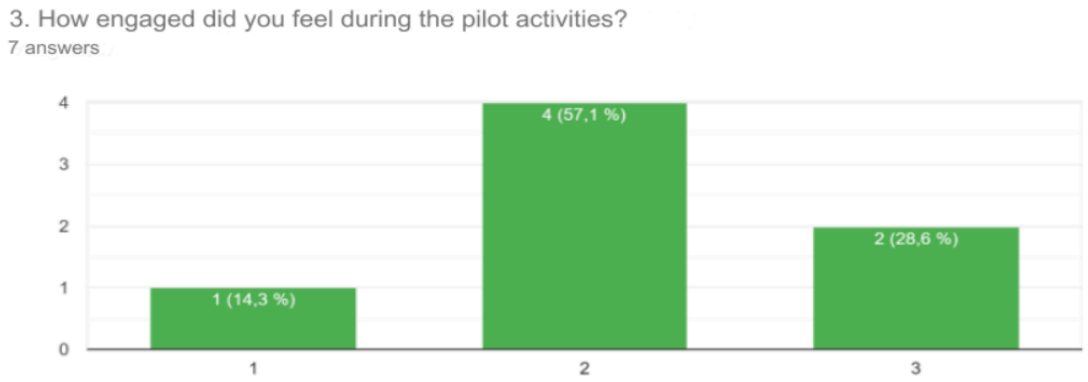
Engagement: Results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

Q3: 3. How engaged did you feel during the Pilots activities?

During the Pilots activities 57,1% felt engaged, 28,6 % felt very engaged and the rest (14,3%) did not feel engaged.



Engagement: Results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

Additionally, 52.9% of Greek students reported that the project met their expectations while 66.7% of Italian and 57.1% of Slovenian students reported that the pilots met their expectations to some extent.

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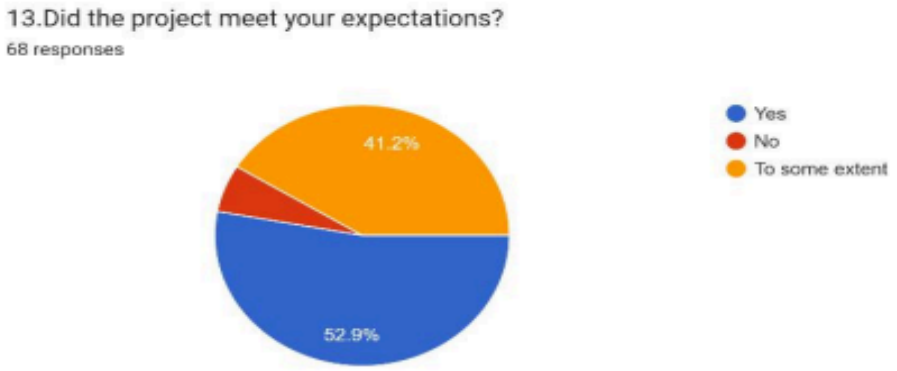
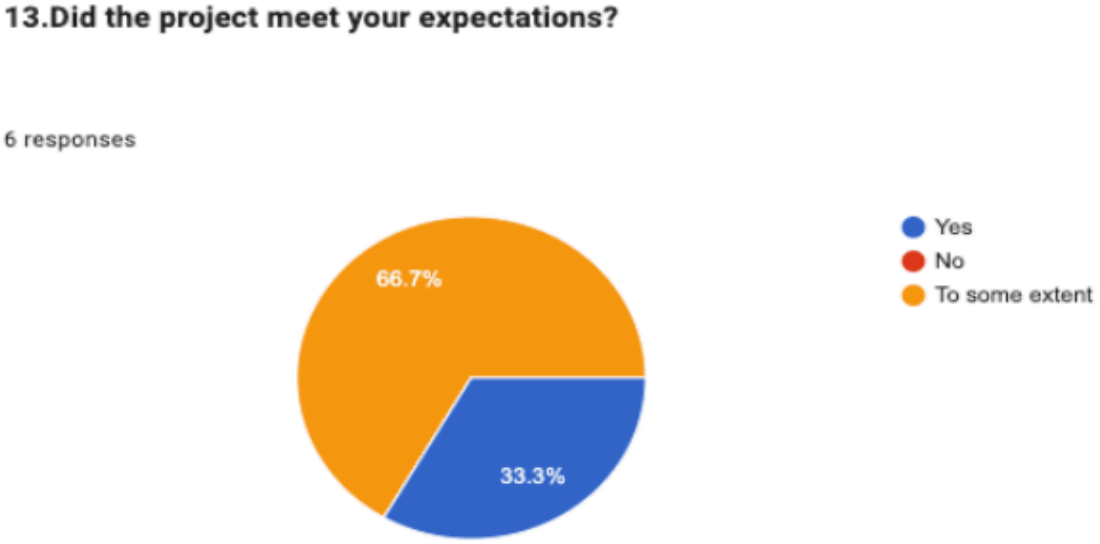


Meeting expectations: results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)



Meeting expectations: results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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Q13: 13.Did the project meet your expectations?

To some extent the project met students' expectations (57,1%).

Meeting expectations: results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

Regarding students' willingness to participate in similar projects in the future, 100% of students from Italy and 54.4% of students from Greece replied 'Yes,' while only 14.3% of students from Slovenia gave the same response

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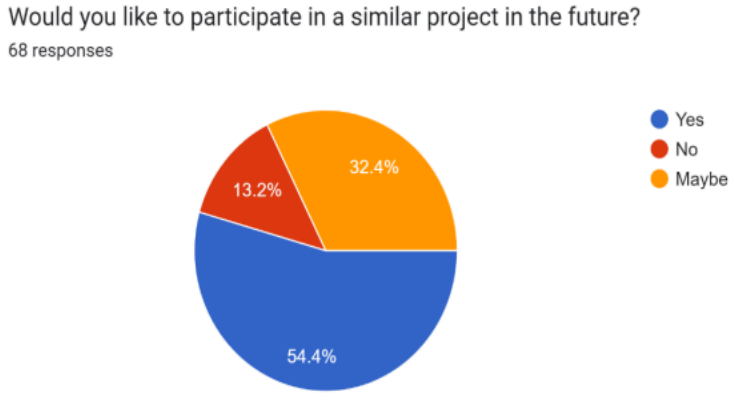
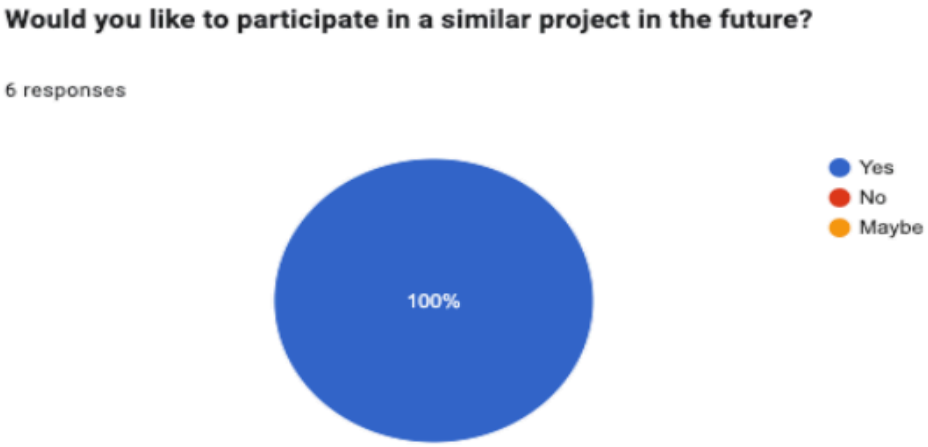
Question 17: Future Participation

54.4% would like to participate in a similar project in the future while 32,4% might do, showing openness to the idea. This suggests a general willingness to engage in similar projects again.



Future participation: Results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)



Future participation: Results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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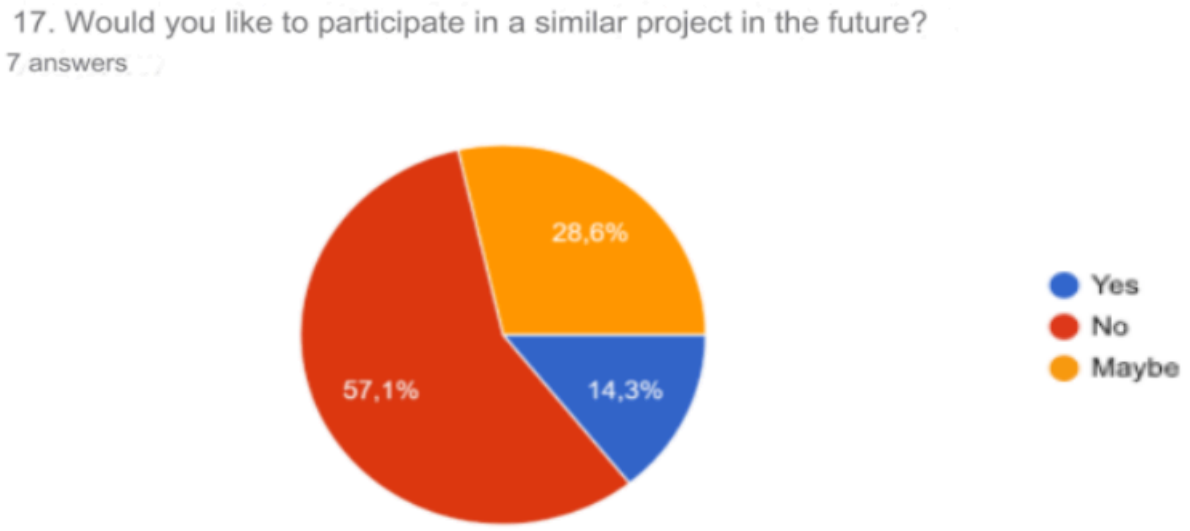

Future participation: Results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

Integrating creative writing has proven effective in **making STEM subjects more approachable and enjoyable**. The Italian report explicitly emphasized this, noting that their narrative-driven approach, using a martial arts storyline, successfully broke down traditional barriers associated with STEM, making it more accessible and engaging.

The Greek report highlighted that 64.7% of students expressed greater confidence in participating in STEM activities. Similarly, the Slovenian report indicated that 42.9% of students showed increased interest in STEM. The engaging nature of these projects—such as mystery movies and hands-on experiments—demonstrates a similar breaking down of barriers, making STEM learning more enjoyable and less intimidating.

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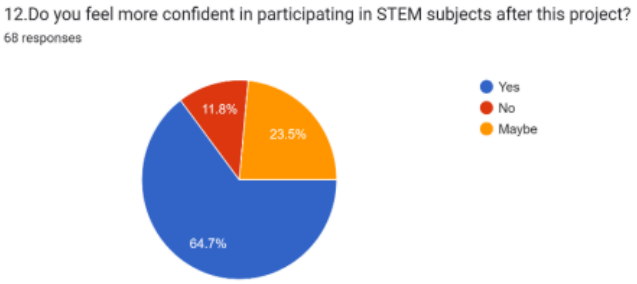
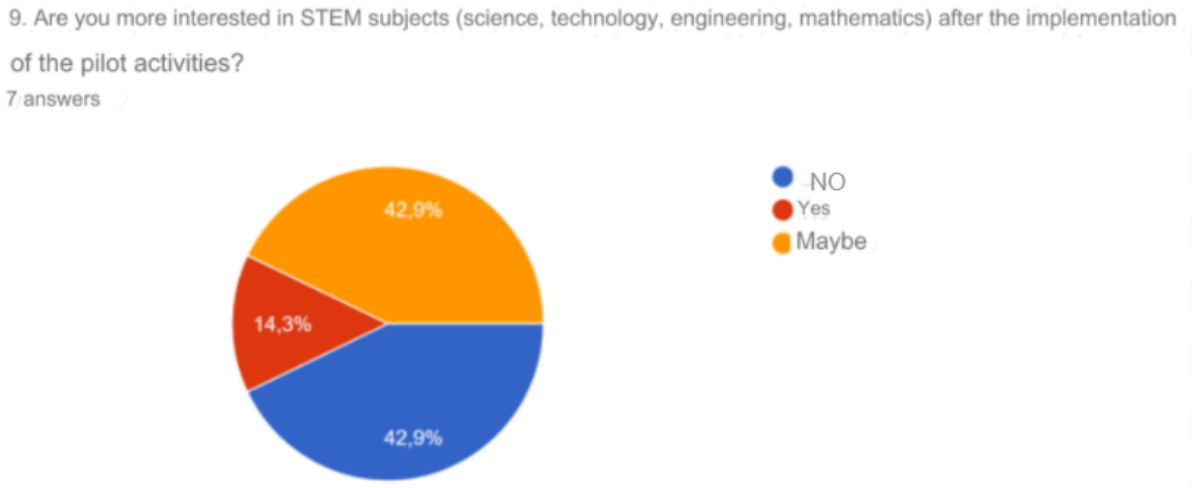
Question 12: Confidence in STEM Subjects

Confidence in STEM participation increased, with 64.7% of students expressing greater confidence. Conversely, 11.8% did not feel more confident, and 23.5% were uncertain. Similar to creative writing, a significant number of students reported enhanced confidence in participating in STEM subjects after the project. This indicates a positive impact on students' confidence in STEM.



Confidence in STEM, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)



Interest in STEM, results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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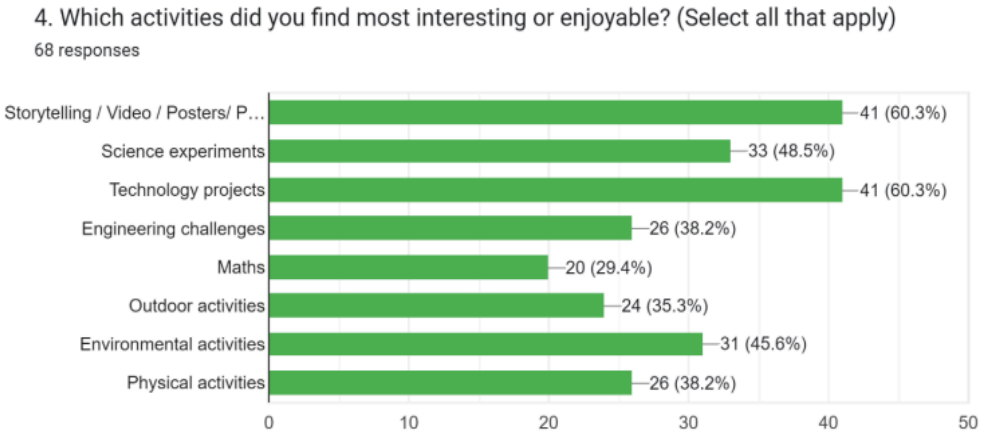
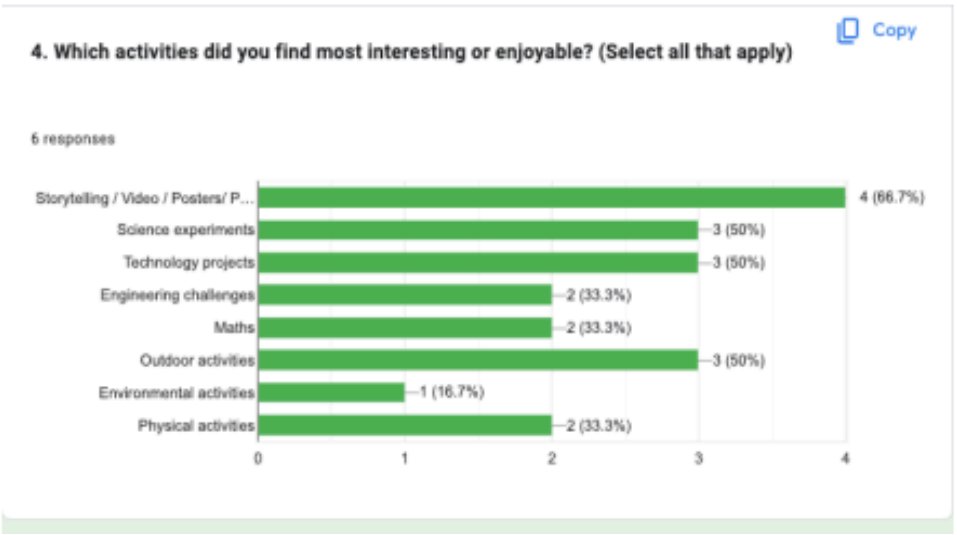
In terms of specific activities, storytelling, video creation, posters, and presentations were viewed as the most interesting and enjoyable by 66.7% of students in Italy and 60% of students in Greece. Greek students also showed a strong interest in technology-related activities (60%). In Slovenia, 85.7% of students enjoyed science experiments, and 71.4% liked outdoor activities.



Most popular activities, resulst from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)



Most popular activities, resulst from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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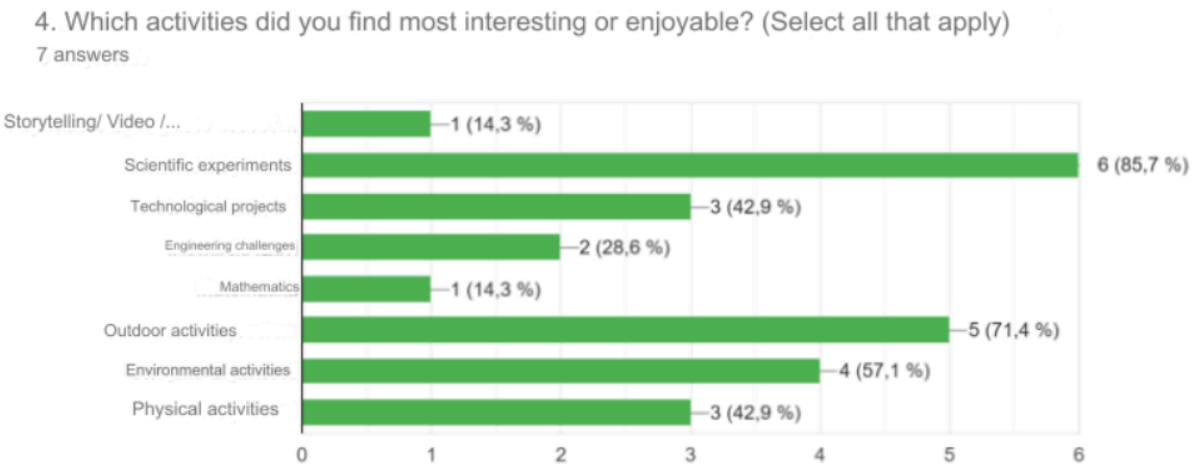
Q4: Which activities did you find most interesting or enjoyable? (Select all that apply)



Most popular activities, resulst from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

4.2 Teacher Observations:

Teachers observed improvements in student engagement, enhanced learning outcomes, and notable gains in collaborative skills. For example, teachers in Slovenia and Italy highlighted student engagement as one of the most successful aspects of the pilot, with 100% and 75% of teachers, respectively, noting its effectiveness.

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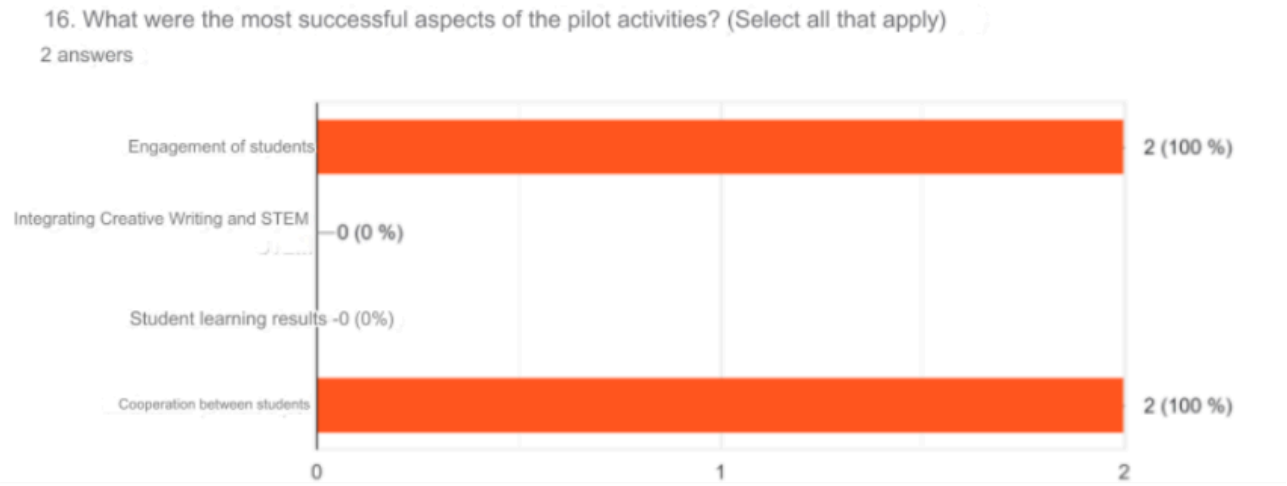
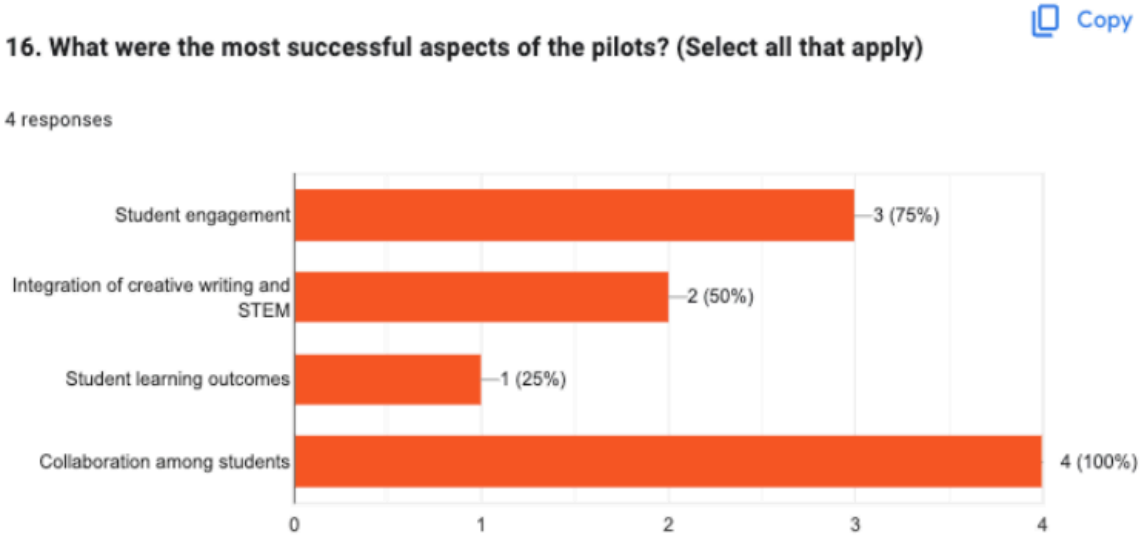
Q16. What were the most successful aspects of the pilots? (Select all that apply)

Both teachers agreed that Student engagement and Collaboration among students were the most successful aspects of the pilots.



Most Successful Aspects of the Pilots, results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)



Most Successful Aspects of the Pilots, results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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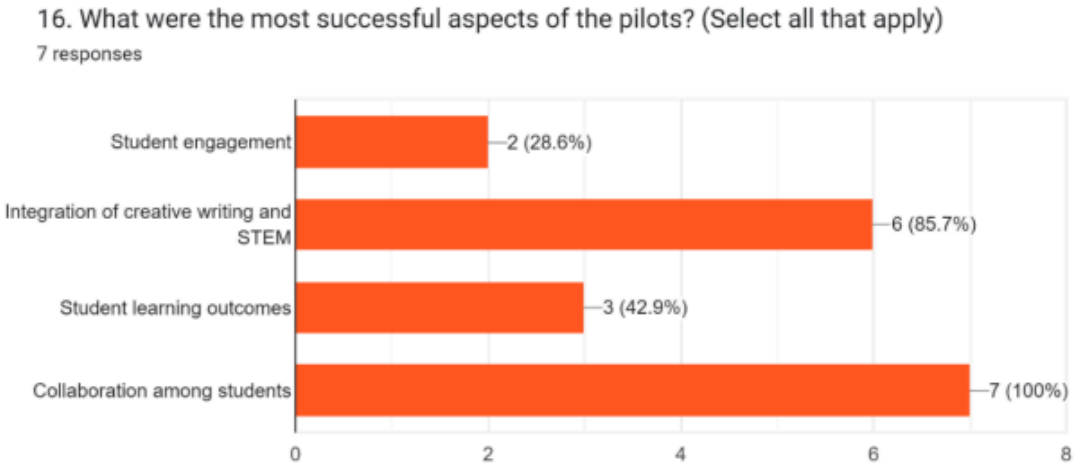
Additionally, all teachers rated student collaboration as a positive outcome of the pilot, with 100% agreement. Overall, the project was highly effective in engaging students across the participating countries.



Most Successful Aspects of the Pilots, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)

5. Pilots' Outcomes

5.1 Learning Outcomes

The pilot projects produced a range of tangible student outputs, highlighting both their learning and creativity. Written work was a key component across all projects, with students creating reports, presentations, posters, and comics. The Italian project focused on narrative development, leading to the creation of a full script for the kamishibai theater performance. Students in Greece and Slovenia also developed multimedia presentations to share their research findings and

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project results. In Italy, creative drawing played an important role, as students produced detailed illustrations to accompany their kamishibai theater performance.

Each project concluded with unique student products that demonstrated the practical application of their learning. For example, the Italian kamishibai theater performance combined physics principles with a martial arts narrative, allowing students to showcase their understanding through a blend of written scripts, artistic illustrations, and theatrical skills. In Slovenia, students engaged in hands-on experimental work, resulting in bioplastic prototypes that applied scientific principles to real-world challenges. The Greek project addressed biodiversity loss by having students develop innovative STEM solutions, such as an AI-powered beehive, coding bee-related games, 3D printing beehives, and creating hands-on beehives to monitor environmental conditions.

Deeper Understanding of STEM Concepts: The combination of creative writing and STEM subjects fostered a deeper understanding of complex scientific concepts. For instance, the Greek and Italian pilots survey showed that 54.4% and 83.3% , respectively, reported a better understanding of STEM topics after using creative writing to communicate their learning about biodiversity.

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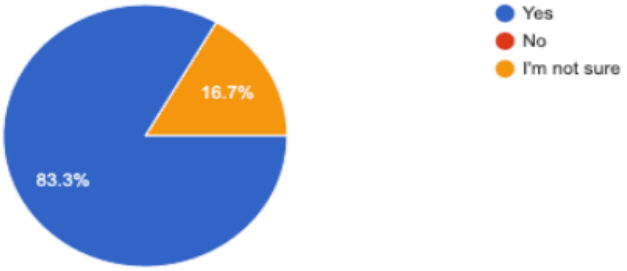
7. Did the integration of creative writing and STEM help you understand the subjects better?

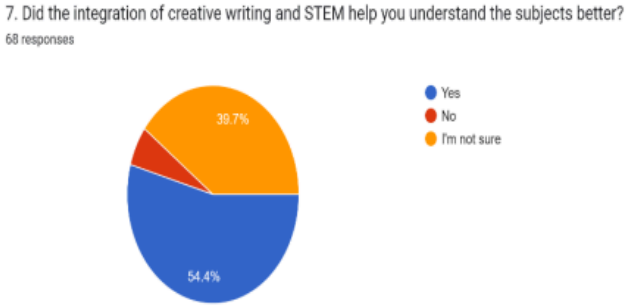
6 responses



Impact on Subjects Comprehension, results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

Question 7: Integration of Creative Writing and STEM

A majority (54.4%) felt that the integration of CWL with STEM helped them understand the subjects better, though 39.7% were not so sure. This reflects a positive feedback regarding the effectiveness of integrating creative writing with STEM subjects.



Impact on Subjects Comprehension, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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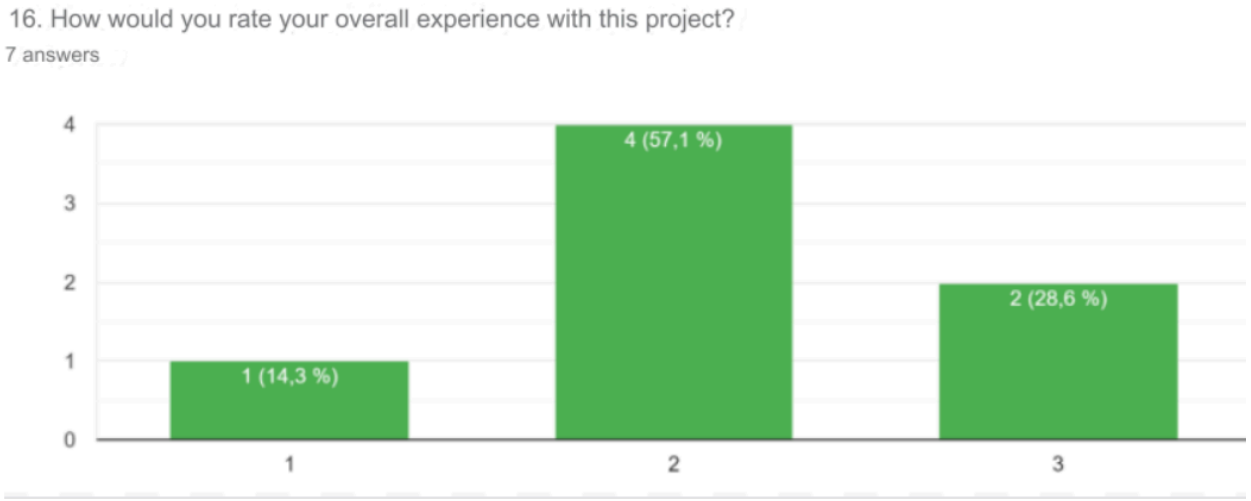
In the Slovenian report, students who created posters, presentations, and a short movie about bioplastics demonstrated a good understanding of STEM principles related to polymerization and waste management. Students reported to be satisfied (57.1%) and very satisfied (28.6%) with overall experience of the pilots.



Overall experience with the Pilots, results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

. Additionally, 42.9% of students expressed a greater interest in STEM subjects following the implementation of the CWL model, while another 42.9% indicated they may have developed a greater interest in STEM

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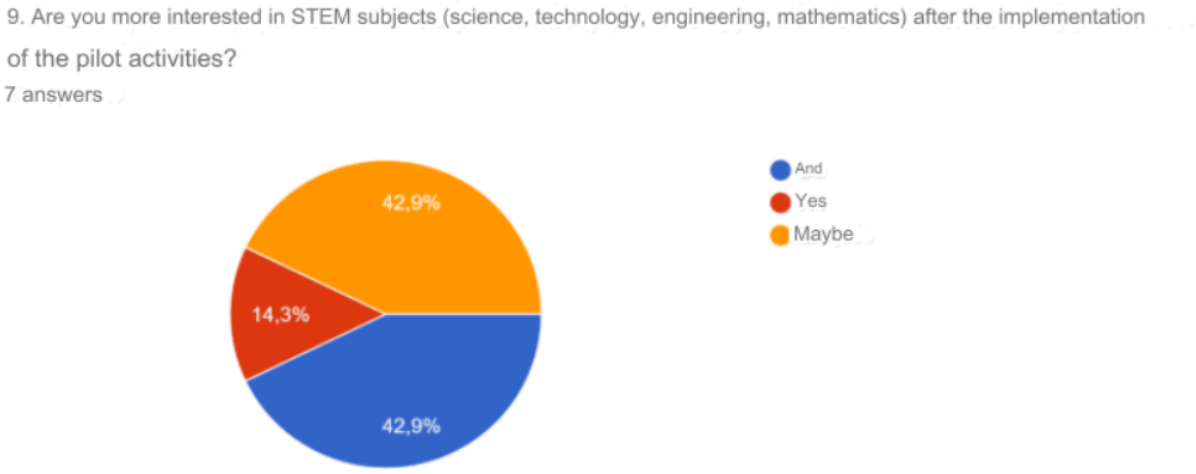

Interest in STEM, results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

The Italian report (*Annexes 13.1 POST PILOT REPORTS*) illustrated that applying physics principles to create martial arts techniques for their theater performance led to a demonstrably improved understanding of physics concepts like dynamics and vectors among the students.

The **effectiveness of the CWL approach** is further supported by various assessment strategies used by teachers across the pilot projects. These strategies included observations, group work evaluations, quizzes, surveys, project presentations, and written assignments. In the Greek and Slovenian projects, teachers observed significant improvements in student engagement, learning outcomes, and collaborative skills. Students' self-reflections, gathered through questionnaires and surveys, also supported these findings.

For example, students in Greece and Slovenia reported not only increased interest in STEM fields but also greater confidence in their scientific understanding (58.8% and 57.1%, respectively).

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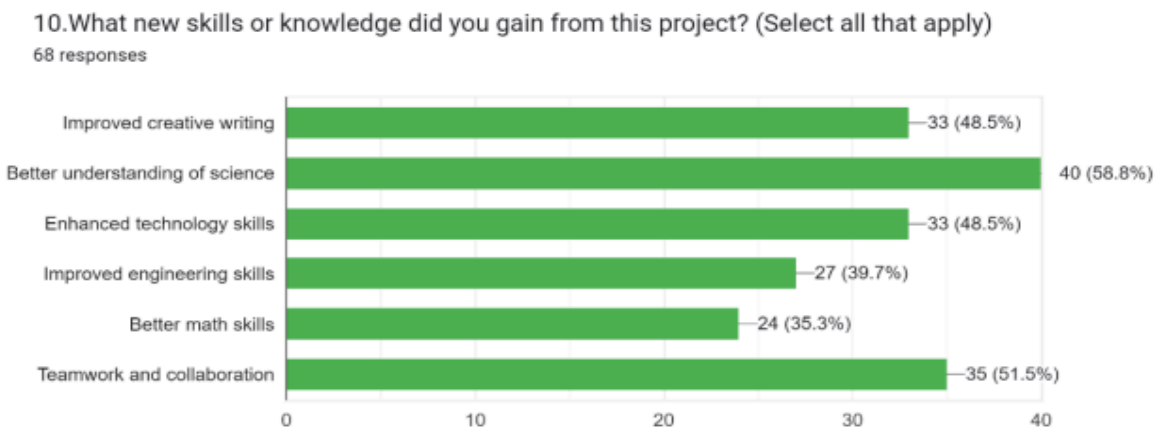
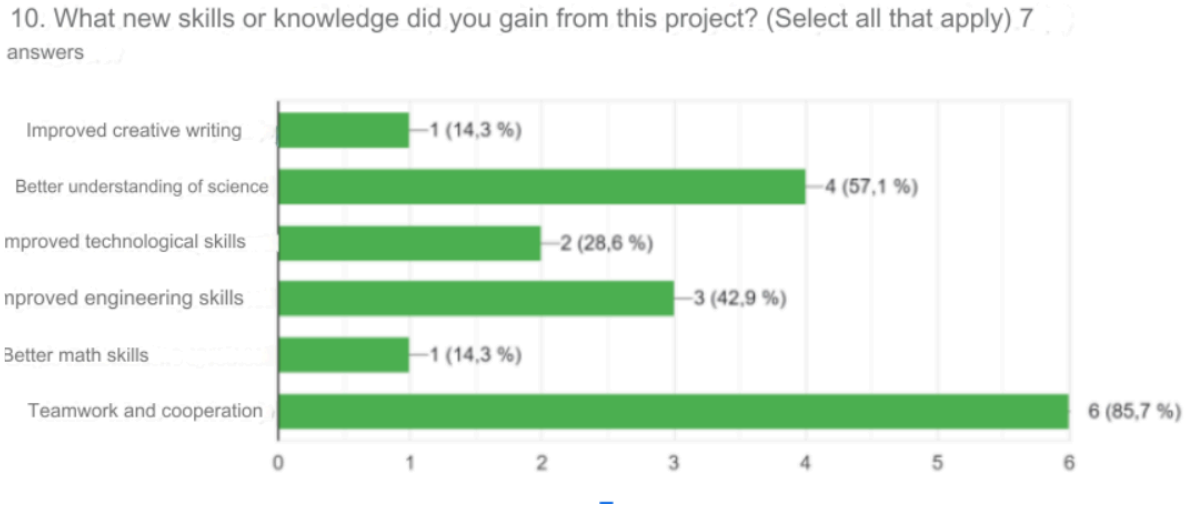


New skills and knowledge, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)



New skills and knowledge, results Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

5.2 Soft skills and Personal Growth

The CWL projects also contributed to the development of essential 21st-century skills among students, particularly in **collaboration**,

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communication, **critical thinking**, **problem-solving**, and **creativity**. Across all projects, students worked in teams, which significantly enhanced their teamwork and cooperation abilities. Teachers in all countries highlighted student collaboration as the most successful aspect of the pilot. In Slovenia and Greece, students developed their teamwork skills through collaborative research, experimental work, and project presentations. Similarly, in Italy, activities such as brainstorming for the kamishibai theatre and practicing judo in pairs provided opportunities for students to strengthen their teamwork.

Communication, collaboration and **presentation** skills were also notably improved through the integration of creative writing with STEM subjects. In Greece, students were encouraged to convey complex ideas through various formats, including presentations, posters, infographics, and comics. Slovenian students communicated their research findings on bioplastics in similar ways. The Italian project culminated in a kamishibai theater performance, providing a platform for students to showcase their communication and storytelling abilities, effectively blending scientific concepts with narrative techniques.

The CWL projects also challenged students to **think critically and solve real-world problems**. For instance, the Greek project focused on developing technology-based solutions to environmental issues, requiring students to analyze problems, research potential solutions, and devise innovative approaches. Slovenian students engaged in experimental work with bioplastics, overcoming challenges in the laboratory. In Italy, students applied physics principles to resolve challenges within their martial arts narrative, demonstrating their ability to connect theoretical knowledge with practical applications.

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Creativity and innovation were central to the CWL approach. The Greek project encouraged students to develop technology-based solutions to address biodiversity loss, fostering innovative thinking and creative communication. Slovenian students demonstrated their creativity in designing bioplastic prototypes and crafting engaging presentations. Meanwhile, the Italian project's integration of martial arts, physics, and storytelling highlighted the power of creative thinking in linking seemingly unrelated disciplines.

6. Assessment of Students and impact:

6.1 Assessment Strategies

The assessment of student learning and the impact of the CWL pilot projects utilized various methods for a comprehensive evaluation. Observations and group work evaluations were key, allowing teachers to monitor students' participation, collaboration, and problem-solving skills (*Annexes 13.1 POST PILOT NATIONAL REPORTS*).

In the Slovenian project, teachers assessed student learning and progress using observations, self-assessments, rubrics, peer reviews, and group work evaluations (50%).

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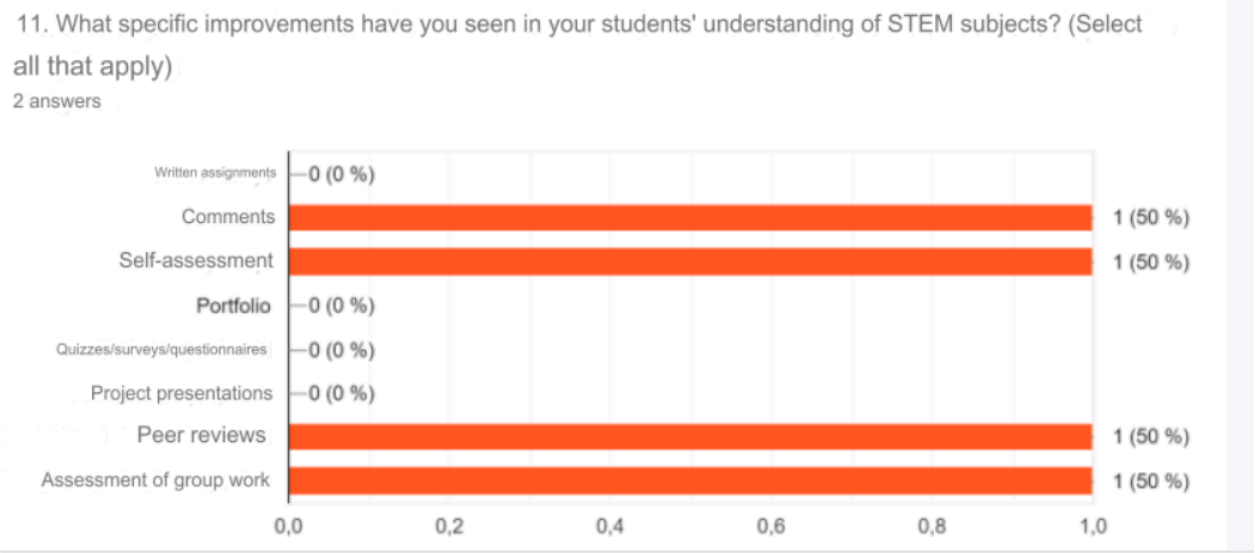
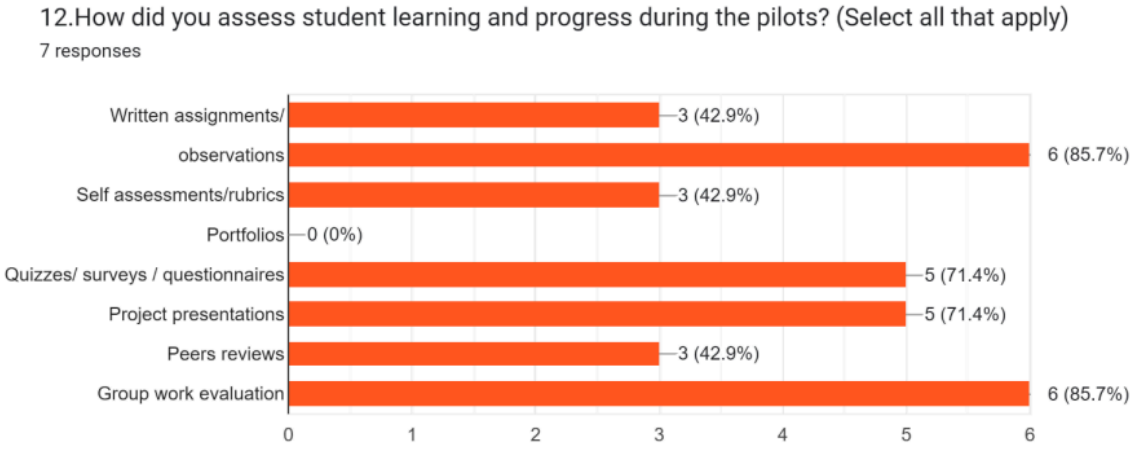


Assessment strategies, results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

Greek teachers primarily used observations and group work evaluations (85.7%), along with quizzes, surveys, and project presentations (71.4%) to assess students.



Assessment strategies, results Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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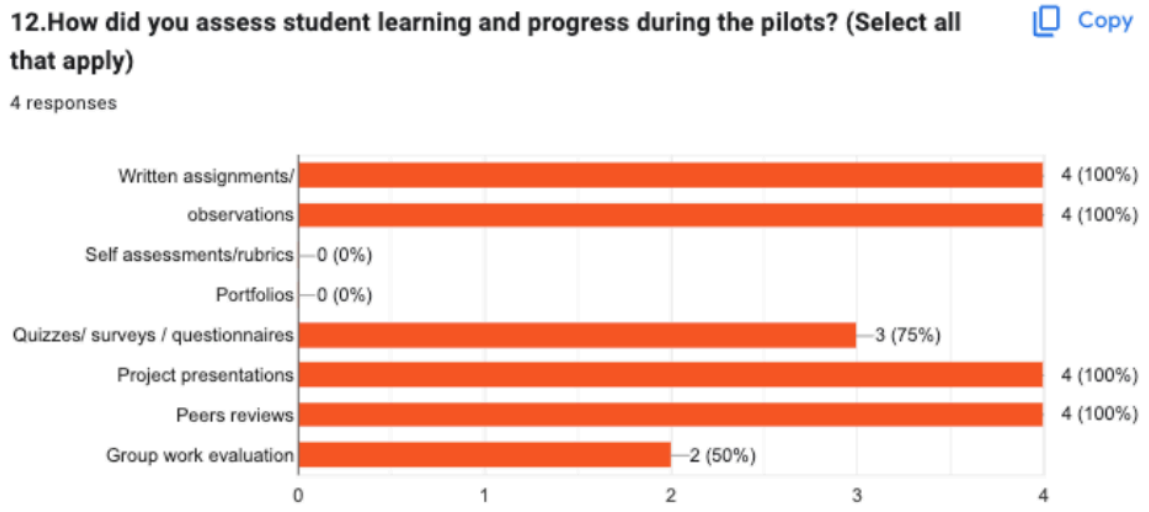
In Italy all teachers applied written assessments, observations,project presentations and peers review (100%) to assess their students.



Assessment strategies, results Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

Quizzes, surveys, and questionnaires played a crucial role in capturing shifts in students' understanding and attitudes. Pre- and post-project questionnaires were used to measure changes in STEM knowledge and overall experiences. These tools provided both quantitative and qualitative insights into student learning gains and perceptions of the CWL model. The Greek project particularly highlighted the use of these questionnaires to evaluate engagement and the integration of creative writing with STEM.

Project presentations were another key assessment tool, offering a platform for students to showcase their work and communication skills. In Slovenia, students presented their bioplastic prototypes, while in Italy, the kamishibai theatre performance blended creative writing with

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physics. Greek students used presentations and experiments to engage the school community, demonstrating their understanding and creativity.

Teachers also analyzed student work, such as worksheets, assignments, and creative outputs, to gauge comprehension and creative thinking. For instance, in Slovenia, worksheets were reviewed and discussed with students, while the Italian project focused on evaluating illustrations and scripts. The Greek project involved assessing programming, coding, and visual presentations.

6.1 Evaluation of Impact

Overall, the combination of observations, questionnaires, project presentations, and work analysis provided a well-rounded view of student progress. These strategies effectively measured cognitive, affective, and psychomotor development. The pilot projects showed positive impacts, including improved STEM understanding, enhanced creative writing, and development of 21st-century skills. For example, 54.4% of Greek students reported a better grasp of STEM topics, and the Italian project demonstrated the application of physics principles through judo techniques.

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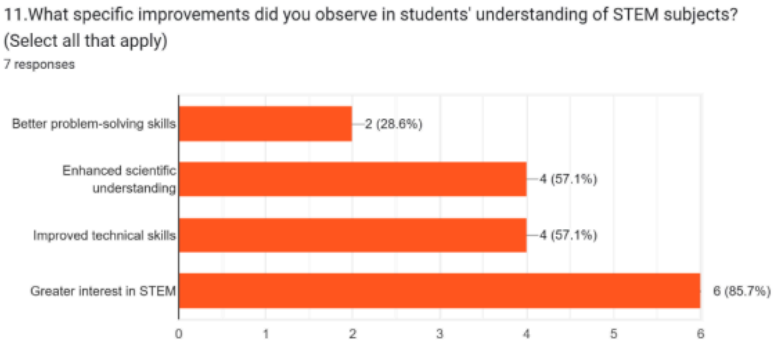
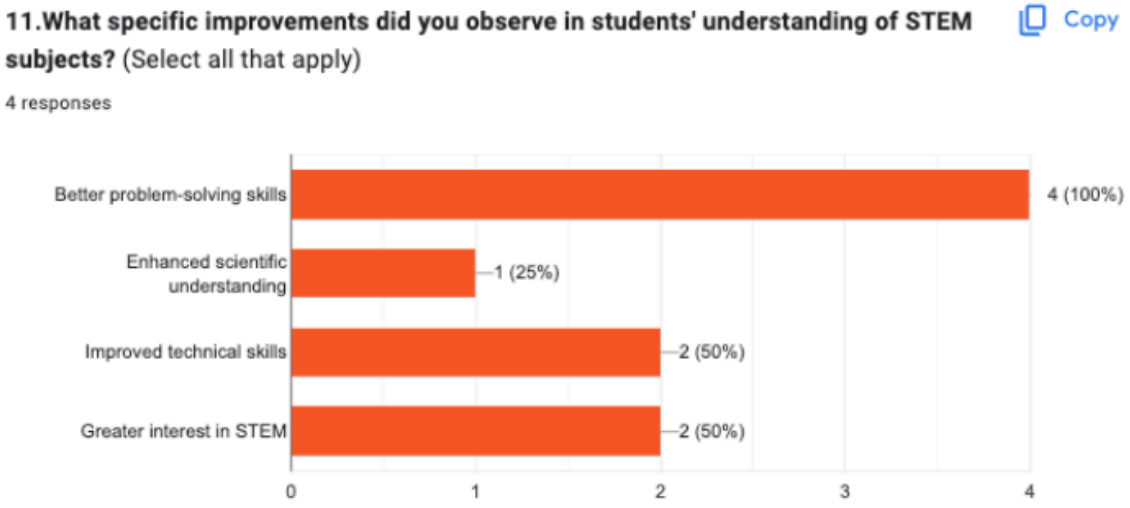
Question 11: What specific improvements did you observe in students' understanding of STEM subjects?

85.7% of teachers observed greater student interest in STEM subjects. 57.1% saw improvements in students' scientific understanding and technical skills. 28.6% of teachers reported observing better problem-solving skills in their students. This suggests integrating creative writing with STEM may be effective in helping students understand scientific concepts.



Improvements in Students' STEM Understanding, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)



Improvements in Students' STEM Understanding, Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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Student engagement generally was improved through the CWL model, with storytelling and hands-on activities, such as the Italian kamishibai theatre, playing a significant role. The CWL projects also successfully fostered essential skills such as collaboration, communication, critical thinking, problem-solving, creativity, and innovation.

In conclusion, the CWL pilot projects employed a comprehensive assessment approach, providing valuable insights into student learning and project impact. The varied assessment methods highlighted the model's effectiveness in enhancing STEM education and preparing students for future challenges.

7. Teachers' Professional Development

The Creative Writing Lab (CWL) pilot projects have notably advanced teachers' professional development across partners' schools, each contributing to a richer, more effective teaching practice.

In Greece, the CWL project had a significant impact on teachers' professional growth. A substantial majority, 85.7%, reported increased comfort with project-based learning, integrating STEM activities, and utilizing the CWL model. The project provided valuable resources, with 85.7% of teachers finding the lesson plans helpful and 100% appreciating the digital tools provided. The positive feedback and unanimous

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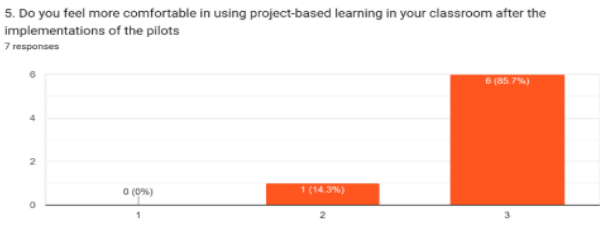
recommendation of the methodology underscore the project's success in enhancing teachers' confidence and skills. The integration of creative writing with STEM education was particularly well-received, contributing to a more engaging and interdisciplinary learning environment.

Question 5: Do you feel more comfortable in using project-based learning in your classroom after the implementations of the pilots?

85.7% of those surveyed felt more comfortable using project-based learning in their classrooms after participating in the Creative Writing Lab pilot program. This suggests that the Creative Writing Lab methodology may be effective in increasing teacher confidence in implementing project-based learning.



Comfort Level with Project-Based Learning, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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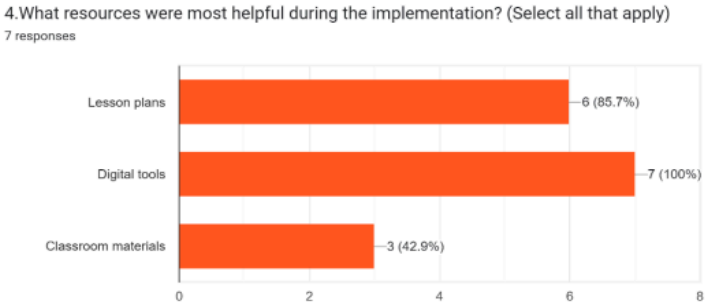
Question 4: What resources were most helpful during the implementation?

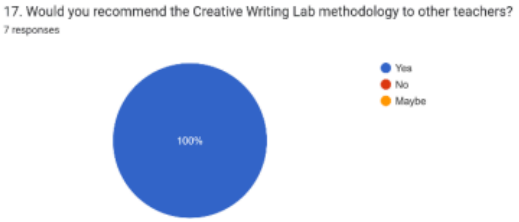
The resources deemed most helpful by teachers during the implementation of the Creative Writing Lab methodology were digital tools (100%) and lesson plans (85.7%) while classroom materials were helpful for 42.9% of respondents. This shows that the provision of lesson plans and digital tools was vital in supporting teachers during the implementation of the Creative Writing Lab methodology.



Most helpful resources, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)

Question 17: Would you recommend the Creative Writing Lab methodology to other teachers?

All respondents (100%) stated they would recommend the Creative Writing Lab methodology to other teachers. This unanimous endorsement suggests a high level of satisfaction with the Creative Writing Lab methodology among participating teachers.



Recommandation of the CWL model, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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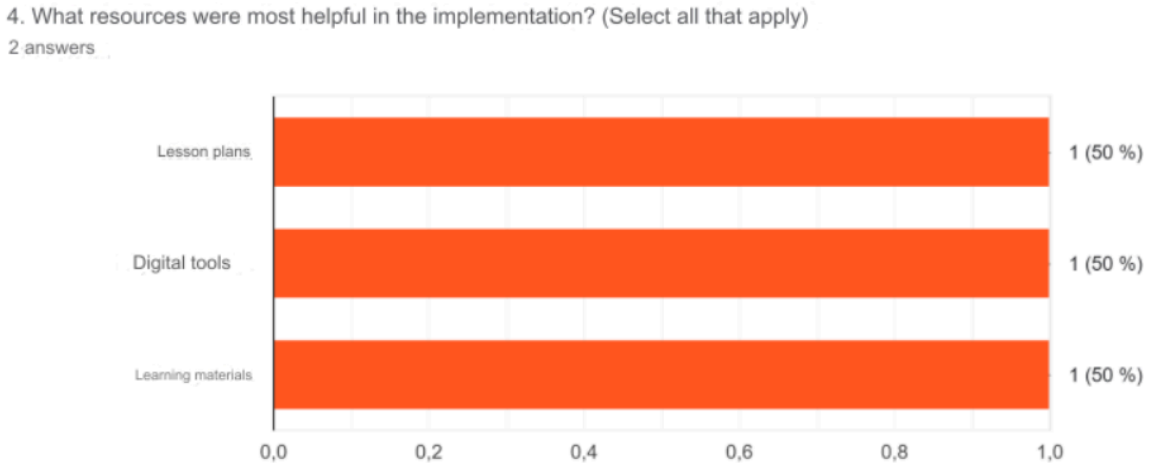
In Slovenia, the focus was on the benefits of collaboration and flexibility (*Annexes 13.1 POST PILOT REPORTS*). Teachers gained valuable insights by working together and exchanging knowledge and ideas. They learned the importance of adapting to new teaching methodologies and using digital tools effectively. The project highlighted the need for adequate resources, such as literature and equipment, to support the learning process and stimulate student interest. This collaborative and resourceful approach helped teachers to enhance their teaching practices and better engage their students. All teachers felt comfortable to very comfortable using project-based learning, STEM and Creative Writing in the classroom after the implementations of the pilots (*Annexes 13.2 POST PILOT QUESTIONNAIRES*).



Most helpful resources, results fromSlovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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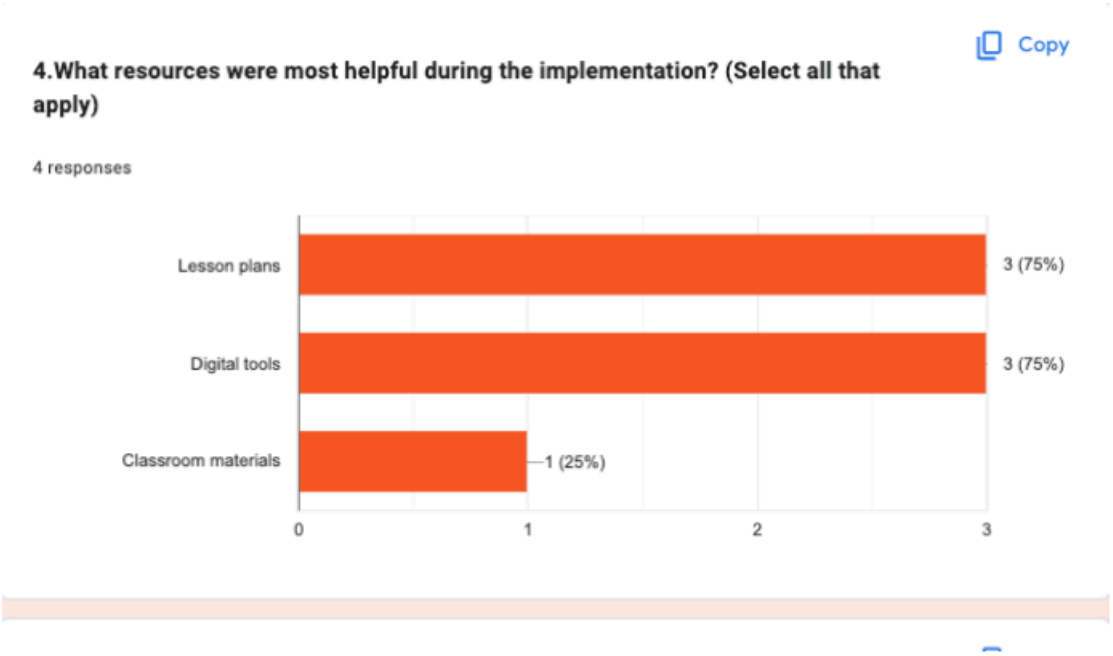
In **Italy,** the CWL project fostered significant professional development through collaborative efforts in instructional strategy and curriculum design. Educators at IEXS worked closely to develop lesson plans that integrated physics principles with creative writing and martial arts. This collaboration was complemented by participation in workshops focused on narrative-driven learning approaches and ongoing training. These efforts aimed to strengthen teachers' pedagogical skills, enabling them to create impactful and interdisciplinary learning experiences. The project effectively enhanced teachers' abilities to engage students and facilitate creative and effective learning environments (*Annexes 13.1 POST PILOT REPORTS)*.



Most helpful resources, results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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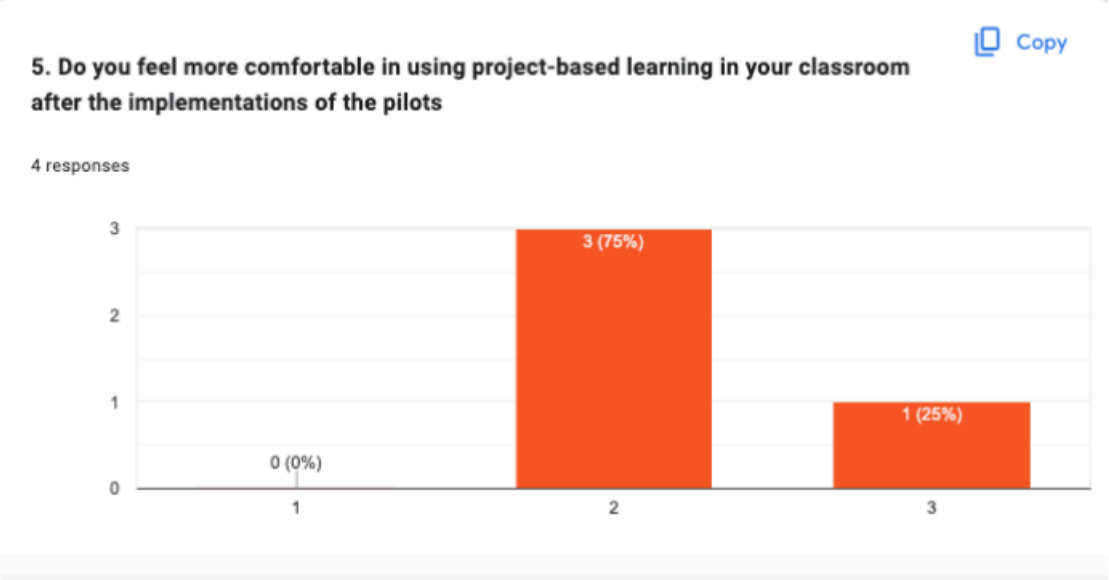
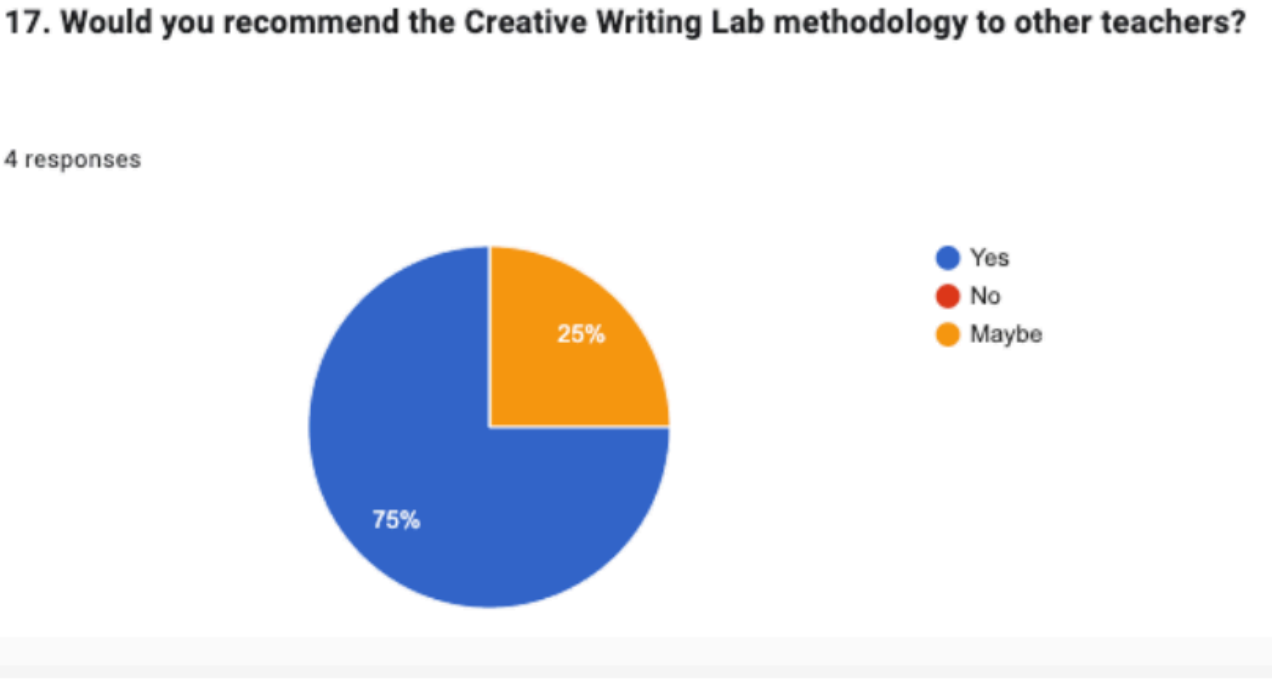


Comfort Level with Project-Based Learning, results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)



Recommandation of the CWL model, results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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All teachers from all countries felt more and much more comfortable implementing project-based projects and Stem projects. Overall, the CWL pilot projects demonstrated a strong commitment to enhancing teachers' professional development through collaboration, resources and teaching materials and innovative training. These efforts have not only improved teachers' instructional strategies but also enriched their ability to deliver engaging and interdisciplinary education.

8. Challenges and Successes

Examining the challenges and successes of each pilot project provides valuable insights for future implementations of the CWL model.

In Greece, teachers faced challenges with time management, student engagement, and curriculum alignment. These issues are common in educational settings, particularly when introducing innovative teaching methods. Despite these difficulties, the project succeeded in creating a supportive learning environment that empowered students to excel both academically and creatively in STEM disciplines. Adjustments to lesson plans, collaboration among colleagues, and additional support for students helped address the initial challenges. Students found the activities manageable and felt well-supported by their teachers and peers.

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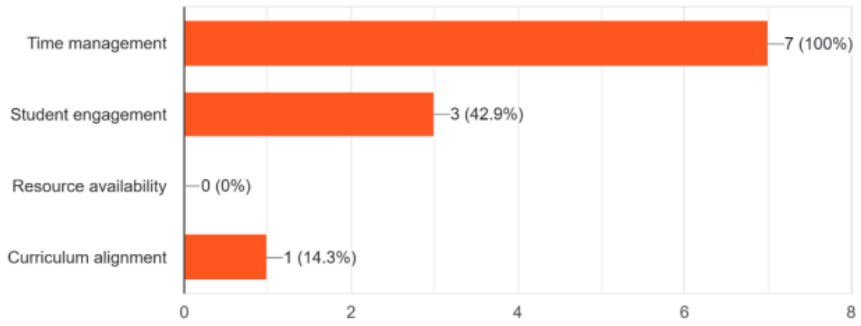
13. What challenges did you encounter during the implementation of the pilotsproject? (Select all that apply)

7 responses



Challenges, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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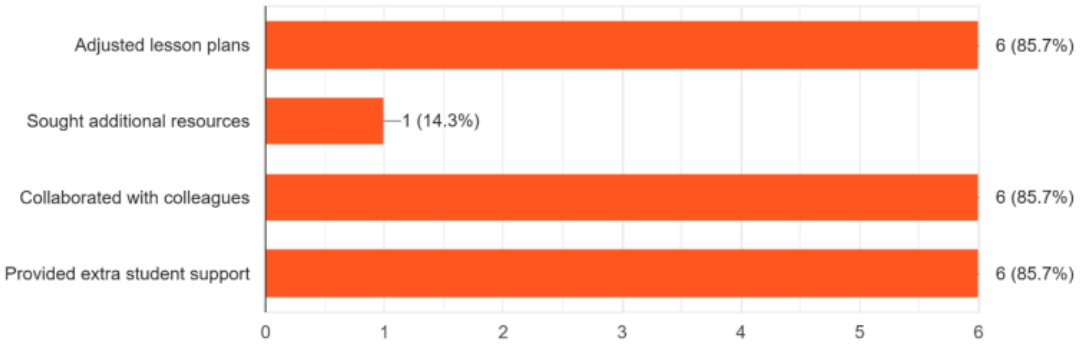
14.How did you address these challenges? (Select all that apply)

7 responses



Solutions, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)

In Slovenia, time management and curriculum alignment were ongoing issues. The project also encountered problems with limited resources for certain topics and varying levels of student engagement, with some

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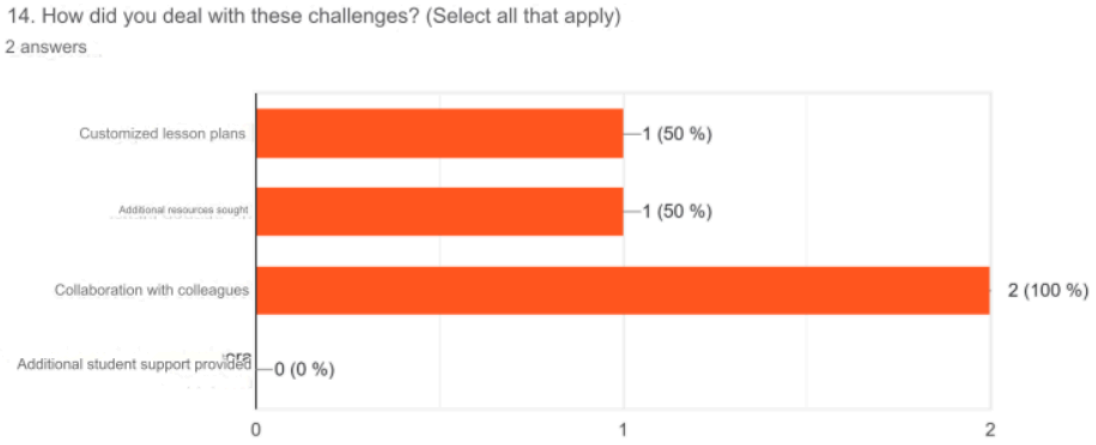
groups reluctant to participate. Laboratory work presented minor difficulties. However, the involvement of an external researcher provided valuable firsthand insights. Individual discussions effectively addressed issues related to student participation and assignment completion. Ultimately, the project achieved positive learning outcomes, with students developing new skills in teamwork, scientific understanding, and experimental work.

Both teachers exposed some Time management issues, the lack of Student engagement and some difficulties with Resource availability and Curriculum alignment. Teachers solve these problems with collaboration with colleagues, adjusting lesson plans and seeking additional resources (Graph 14).



Challenges, results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

In Italy, the project faced challenges related a) to time management and b) in translating abstract physics concepts into practical judo skills and in coordinating diverse student ideas during collaborative activities. Despite these obstacles, interactive demonstrations, incremental teaching methods, and frequent hands-on practice effectively conveyed complex

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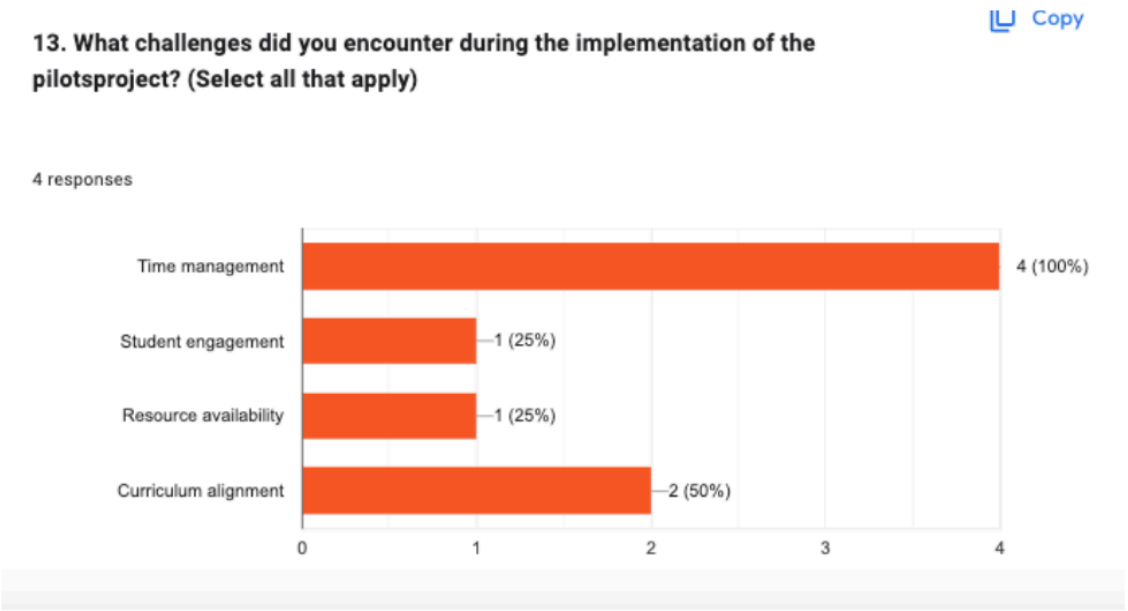
physics concepts. Teachers facilitated teamwork exercises and encouraged peer learning to enhance collaboration during group activities. The project successfully boosted student engagement, improved their judo techniques and understanding of physics, and fostered teamwork and manual dexterity.



Challenges, results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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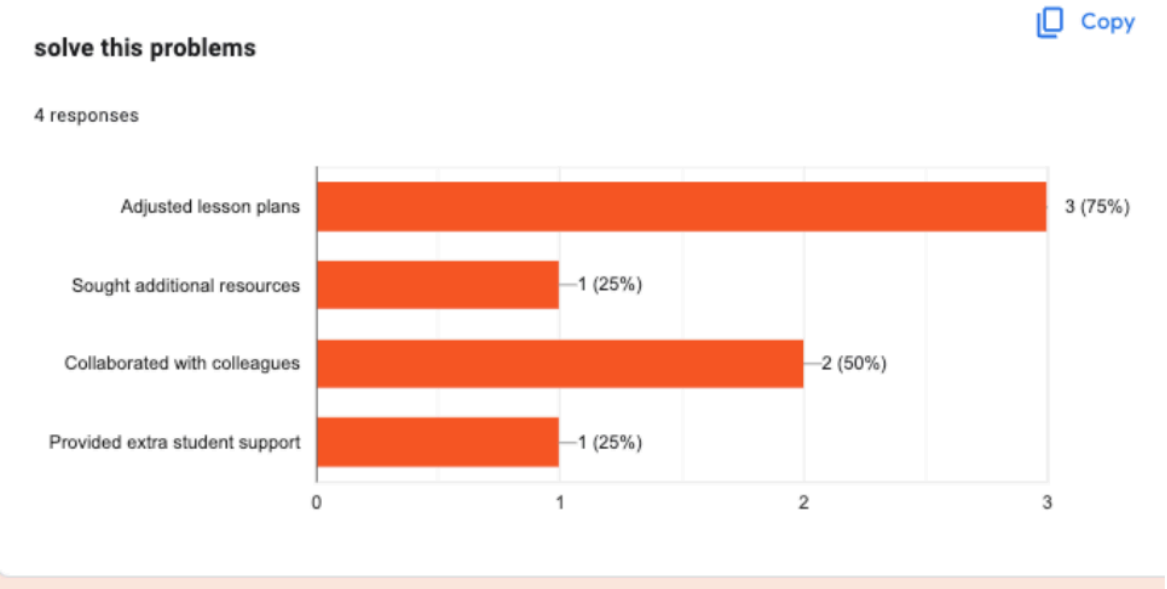

Solutions, results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

9. Documentation and Output

The CWL pilots employed diverse approaches to documenting student work, showcasing methods that fostered engagement, creativity, and scientific understanding *(Annexes 13.1 POST PILOT NATIONAL REPORTS).*

In Greece (*13.3 Implementation Strategies: Plans, Learning Scenarios, and Success Stories*), students employed a wide range of methods to document their work, reflecting both creativity and an emphasis on community involvement. They created presentations, games, simulations, bee and hive models, infographics, and comics, effectively using these diverse formats to communicate their findings on biodiversity and STEM-related topics. The projects didn't stop at the classroom level; students took their work beyond their groups and engaged the broader school community. By organizing and delivering seminars for their peers,

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they actively raised awareness about their projects, ensuring that the entire school benefited from the insights gained during the pilot. This outreach component fostered not only student engagement but also a sense of shared responsibility and collaboration within the school.

In Italy, documentation was thorough and multifaceted, capturing students' learning experiences in a variety of ways. Students reflected on their progress through pre- and post-project questionnaires, which provided valuable insights into their evolving understanding of physics concepts and engagement with the narrative-based learning approach. The project was visually documented through video recordings and photos, allowing both students and teachers to capture key moments during lessons, rehearsals, and the final kamishibai theater performance.

The creative integration of art and science was central to the Italian project. Students created detailed illustrations that visually represented physics principles, which were then incorporated into the kamishibai theater performance. This creative documentation not only enhanced the students' understanding but also made complex concepts more accessible to the audience. Additionally, the hands-on construction of the kamishibai theater provided students with a tangible way to apply spatial and narrative skills, reinforcing their interdisciplinary learning.

In Slovenia, students documented their work through a structured approach, combining worksheets, experimental work, and multimedia outputs. From the outset, each group was provided with worksheets that guided their assignments and served as a record of their progress. These worksheets were regularly reviewed in class, encouraging reflective learning and fostering a collaborative review process between students

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and teachers. In the laboratory, students created "alter pots" as part of their hands-on experimentation, which were later exhibited during their final presentations. These physical creations showcased the students' ability to apply scientific principles to practical challenges. In addition to these hands-on projects, students also produced posters, PowerPoint presentations, and a short movie, all of which documented their learning journey and allowed them to communicate their findings in a variety of formats.

Across all countries, students demonstrated high levels of creativity and adaptability in documenting their work, with each country emphasizing different aspects of the process tailored to their curriculum and students' ages.

In Greece, the focus on community engagement stood out, with students actively raising awareness and involving their peers in the learning process. The Italian project was notable for its combination of narrative and scientific documentation, where students used artistic expression to deepen their understanding of STEM concepts. Slovenia adopted a more structured approach, emphasizing the importance of experimentation and reflective learning through guided worksheets and hands-on activities.

While the methods varied, all pilots successfully integrated creative writing and scientific documentation, helping students not only understand STEM concepts but also communicate their findings in innovative and engaging ways. These documentation practices played a crucial role in reinforcing the students' learning experiences and in

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fostering essential 21st-century skills such as communication, collaboration, and problem-solving.

In Poland?

10. Lessons Learned and Recommendations

The pilot projects offer valuable insights and recommendations for future implementations of the CWL model in STEM education.

Flexibility is crucial for adapting the CWL model to various contexts, student needs, and available resources. The Greek and Slovenian projects particularly emphasize the importance of being adaptable in lesson planning, time management, and addressing unforeseen challenges.

Continuous assessment plays a key role in effective teaching. Regularly evaluating student progress through diverse methods—such as observations, group work evaluations, quizzes, and student self-reflections—helps inform teaching strategies and ensures that the CWL model meets learning objectives.

Collaboration is another vital aspect. Working together with other teachers and, when possible, external experts can facilitate the sharing of ideas, resources, and best practices, as well as provide support during implementation.

Adequate resources are essential for the successful implementation of CWL. This includes providing sufficient time, materials, and professional development opportunities for teachers, as well as access to relevant

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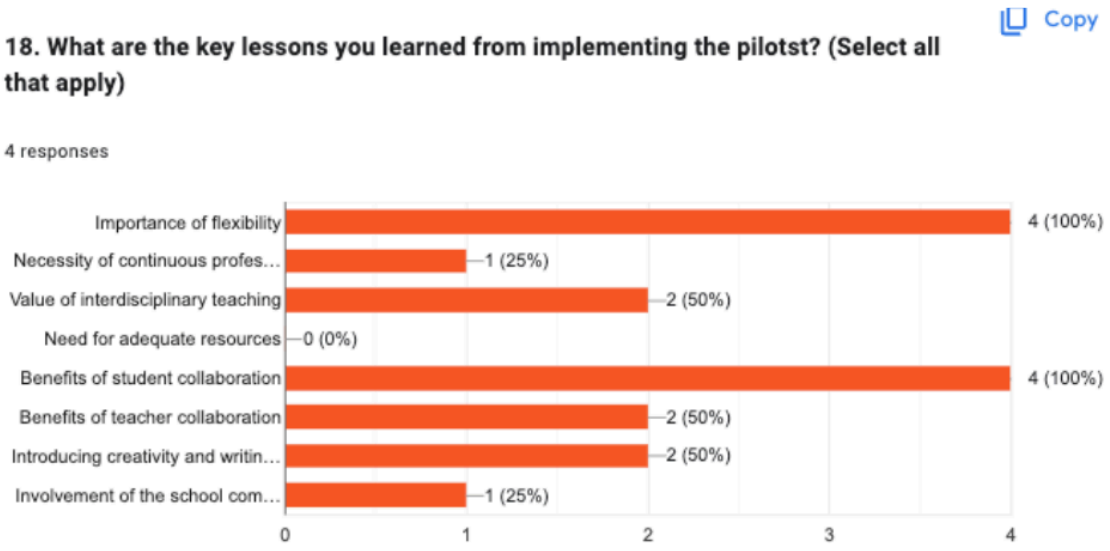
technology and laboratory equipment. External partnerships can also enhance learning experiences.

Finally, **incorporating storytelling** can significantly enhance student **engagement** and **motivation**. A compelling narrative makes complex STEM concepts more relatable and offers a creative framework for students to explore and apply their knowledge. It also helps reinforce their learning through reflection as they create multimedia elements—such as posters, infographics, comics, and presentations—to showcase their work.

These lessons offer a roadmap for educators aiming to implement the CWL model effectively, underscoring the need for flexibility, collaboration, continuous assessment, and proper resource allocation to create impactful learning experiences that foster interdisciplinary understanding and student creativity in STEM.



Key lessons, results from Italy (Annexes 13.2 POST PILOT QUESTIONNAIRES)

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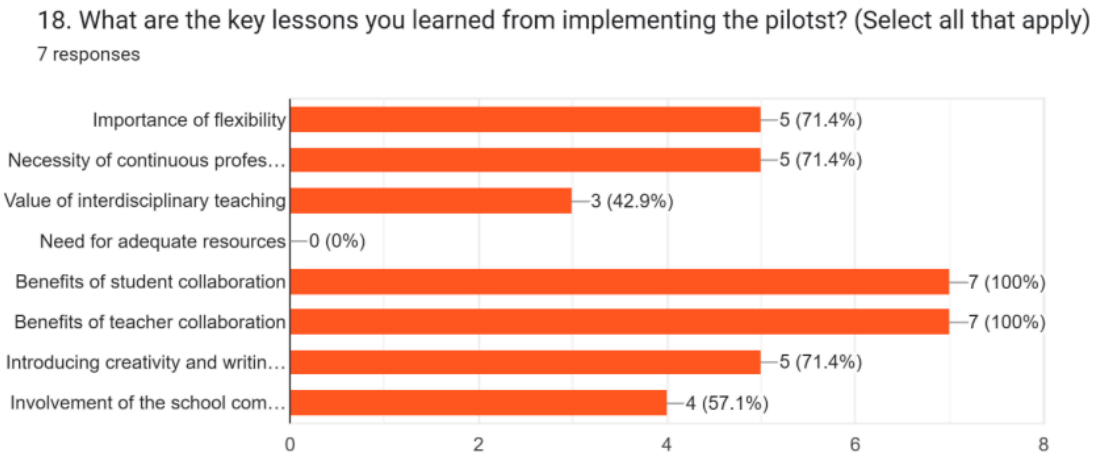
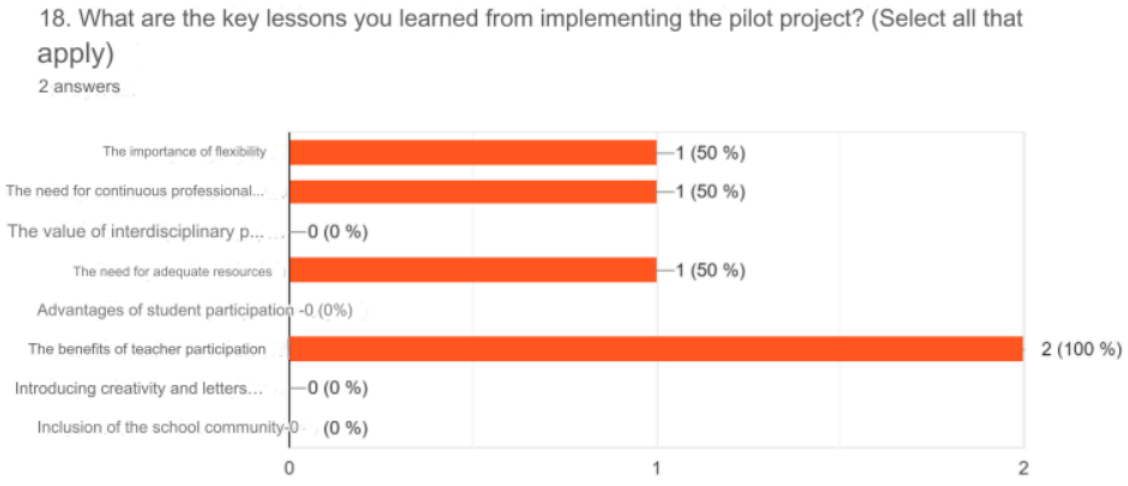


Key lessons, results from Greece (Annexes 13.2 POST PILOT QUESTIONNAIRES)



Key lessons, results from Slovenia (Annexes 13.2 POST PILOT QUESTIONNAIRES)

11. Sustainability and Scalability

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11.1 Sustainability:

The CWL model has shown considerable promise for long-term adoption and integration into educational practices. Positive feedback from teachers and students alike indicates that the model is well-received. In Greece, all participating teachers expressed their intention to recommend the CWL methodology, suggesting strong potential for continued use. Similarly, teachers in Slovenia appreciated the model for its ability to foster student collaboration and engagement, implying that its benefits could extend beyond the pilot phase.

The successful incorporation of the CWL projects into existing curricula across all pilot locations further supports the model's sustainability. By aligning with curriculum objectives, the CWL approach is integrated into regular teaching practices, ensuring it is more than just a temporary initiative.

Teacher training and support are essential for the model's continued success. While specific details on training are not extensively covered, the positive feedback suggests that sufficient support and resources were likely provided. Ongoing professional development and access to resources such as lesson plans and digital tools will further aid in sustaining the CWL approach.

11.2 Scalability

The CWL model has demonstrated adaptability across various educational contexts, as evidenced by its implementation in Greece,

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Slovenia, and Italy and Poland. This adaptability extends to schools with different student populations and educational systems, highlighting the model's potential for broader application.

The flexibility in project themes also supports scalability. The pilot projects addressed a wide range of STEM topics, from biodiversity and pollination to bioplastics, physics and mathematics allowing the CWL model to be tailored to local contexts and curriculum objectives.

An important aspect of scalability is the model's ability to cater to a diverse age range, including students aged 12 to 18. The CWL approach has proven effective across this broad spectrum, indicating that it can be adapted to meet the developmental and educational needs of different age groups.

12. Conclusion

The CWL project has effectively demonstrated the benefits of integrating creative writing with STEM education to enhance student learning, engagement, and the development of 21st-century skills. The project successfully engaged students in STEM, fostering collaboration and communication while deepening their understanding of complex concepts. As a result, students showed increased interest in STEM subjects, improved creative writing abilities, and enhanced problem-solving skills.

For teachers, the project offered valuable professional development opportunities, encouraging collaboration and innovative teaching

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practices. It increased their confidence in implementing student-centered, interdisciplinary learning experiences, contributing significantly to their professional growth.

The project utilized a variety of assessment methods, including observations, questionnaires, project presentations, and analysis of student work. These strategies provided a comprehensive understanding of student progress, attitudes, and the overall impact of the CWL approach.

The CWL project contributes notably to advancing innovative teaching practices by offering a practical and adaptable model for integrating creative writing into STEM education. It underscores the importance of collaboration among students and teachers, fostering a supportive learning community and promoting shared ownership of the learning process. Additionally, the CWL model empowers students to take ownership of their learning, explore their creativity, and apply their knowledge in meaningful ways.

For future research and dissemination, it is recommended to investigate the long-term impact of the CWL model on student achievement, attitudes towards STEM, and the development of 21st-century skills. Sharing the project's findings and resources with a broader audience of educators through conferences, publications, and online platforms will also be beneficial.

Overall, the CWL project exemplifies how innovative teaching practices grounded in collaboration, creativity, and student-centered learning can transform STEM education and equip students with the essential skills needed to thrive in the 21st century.

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13. ANNEXES

13.1 POST PILOT NATIONAL REPORTS

- Edumotiva, Greece: national feedback report (Author: Georgia Lascaris)
- IEXS, Reggio Emilia, Italy: national feedback report (Authors: Hafiz Tariq & Federico Semeraro)
- Grm Novo mesto – Centre of Biotechnics and Tourism, Slovenia: national feedback report (Authors: Nina Gerjevič, Barbara Turk)

13.2 POST PILOT QUESTIONNAIRES: ANALYSIS & RESULTS

- Edumotiva, Greece: students and teachers survey results (Author: Georgia Lascaris)
- IEXS, Reggio Emilia, Italy: students feedback report (Authors: Hafiz Tariq & Federico Semeraro)
- IEXS, Reggio Emilia, Italy: teachers feedback report (Authors: Hafiz Tariq & Federico Semeraro)
- Grm Novo mesto – Centre of Biotechnics and Tourism, Slovenia:students and teachers feedback report (Authors: Nina Gerjevič, Barbara Turk)

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13.3 Implementation Strategies: Plans, Learning Scenarios, and Success Stories

- Edumotiva Greece: "Biodiversity and Pollinators Project", Story of implementation.
- Edumotiva – Greece: "Biodiversity and Pollinators Project", Learning Scenario.
- IEXS – Italy: "Quest for Balance", Pilot Implementation Plan.
- Grm Novo mesto, Slovenia: "CWL Alter Cup"
- ZSO, Poland:

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