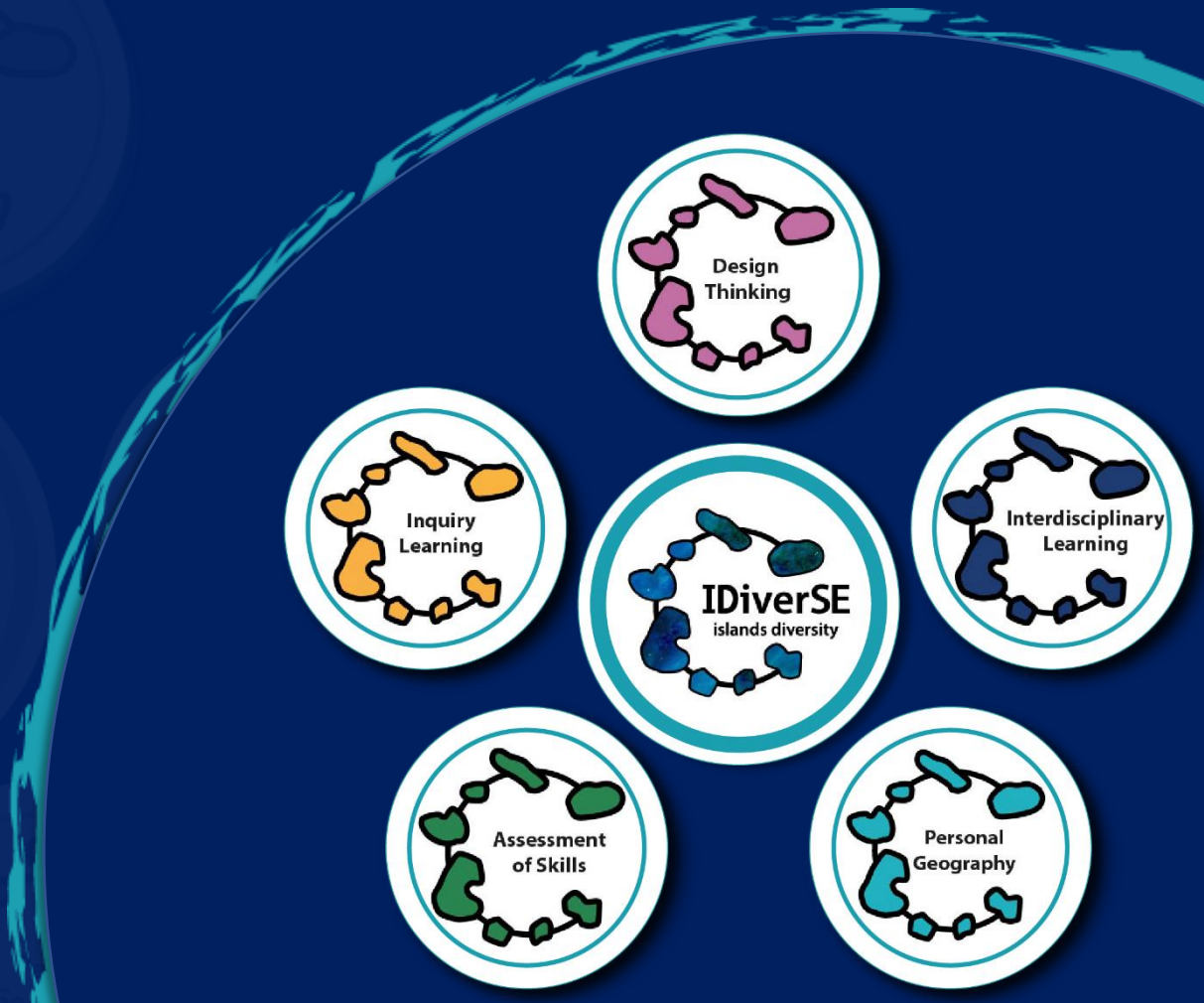
DESIGN THINKING IN STEAM EDUCATION:

A legacy from the Islands Diversity for Science Education project



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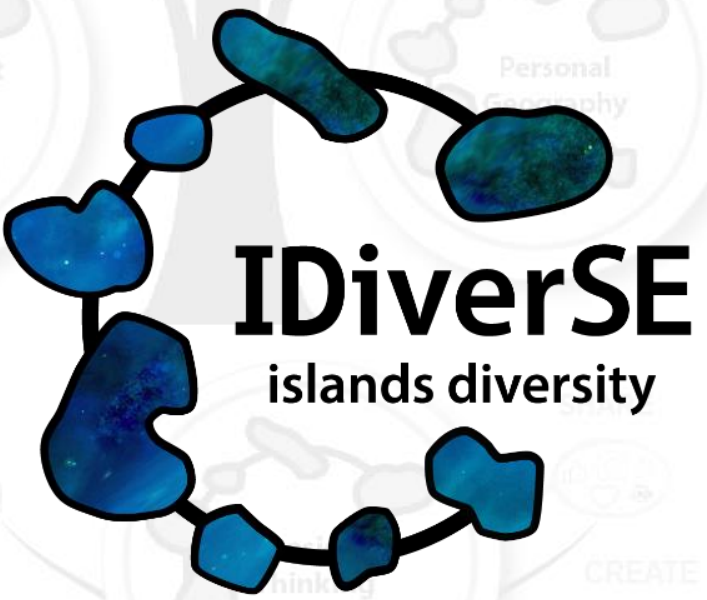

A legacy from the Islands Diversity for Science Education project

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Editors:
Priscila Doran (Núcleo Interactivo de Astronomia, Portugal)
Eleftheria Tsourlidaki (Ellinogermaniki Agogi, Greece)
Iratxe Mentxaka (University of Deusto, Spain)
Tânia Vicente (Associação Bandeira Azul da Europa, Portugal)
Margarida Gomes (Associação Bandeira Azul da Europa, Portugal)
Rosa Doran (Núcleo Interactivo de Astronomia)

Artwork:
Priscila Doran (Núcleo Interactivo de Astronomia)

Partners in the project:
NUCLIO – Núcleo Interactivo de Astronomia (Portugal)
ABAE – Associação Bandeira Azul da Europa (Portugal)
Ellinogermaniki Agogi (Greece)
University of Deusto (Spain)
University of Azores (Azores, Portugal)
Globallab (UK)
Escola Secundária Jaime Moniz (Madeira, Portugal)
Escola Dr. Horácio Bento de Gouveia (Madeira, Portugal)
Escola Jerónimo Emiliano de Andrade (Azores, Portugal)

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Acknowledgments

This book is a result of the amazing journey followed by all the IDiverSE partners and the great teachers and students that implemented the project. For this reason, it is important to say that without this amazing group of people, this project would not have been the success that it was, and this book would not be so special.

During the IDiverSE adventure, teachers were called into stepping out of their comfort zone to innovate and bring their students a completely new set of challenges. As big of a challenge as this was to teachers themselves, they faced it with such a motivation and respectful courage that it made us feel amazed. Not only that, but the students also embraced the challenges as well and turned our ideas into incredible results, making us very proud of them.

For this reason, a big thank you goes to all the brilliant IDiverSE teachers and to their brave IDiverSE explorers (students).

A letter for teachers

Dear teacher/reader, it is with great pleasure that we publish this book for you. We are experiencing a big movement in education, where teachers all over the world are seeking for ways to innovate and to bring their students a more meaningful, enjoyable, and valuable learning experience. As teacher trainers and education content developers, we believe that teachers have the most important job in the world, to educate the future adults of our world. As teachers, you have the power to bring value to the education of all students that cross your path and to plant the seeds of a better world in them. Our job is to help you achieve that by crossing research with practice and developing the tools and resources that you need and most importantly to build the community that will guide and support you on the way.

Scientists, researchers, and educators from all over the world have been developing various approaches to innovation in education. Many methodologies are being proposed to teachers, while a multitude of resources is being created. We feel that this often leads teachers to feeling a little bit lost and in need of guidance. So, considering this, we thought it would be helpful to create a simple guide in the form of a book, that teachers could use anytime for guidance, ideas, and support to their innovation.

In this book we focus on what we consider to be one of the most relevant methodologies being introduced in education, the Design Thinking method, combined with a STEAM approach, which combines Science, Technology, Engineering, Arts and Maths. In this book, however, we contemplate all subject domains, and we embrace all teachers of all disciplines and of all grade levels.

This manual aims to provide practical support, guidance, and inspiration for teachers, who will have at their disposal several tools and complementary teaching methodologies in order to implement existing IDiverSE activities or design their own.

We hope that this book with theory, practice and concrete examples helps you in your path towards innovation and brings you a newfound inspiration 😊

Contents

1. Introduction

The world has been changing at a fast pace. Technology has never been more evolved and is leading companies, businesses, and our daily personal and social lives to rapidly change as well. As our lives become accelerated and more adjusted to the digital world, humans have to adapt and reinvent themselves and education is no exception to this. School leaders and teachers have been stepping out of their comfort zones to learn how to embed all these societal changes into a more adequate education. Teachers from all over the world have been collaborating, exchanging ideas and knowledge and it is a very empowering thing to see. We believe that teachers hold one of the most important jobs in the world, as they have the education of our future leaders in their hands. It is no easy job but it's a very relevant one. However, although many teachers are seeking to improve and update their practice, many schools remain stagnant in time, providing students with an education that often brings them no motivation or interest.

One of the major problems that education is facing today is the lack of interest and disengagement of students from school. While the world is evolving at such a fast pace that almost all the knowledge can be obtained by making a quick search on a smartphone, many schools seem to maintain the same methods as 100 years ago. It is ever clearer that in this 21st century it becomes pointless to ask students to remain sited for hours, with no technology at hand, listening to a teacher talking. While many students are still able to memorize the knowledge and pass the exams, after a short period of time, most forget what they have learned or are incapable of transferring it to other situations.

As the future becomes so complex and students have the possibility of being whatever they want, it is nearly impossible to predict what career they will follow. It has been predicted that 80% of the jobs that students in primary school now will have when leaving school do not yet exist! (see reference for "White Paper on the future of Europe" in the end of book). Many students will not even follow one career but will work in many jobs and maybe even invent new ones. Students will face a world of endless possibilities where they will be able to invent and reinvent themselves as much as they want and will be called into being creative and innovative. This means that, more than a list of pieces of knowledge to be memorized, students need to be stimulated to develop certain key skills that will make them resilient, creative, and successful in whatever future they pursue.

Furthermore, development and growth in society need to be tackled with intelligence and respect for the planet that sustains us and for all living beings on it. The UNESCO's 2030 Agenda for sustainable development proposes 17 Sustainable Development Goals, of which number 4 is "Quality Education". Although education is one of the goals, itself, it is also considered a fundamental part of achieving all other goals. These goals, altogether, aim at achieving a unified peaceful and healthy society that thrives in an economically and environmentally sustainable way.

Sustainable development goals: https://en.unesco.org

Envisioning an education that embraces sustainability and promotes the necessary skills to prepare students for the future, the IDiverSE project gathered a series of innovative teaching and learning methodologies and integrated them into one. This methodology integrates the following components in a simple and easy to use method:

- The **Design Thinking methodology** following four steps where the community becomes an integral part of the schoolwork as the school becomes an important development force for the community.
- The **Inquiry-Based Learning** and the development of fundamental skills and competences in the students.
- **Interdisciplinarity** and collaboration between teachers from different disciplines which allows teachers to find relevant connections between the topics they teach and bring an interdisciplinary approach into their practice.
- The **Personal Geography** method that brings emphasis to the emotional development and promotes a deeper cognitive absorption of knowledge through artistic expression.
- The **Assessment for the 21st** century, focusing on the development of skills.

This book aims to provide practical support, guidance and inspiration for teachers, who will have at their disposal several tools and complementary teaching methodologies in order to implement existing IDiverSE activities and design their own.

Finally, the IDiverSE methodology falls in line with the Eco-Schools program, which was a partner in the project. As such, for those interested in understanding how both integrate each other, a brief explanation can be seen in chapter 5.

Concrete examples of how the methodology was implemented with big success can be found in chapter 10 along with a selection of testimonies from the amazing IDiverSE teachers and students.

2. The IDiverSE project

Islands Diversity for Science Education – IDiverSE - was an educational project, co-funded by the Erasmus+ Agency of the European Union from 2017 to 2020 composed of partners from Portugal, Greece, and Spain. The project combined the Design Thinking methodology with an interdisciplinary STEAM and beyond approach that provided students the opportunity to be "change makers" in their community, while learning meaningful curricula content. In other words, IDiverSE brought students the opportunity to lead their own path of learning while diving into the heart of their communities and creating meaningful content to promote community development and scientific awareness.

The project settled on the fact that with the use of a scientific approach and a Design Thinking method, students can discover the value of their community, link the curriculum content with their everyday lives and turn their learning pathways into meaningful contributions to their community and their own lives. In other words, instead of seating in their desks and memorizing content, students can find a way of deep learning while seeing their work valued and practically used in their community.

This project intended to bring innovation to the school environment and open the school to the community, namely based on outdoors pathways where students experience their community, and the community experiences science through hands-on activities and awareness actions.

IDiverSE also stands for "I diverse". Diversity is a crucial part of the survival of life on earth, and humans themselves should embrace this concept as a fundamental part of life. Human beings are all different physically, socially, and emotionally. As such, IDiverSE focused in fostering a deeper view of Diversity, bringing awareness for each student's internal world as unique and precious and to be respected.

Considering a fundamental part of education, the development of students' social and academic skills (like creativity, collaboration, critical thinking, problem solving, communication, respect, tolerance, empathy, etc.) the project focused on an Inquiry, project-based approach. Students were introduced to an artistic expression of thoughts, ideas and learning records and then decided on which problem of their community they would like to focus for the development of the projects. They could already find some project ideas on the website and develop those or create their own. During the two school years of the implementation of the project (2018/19 and 2019/20) students developed their projects following the four phases of the Design Thinking approach: Feel, Imagine, Create and Share and kept an artistic expression of their journey. This methodology will be explained in detail in the next pages, as well as concrete examples of their achievements.

As you will be able to see in this book, IDiverSE teachers and students did make a difference in their communities and became active change makers in this world.

IDiverSE collaborated with a European Horizon 2020 project called OSOS - Opens Schools for Open Societies, by using the open schooling philosophy and the digital platform of the project.

IDiverSE project
idiverse.eu

OSOS project
openschools.eu

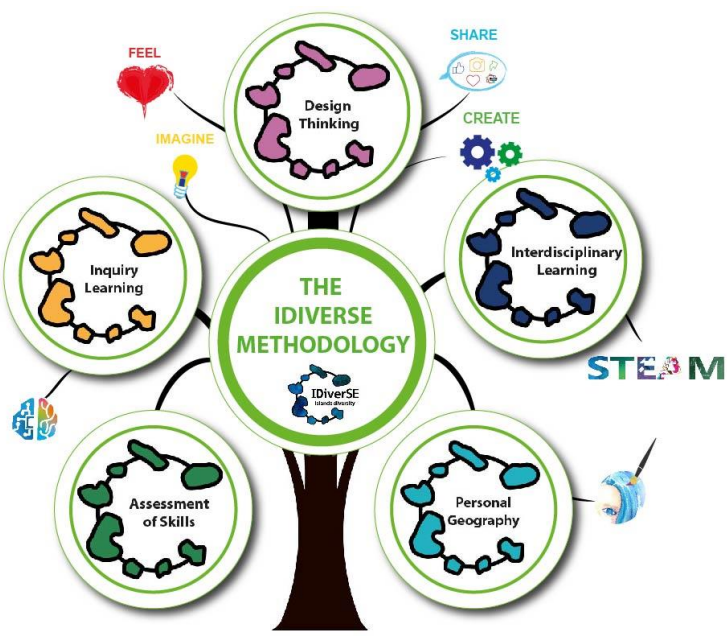
3. Introduction to the IDiverSE methodology

Design Thinking has been widely used in the business world to tackle problem solving in a deeper and more effective way. Through this methodology companies tend to find a deeper insight into the problem and into their client(s), and as such, create solutions that are more effective. While it is usual that we look into our goals and focus on the solution with little understanding of the problem, Design Thinking pulls us to deeply focus on the problem and widely learn about it in multiple perspectives. By doing so, it empowers us to create solutions that tackle all relevant details of the problem and that are suitable for any given situation/client/user.

Although this method is very recognized in the business world, it has recently been introduced in education. Being such an effective way of problem solving and a powerful creative tool to design any given content/solution, it has been considered a very powerful tool for education as well. It can be an extremely useful tool to be used by the school administration, when making decisions that involve the whole school. It can be used by the teachers when designing classes and content for any specific group of students, and it can be used by the students when learning through a problem-solving approach.

In IDiverSE, the Design Thinking approach was introduced in the students' perspective. It was used as a powerful tool to promote an open school philosophy where students' learning experience directly related to problems in their community. It allowed students to follow a series of four steps (see fig. 1) where they discovered the connections between what they learned in school with their everyday context and led them to the creation of a community development strategy to increase awareness and mitigate problems. Thus, Design Thinking was implemented, guiding them through a journey of understanding about a given topic/problem (Feel) and leading them to imagine, create and share solutions to that problem.

Through all the phases of the Design Thinking process, students were guided in an interdisciplinary and Inquiry Learning way, with the teacher acting as a support agent, instead of giving them straight answers. Students were challenged to decide on what questions/problems they would like to focus, find the relations to their community, make their hypothesis, and then research and experiment to collect data to finally discover whether their hypothesis were correct or not. An artistic method called *Personal Geography* was also included in the process, bringing students a creative approach to expressing their feelings, ideas and recording the acquired knowledge in a creative way. In the next few pages, we will describe how these methodologies were seamlessly integrated to create one innovative and meaningful holistic approach to learning.

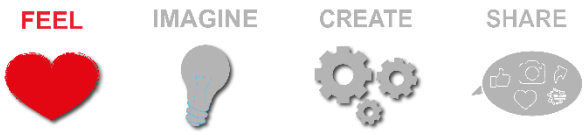


The IDiverSE methodology

4. The four steps of Design Thinking

The main pillar of the IDiverSE methodology was the collection of local culture references and community relevant issues through Design Thinking. As previously mentioned in this book, this methodology has been widely used in the business sector and has now started to be integrated in the education world. It allows students to learn their curricula while deeply and meaningfully communicating with their community, looking at the world through the perspective of their community and discovering main relevant issues that should be worked on. The goal of this process was to allow students to develop projects on topics that were relevant for their community and to create a final output that would be successful in promoting awareness and community development.
This Design Thinking approach followed 4 steps: Feel, Imagine, Create and Share. Each step being an important part of the process and representing a meaningful stage of the students' learning experience. On chapter 9 you will find a detailed guide for teachers on each of the four phases, with useful tips and suggestions for implementation, however, we leave you here with a brief and simple description:

*Design Thinking Steps: **FEEL***



As the name of this phase indicates, this is the moment where students feel the problem/topic. It is their first encounter with the subject at hand. This phase is usually the most extensive phase on a lesson based on Design Thinking, as it is the moment where students will collect all relevant information about the problem, make their research and experiments and start the collaboration with their community. In other words, it is the moment when students learn the topic in an academic, social, and emotional way, developing empathy, creativity, and a social perspective of the topic in their community.

This step requires students to deeply focus on the problem they will try to solve, before jumping to the solution, as it is often our nature. All individuals are different, as are communities. Developing solutions that are not suitable for a specific community, may be useless and students will not see their work valued and applied. However, FEEL calls students to deeply connect with their community, discover how any given problem exists in their community and how their community relates to it. It allows students to know which main features of their community and of the problem should be considered when discussing possible solutions.

The FEEL phase is strongly connected to the Inquiry-Based Learning method, although the whole design thinking process is in line with the same Inquiry principles. In chapter 5 we discuss more in depth about the relation between Inquiry and Design Thinking.

After learning all the relevant perspectives of the problem at hands, students will start imagining solutions.

Skills being developed in the FEEL phase:	*Examples of tools and resources useful in the FEEL phase:*	*Tips for inclusion and diversity in the FEEL phase:*
Academic: Critical Thinking, Creativity, Investigation, Collaboration **Social:** Respect, Tolerance, Citizenship, Collaboration **Emotional:** Self-security, Self-esteem, Sense of belonging, Endurance	**Digital:** Tools to create tables and graphics, data analysis, videos, search engine, online labs and apps, online games, surveys, quiz tools (like Mentimeter or Kahoot, for e.g.), organization platforms like Trello, cameras, etc. **Offline:** Books, games, puzzles, paper surveys, drawings (e.g., Personal Geography, see chapter 7), etc.	• When dividing students in groups, make sure groups are diverse in terms of gender, culture, age, etc. • Guide each group into showing tolerance towards difference and respect for other ideas and different strategies. • Help the students that are shyer to participate and to feel valued. • It is important to understand that although all students are different, all of them will have personal features that can bring value to the project, so it is essential to allow each student to express themselves and to discover how their traits can benefit the whole.

Design Thinking Steps: ***IMAGINE***

The Imagine phase of the Design Thinking process is the phase when students are called into unleashing their imagination and sharing all possible ideas to solve the problem (or to achieve any other given goal). This is a very critical and important phase, where all ideas come together, and students develop their creativity and their communication.

This phase brings students the idea that a change is always possible, and that they have the power to act and to make their place a better place. It allows them to feel a sense of belonging to their community and to understand that they are important, and their presence can bring a positive effect. Furthermore, it allows them to understand that their learning experience in school can have meaning and value, for them and for others.

In this phase, the more ideas are shared, the better. Several strategies can be used when brainstorming. Students can openly discuss ideas, they can draw their ideas or write them down, they can have a limited time or an extended period of discussion, etc. It is up to the teacher to decide how to approach this phase.

If students are feeling uninspired, teachers can choose to play a game to stimulate their creativity. For example, present them with a fake scenario with a fun dilemma like “a cloud of marshmallows is approaching the city and is threatening the life of all citizens” and give them 5 minutes to write down all possible ideas to save the population. As this is such a nonsense problem, students will feel free to give all possible ideas, even if they are also nonsense. After this, let them discuss their ideas and enjoy the playful time for another 10 minutes. Ending these 15 minutes, ask them to do the same again, but now for the real problem they are working on. Give them 10 minutes to write down all possible ideas, even if they seem nonsense.

After this, all ideas should be discussed in class and students should organize them into categories, to facilitate the process of choosing the ideas to be implemented. Ideas can be divided into any given set of categories. A few examples are presented below:

Short term ideas • ….	*Medium term ideas* • ….	*Long term ideas* • ….
Most Difficult Ideas • ….	*Medium difficulty ideas* • ….	*Easiest ideas* • ….
Funniest ideas • ….	*Not so funny* • ….	*No fun at all* • ….
Best at addressing the problem • ….	*Addresses part of the problem* • ….	*Does not address the problem* • ….

After organizing the ideas, into categories and making the first selection of ideas, the organization can be repeated, and different categories can be added. Some research may be required to decide whether an idea can be feasible or not in a given timeframe and available tools.

When students reach the best ideas to be followed, the class can be divided in groups and each group can uptake one or more ideas to work on, to create something meaningful.

Throughout this process, students can involve their community, both in the sharing of ideas and in the selection of the ideas that will be put into action.

Skills being developed in the IMAGINE phase:	*Examples of tools and resources useful in the IMAGINE phase:*	*Tips for inclusion and diversity in the IMAGINE phase:*
Academic: Critical Thinking, Problem Solving, Creativity, Communication, Collaboration **Social:** Respect, Tolerance, Citizenship, Collaboration **Emotional:** Self-security, Self-esteem, Sense of belonging	**Digital:** Online mind-mapping tools, Quiz tools to share ideas (Mentimeter, Kahoot, etc.), etc. **Offline:** Mind-mapping, inspiration stimulating games, drawings (e.g., Personal Geography, see chapter 7), etc.	● When dividing students in groups, make sure groups are diverse in terms of gender, culture, age, etc. ● Promote the participation of all students ● Ensure that all ideas are respected, and a positive environment is fostered ● Promote an environment where students feel secure to share all their ideas

*Design Thinking Steps: **CREATE***

For those who like to get creative and to do more practical work, this is your moment! This is the phase when the ideas are put into action and concrete outputs are created. It is very important that students begin by making a plan of action, considering time, tools available, all important variables to be worked on and possible challenges.

Students should collect all the materials they will need, and make sure that they make a full register of their process. They can take pictures, make videos, write down all the details of their creative process and of all the obstacles they face. Creativity is in its highest requirement at this moment.

In this phase, it is important to allow students to be creative and to carry out their ideas as they want. However, teachers should be a constant guide and lead the students to the right path. This, however, should be done in a seamless way, by giving students questions to think about, instead of telling them directly the way to follow.

It is also important to note that in this phase, collaboration with teachers from other subject domains is very positive. For example, the arts, engineering, language, science, etc. are all parts that usually collaborate in any given creation. Hence, having different teachers collaborating and supporting students is always a good idea. It also brings more motivation to teachers since it fosters a community environment in the school as well.

Students will possibly need to make their research in this phase as well to learn how to create what they want and to discover how to overcome possible obstacles they find in the way.

If possible, inviting the community to be part of this process is also a great win!

Skills being developed in the CREATE phase:	*Examples of tools and resources useful in the CREATE phase:*	*Tips for inclusion and diversity in the CREATE phase:*
Academic: Collaboration, Research, Entrepreneurship, Creativity, Problem Solving, Critical Thinking, Innovation **Social:** Respect, Tolerance, Collaboration, Cooperation, leadership **Emotional:** Pride in their work, self-esteem, friendships	**Digital:** Organization boards like Trello, tutorial videos, cameras to take pictures and film, simulators, online labs, etc. **Offline:** All creative tools they can find 😊 (trash that they can reuse, building tools, art supplies, etc.)	● When dividing students in groups, make sure groups are diverse in terms of gender, culture, age, etc. ● Promote the participation of all students. ● Ensure that all ideas are respected, and a positive environment is fostered. ● Promote an environment where students feel secure to work and create.

Design Thinking Steps: ***SHARE***

Sharing is the final phase of any meaningful project! In science, as in any relevant project, a fundamental part is sharing and the process of peer review. There is no real change and progression without sharing and collaboration. As such, after students have created their outputs, it is important that they share their journey with others and spread their outputs to the community (or any other target). This is the moment when all the hard work is shared, and the change is in place. Students have travelled a deep and meaningful journey where they have learned a lot and created something meaningful. It is their turn now to teach others about what they have learned and to bring awareness through their creations. Students have been exposed to a new way of learning, they have given wings to their creativity and inspiration and have come out of their comfort zones. By finally sharing their work, both students and teachers discover a sense of accomplishment and pride in their work and of themselves.

Sharing can be done in many ways. In IDiverSE this has been done through the creation of videos, the representation of theatre, the composition of songs and lyrics, art exhibitions to the community, leaflets and visits to local stakeholders, conferences in the school, etc. Students and teachers can decide on how they will share their work with others.

Students should also prepare a 5-to-10-minute presentation about their whole journey to present to their colleagues and/or school community. This will allow them to gain presentation skills and to teach others about what they have learned in their journey.

It is important to note that a good dissemination plan should be designed, where students decide on how, when and with whom they will share their work. This is an especially important part of this process as marketing and dissemination are today a big part of any successful business. By introducing students to the world of dissemination, teachers are already preparing them to have the basic knowledge to create successful projects in the future.

Skills being developed in the SHARE phase:	*Examples of tools and resources useful in the SHARE phase:*	*Tips for inclusion and diversity in the SHARE phase:*
Academic: Collaboration, Entrepreneurship, creativity, Problem Solving, Innovation, Communication and Marketing **Social:** Communication, Respect, Tolerance, Collaboration, Cooperation **Emotional:** Pride in their work, self-esteem, self-promotion	**Digital:** Social media, YouTube, video editing tools, digital design tools to create leaflets and posters, etc. **Offline:** Creating posters and cards by hand (with any creative material they can find), musical instruments, puppets, exhibitions, etc.	● When dividing students in groups, make sure groups are diverse in terms of gender, culture, age, etc. ● Promote the participation of all students. ● Ensure that all ideas are respected, and a positive environment is fostered. ● Ensure that all students feel comfortable sharing their knowledge and are prepared to answer questions about their work.

How to implement Design Thinking

Design Thinking should be considered a form of student-centred approach, where the teacher acts as a guide. The role of the teacher is to lead students while they develop their own leadership and research skills. The main goal is for students to learn how to learn and to become active agents of their own process. The teacher can design a set of guidelines for each of the phases of the project and students will follow them in an independent way.

This whole process can be done online, with the help of any useful authoring tool or using any digital or paper tool (e.g., any word processor like Word, Google docs, etc.)

On chapter 9 of this book, you can find a Design Thinking template with detailed guidelines on how to create a project for your students as well as concrete examples created in the framework of IDiverSE.

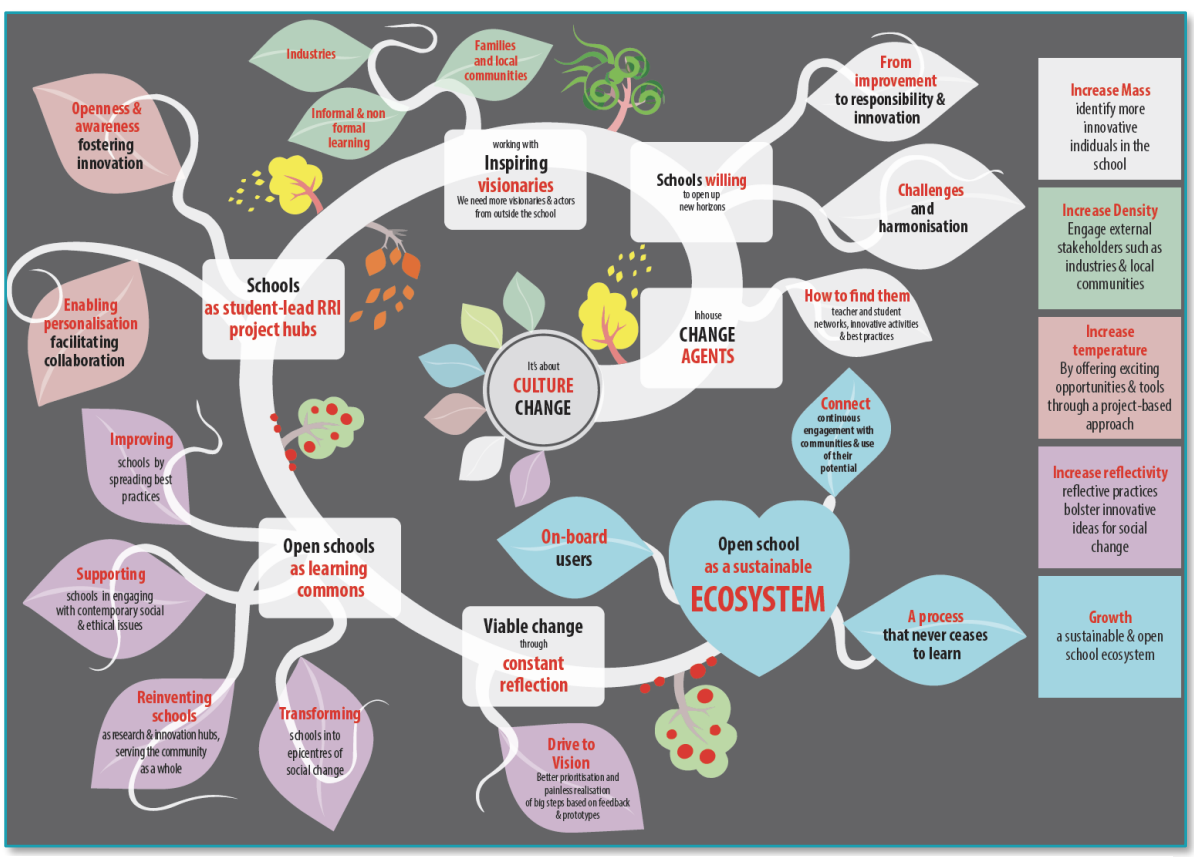
The Open Schooling Philosophy

The Open Schooling Philosophy describes a model that helps schools reduce their isolation from other schools and from the community, by creating joint projects and co-creation. This philosophy was widely developed in the Open Schools for Open Societies (OSOS) project, a Horizon 2020 project, that partnered with IDiverSE.

An Open School is a place of knowledge and a reference to the community. It is the place that people visit to learn and to evolve. A school that is open to the community is a school that cares for the community and that brings students a sense of citizenship, solidarity and belonging. While students can learn any given content through a multitude of possible projects, in an open school, students work on projects that bring value to their community. The community becomes part of the school's work and is invited to co-create and learn. Schools have the power of making a change in their students, their families, and the whole surrounding community. Design Thinking is then a powerful tool to promote the Open Schooling philosophy. Any student project that focuses on a community reference and uses Design Thinking is a project that promotes the opening of the school to the community.

OSOS project
openschools.eu

Hence, in IDiverSE, Design Thinking was a very important part on the promotion of the Open Schooling philosophy and on the creation of projects with and for the community.



The Open Schooling philosophy from the Open Schools for Open Societies project

5. Inquiry-Based Learning

Inquiry-Based Learning is a methodology through which students become active in their own learning by following the steps of science research. Instead of transmitting to students a certain amount of knowledge that they have to memorize, through Inquiry, the teacher creates a scenario where students go through an autonomous learning journey beginning with a question, making hypotheses and experiments to test the hypotheses and reaching conclusions on their own. The teacher plays a major guiding role, while students follow their own path of discovery.

Several studies show how learning through Inquiry enhances the knowledge uptake, the ability to transfer knowledge to different situations and, most importantly, the development of fundamental skills.

As previously explained, the Design Thinking method is a form of Inquiry. This way, even if teachers are not aware of this methodology, by implementing a Design Thinking project with their students, they automatically implementing Inquiry as well. However, being experienced in Inquiry is a plus for any teacher wiling to update their practice. As such, we hereby introduce a very effective Inquiry approach that allows teachers to uptake the Inquiry mindset in a gradual way, using a tool called "Inquiry under the Microscope". This method was created in a project called PLATON – Promoting Innovative Learning Approaches for the Teaching of Natural Sciences - and introduces Inquiry to teachers in a step-by-step way. This toolkit breaks down Inquiry into a set of 9 components (IC) that teachers can introduce separately and gradually in their practice. These are:

Inquiry Under the Microscope
http://platon.ea.gr/content/inquiry-under-microscope

IC1: Setting the scene
IC2: Refreshing prior knowledge
IC3: Wondering about how something works
IC4: Thinking about how to test hypotheses
IC5: Doing research and collecting data
IC6: Interpreting data and drawing conclusions
IC7: Comparing conclusions to hypothesis and existing theory
IC8: Reviewing and reflecting on what has been done
IC9: Discussing and connecting with everyday life

These components should be present in any Inquiry activity, regardless of the Inquiry Cycle used. Educators use many different cycles of Inquiry and divide it into different phases. Some use the most widely used five phase approach: Orientation-Conceptualization-Investigation-Conclusion-Discussion.
Some divide in 7. Others, like in the Design Thinking approach used here, divide it in 4 phases. However, it all translates into the same process. Students are introduced to the topic, make their questions and hypothesis, research to collect data, analyse the data and discover whether their hypothesis were correct or not, make their conclusions and share their work.

Design Thinking Step	Most relevant Inquiry Components
FEEL 	**IC1:** Setting the scene **IC3:** Wondering about how something works **IC5:** Doing research and collecting data **IC6:** Interpreting data and drawing conclusions **IC7:** Comparing conclusions to hypothesis and existing theory **IC9:** Discussing and connecting with everyday life
IMAGINE 	**IC2:** Refreshing prior knowledge **IC3:** Wondering about how something works **IC4:** Thinking about how to test hypotheses **IC8:** Reviewing and reflecting on what has been done
CREATE 	**IC2:** Refreshing prior knowledge **IC5:** Doing research and collecting data **IC6:** Interpreting data and drawing conclusions **IC7:** Comparing conclusions to hypothesis and existing theory **IC8:** Reviewing and reflecting on what has been done
SHARE 	**IC1:** Setting the scene **IC2:** Refreshing prior knowledge **IC8:** Reviewing and reflecting on what has been done **IC9:** Discussing and connecting with everyday life

It is important to note, however, that although it is usual to divide Inquiry into a set of phases, it should be viewed more as a set of principles to be always present than a straight line. It goes forward and backward, and all the phases of Inquiry can fit inside each other. This way, working with the Inquiry Components becomes more effective and more helpful into reaching the goals on Inquiry.
The table above represents the relation between the Design Thinking method described in this book and the different Inquiry Components.

As many of the schools that participated in IDiverSE were also Eco Schools, we also present a table that includes the 7 steps of the Eco Schools program, which is also, an example of an Inquiry process.

Design Thinking Step	Most relevant Inquiry Components	The Eco Schools Steps
FEEL 	**IC1:** Setting the scene **IC3:** Wondering about how something works **IC5:** Doing research and collecting data **IC6:** Interpreting data and drawing conclusions **IC7:** Comparing conclusions to hypothesis and existing theory **IC9:** Discussing and connecting with everyday life	**1. Eco Schools Committee** The Eco-Schools Committee is formed by the students and is the driving force behind the Eco-Schools process and will represent the ideas of the whole school **2. Environmental Review** Carrying out an environmental review helps the school to identify its current environmental impact and highlights the good, the bad and the ugly **Curriculum work / interdisciplinarity** Besides increasing the status of the programme, linking Eco-Schools activities to the curriculum ensures that Eco-Schools is truly integrated within the school community
IMAGINE 	**IC2:** Refreshing prior knowledge **IC3:** Wondering about how something works **IC4:** Thinking about how to test hypotheses **IC8:** Reviewing and reflecting on what has been done	**3. Action Plan** The Action Plan is the core of the Eco-Schools work and should be developed using the results of the Environmental Review. **Curriculum work / interdisciplinarity**
CREATE 	**IC2:** Refreshing prior knowledge **IC5:** Doing research and collecting data **IC6:** Interpreting data and drawing conclusions **IC7:** Comparing conclusions to hypothesis and existing theory **IC8:** Reviewing and reflecting on what has been done	**4. Action** Put the plan into action **5. Monitoring & Evaluation** To find out whether or not the targets set out in the plan of action are being successfully achieved, you must monitor and measure your progress
SHARE 	**IC1:** Setting the scene **IC2:** Refreshing prior knowledge **IC8:** Reviewing and reflecting on what has been done **IC9:** Discussing and connecting with everyday life	**6. Informing & Involving** Getting everyone on board! Actions should not just be confined to the school: for example, pupils should take home ideas to put into practice. **7. Eco-code** A statement that represents the school's commitment to the environment

How to implement Inquiry

First, we would like to highlight the fact that Inquiry can be used in **all subject domains**. It is common that teachers believe that Inquiry is a learning method only applied in science education, but this is definitely not the case. It can be applied in any given learning situation in school, home, business, etc. In IDiverSE, Inquiry was used in Portuguese, Psychology, History, Geography, Physical Education, Music, Arts, Sciences, etc.

Whatever subject domain you teach, the Inquiry Under the Microscope is our election tool when introducing Inquiry to teachers. We often see that teachers feel very insecure and uncomfortable with changing their practice, and this is very understandable. The Inquiry Under the Microscope toolkit relieves a lot of this anxiety as it presents to teachers a gradual approach that to many may even appear as seamless. You can access the Inquiry Under the Microscope toolkit through the QR code or the link presented in the previous page. There, you can either access the toolkit online, or you can print the Inquiry Components in the form of cards.

The Inquiry Components were designed to lead teachers to activate different attitudes and promote different practical and cognitive stimuli to their students throughout the inquiry process gradually and comfortably. These are meant to be integrated in teachers' everyday practice in the form of on-going and progressive small adaptations. This gradual integration of inquiry into everyday teaching will help you to upgrade your teaching approach as a whole and help you implement the inquiry approach more efficiently, even when you have very limited time. The process should be the following:

1. Look to all the Inquiry Components and study them carefully,
2. Choose the components that you already naturally integrate in your practice and put them aside,
3. From the remaining ones, select **one**, regardless of order, to focus on,
4. For several days, weeks, months focus on that **one** Inquiry Component, integrate it in your practice as much as you can, until it becomes a natural part of your teaching,
5. Once you are comfortable with this component, put it aside as well and chose another one,
6. Repeat the process until you are naturally using all the components naturally.

If you are new to Inquiry and you are starting your innovation journey now, there are two very important things to consider:

A. The integration of the IC in your practice should be gradual and on-going. It should be a process of trial and error until you discover what works for you and your students,

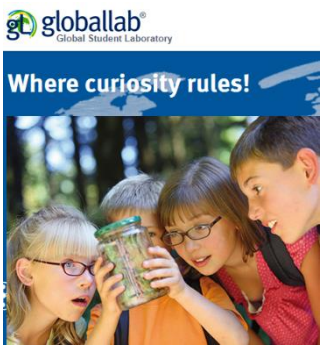
B. You should not be disappointed if your first trials are not in line with what you anticipated. It is OK not get it right from the first time. There is an adjustment period for you and also for your students (which may complain in the beginning 😊). However, the eagerness and active participation you will receive from your students in the end will not disappoint you.

Note: If you are interested in learning more about Inquiry-Based Learning, we recommend that you explore the PLATON website and read the book: PLATON-Roadmap Towards Innovation, where you can find detailed information about each Inquiry Component and useful tips on how to implement inquiry.

Second note: Some of the IDiverSE projects include one extra activity that follows the 5-phase Inquiry cycle and is lodged in an online platform called graasp.eu, created under the Go-Lab initiative. These activities are part of the Feel or Imagine phases of the Design Thinking process and are seamlessly integrated in the projects. Through these extra-activities, students discover new ways of learning and of feeling the problem and imagining solutions.

Collaborative Inquiry: From local to global

Collaborative inquiry takes the notion of inquiry a step further and brings in the aspect of collaboration and exchange of data between students coming from different schools, cities, or countries throughout the different phases of the process. Adding this collaborative factor to the equation, students become aware of the global perspective of the local problems. It also allows them to discover different realities but also similarities across the globe and develop fundamental skills of tolerance and respect for human and environmental diversity. Although this is a completely optional approach to whoever wants to use the IDiverSE methodology, we leave a simple explanation of how it can be implemented.



In IDiverSE, collaboration overseas was achieved using a collaborative inquiry platform called Globallab. This platform accommodates protocols that allow for students, researchers, and citizen of any kind to collect data, input the data online and compare it to the data collected by others elsewhere. Although we frequently hear that Inquiry presupposes the use of no standardized protocols, we find it important to say that this is not entirely true. Inquiry is a form of learning which is extremely flexible and adjustable to any situation. In the absence of a standardized protocol in a collaborative Inquiry, students from different locations would collect different data, or collect the same data but in a different way, causing it to be invaluable for comparison. An Inquiry learning process can include a standardized protocol, if it also includes the opportunity for students to make their hypothesis, collect any other data they would like to, organize, and analyse the data autonomously and come up with their own conclusion.

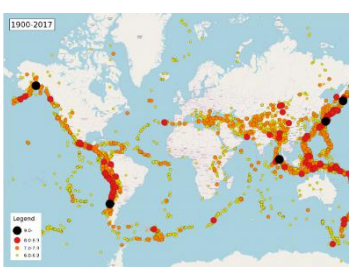
Several of the IDiverSE projects included one collaborative data collection protocol using Globallab and the comparison of results to achieve a global view of the problem at hands. Students also had the chance to engage in communication with others, through a chat box facility in the platform.

The collaborative Inquiry protocols created in IDiverSE are still available for you to engage your students and are the following:

BEES FOR THE FUTURE

UV LEVELS AROUND THE WORLD

OUR RESTLESS EARTH



MARINE LITTER

MOON JOURNAL

ACCESS PROTOCOLS HERE

https://idiverse.eu/globallab/

When engaging your students in such collaborative activities, you should always make sure that they understand the protocol and that they are able to collect the data carefully respecting all the steps. You should also suggest that they communicate with at least one student from a different country, who is working on the same protocol. This will be fundamental for having a consistent set of data that allows for a collaborative international comparison of results and will provide students a sense of global cooperation and citizenship.

6. Interdisciplinary learning: STEAM and beyond

STEAM is an acronym that stands for Science, Technology, Engineering, Arts and Maths. STEAM education entails a learning experience that connects these domains. STEAM is a step-forward from the STEM education, by introducing the Arts component into the equation. As such, STEAM education presupposes an interdisciplinary work that relates science education in school with real-life problems and embraces an artistic, empathetic, and purposeful learning. Because IDiverSE embraces all subject domains (as in not just the scientific ones, but also Language, History, Geography, Psychology, Philosophy, etc.), we often refer to our interdisciplinarity approach as STEAM and beyond.

Interdisciplinary learning in the school is an approach that integrates two or more subject domains in a way that creates a meaningful and contextualized connections between them, and which increases the understanding of each of the subjects involved. Nature is composed of complex systems that are interconnected and dependent on each other. Although different subjects might explain certain phenomena of the natural world in a very specific and rigorous way, in isolation they can never represent the natural systems that compose our real world.

Let us use a visual example to understand this better. Imagine that the circles below represent the subject domains in school (just as an example).

Each circle seems organized, pretty and makes sense. We can imagine that, for example, the blue circle represents Biology, the yellow Physics, the green Chemistry, and the orange Geology. This is how students learn in school. They jump from "circle to circle" learning different disciplines separately. Very often, they do not realize how what they learn in each "circle" correlated to what they learn in another. Even more importantly, they often lack the notion of how any of these circles relate to their daily lives, leading them to question why they need to learn at all. But the truth is that different disciplines are not isolated from each-other. Each discipline describes one part of the whole and by artificially separating them in school, knowledge becomes distant from reality, which leads to students' demotivation and alienation from an otherwise very engaging learning process. Put these disciplines together, and what do you get? A colourful, complex, beautiful, and much more meaningful scenario.

When explaining this to teachers, very often they become confused, not about the importance of interdisciplinarity, but as to how they could deploy it. Very often, questions like "but how can I teach my students about all subject domains? I didn't study them!" appear and some anxiety shows. However, the trick here is collaboration!! Teachers do not have to know everything or study all domains. By collaborating with colleagues from other disciplines, teachers become supported and find numerous ways to include interdisciplinarity in their classes. This can be as simple as having a monthly meeting with colleagues from the school, to discuss how their content is related, and then spending 5 minutes each week to discuss these connections with students. Or it can be as complex as planning interdisciplinary lessons with teachers from different domains and lecturing together. However deep you want to go in the interdisciplinary teaching, what really matters is providing your students with the connections between what they learn and other disciplines and, most importantly, with their daily lives (day-to-day routines, contemporary science, national news, etc.)

In IDiverSE interdisciplinarity was promoted through the development of projects that related to different subject domains and with the collaboration between teachers of different subjects from the same school. In some cases,

teachers worked together, and in others, the teachers provide students with the connections to other domains, as part of their projects.

How to implement interdisciplinary learning

Implementing interdisciplinarity in school is mainly providing students with connections between the different subject domains and with real-life. Finding these connections isn't always easy, especially since collaboration between teachers from the same school is often lacking. Moreover, even when collaborating, it is usual that some teachers need some support in finding connections between their subject domains. The reality is that all subjects are connected in one way or another and it is always possible to find meaningful connections to present to students. In many cases, teachers find these connections on their own. I other cases they simply miss an initial push.

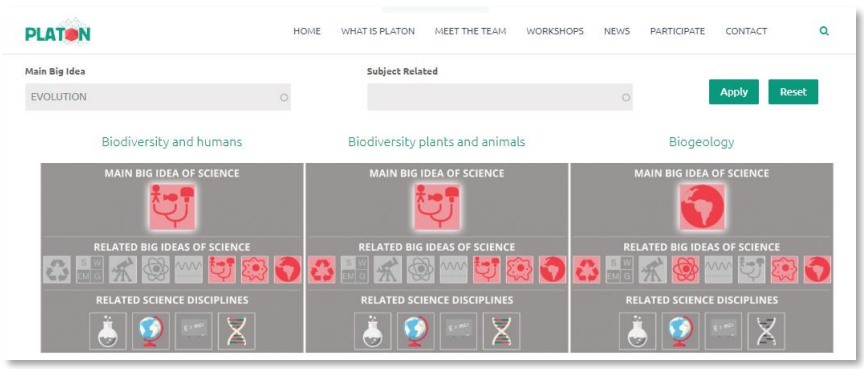
With this in mind, we present to teachers a very helpful tool to start discovering the connections between the different subject domains. This is the **3D Interdisciplinary Map of Science Ideas.** This map was created in the PLATON project (as was the Inquiry Under the Microscope toolkit presented in chapter 5) and it built over the Big Ideas of Science. The Big Ideas of Science are a set of ideas that describe the main concepts that any student should know when leaving school. It was a concept first introduced in 2010 and further explored and adapted in the Go-Lab (https://www.golabz.eu/) and PLATON projects, where 8 main Big Ideas were considered (you can find references to this work in the end of this book):

Energy	Forces	Universe	Particles
Energy can neither be created nor destroyed.	**There are four fundamental interactions/ forces in nature.**	**Earth is a very small part of the Universe.**	**All matter in the Universe is made of very small particles.**
Quantum	**Evolution**	**Cells**	**Earth**
In very small scales, our world is subjected to the laws of quantum mechanics.	**Evolution is the basis for both the unity of life and the biodiversity of organisms (living and extinct).**	**Cells are the fundamental unit of life.**	**Earth is a system of systems which influences and is influenced by life on the planet.**
Big Ideas of Science platon.ea.gr/content/big-ideas-science-0		**Printable** platon.ea.gr/content/platon-big-ideas-science-printable-cards	

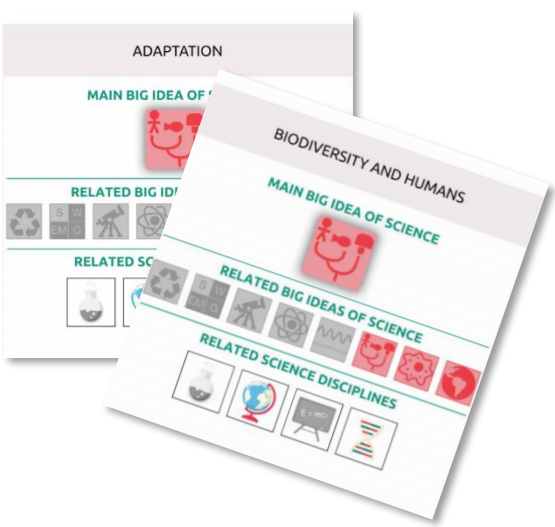
To their total these ideas describe the world around us and represent the core concepts that every student should have learned when leaving high school. But how do these ideas promote interdisciplinarity? This is where the Interdisciplinary Map of Science Ideas comes into place. Having as a core base the Big Ideas of Science, this map presents connections between the curricula content of the different subject domains and the Big Ideas. It brings an

awareness of how different curricula topics (here considered as “small ideas of science”) relate to one or more Big Ideas and, hence, with each other. In other words, two topics from different subject domains that are related to the same Big Idea are automatically related to each other. This map, then, helps teachers to discover which topics are connected and provides meaningful tips on what connections exist.

The 3D map can be used online, where you can use the search boxes to look for any particular topic (like for example: Adaptation, Energy and Mass, Galaxies, Macromolecules, The Eras of Earth, etc.), or any subject domain (BIOLOGY, CHEMISTRY, PHYSICS or GEOLOGY) and the system will show all small ideas related to it.



Or you can print the cards along with the cardbox designed to organize them. These cards can be used in several different ways. To work with your colleagues and find connection between what you teach, the first thing you should do is to select from the collection all the cards that relate to the contents you will teach in the following month/year. Study them and review to which Big Ideas they are connected. Then ask your colleagues to do the same. When all of you have collected and organized your cards, discuss which of your topics relate to the same Big Ideas and how. This will be the base to find many connections. To work with the cards yourself, the idea is the same, however after choosing your own topics, you play the role of your colleagues from other disciplines and you discover the connections on your own. Students can come into play as well. Each student can have their own set or the class can work with one set together. After each lesson, the students can find the cards that relate to what they have learned and they can establish a routine of always linking what they have learned with one of the Big Ideas of Science.



3D Map of Science Ideas: platon.ea.gr/elements-table

Printable 3D Map cards http://bit.ly/3D-map-print

The IDiverSE projects are not all interdisciplinary on their own, however, they include information about to which Big Ideas of Science they are related and how, suggestions of collaborations among teachers and information about the subject domains on which it can be explored. Using this information, teachers from different subjects can perform different projects with the same students establishing connections between them or work together in the same project from providing input from their subject domain.

7. Personal Geography

"A map has no vocabulary, no lexicon of precise meanings. It communicates in lines, hues, tones, coded symbols, and empty spaces, much like music [...] A map provides no answers. It only suggests where to look: Discover this, re-examine that, put one thing in relation to another, orient yourself, begin here ... Sometimes a map speaks in terms of physical geography, but just as often it muses on the jagged terrain of the heart, the distant vistas of memory, or the fantastic landscapes of dreams."

- Miles Harvey, The Island of Lost Maps

Art is a very important part of human life and it is present in all parts of human existence. From the simple look into a pretty landscape to the construction of an important building. All human activities relate to art in one way or another. Art may include music, dance, theatre, singing, building, drawing, painting, designing, planning, etc. It is also strongly linked to emotions and used by many creators to express feelings and tell stories. Art is an important component in human development as it stimulates emotional development, creativity, intuition, empathy, innovation, and a deeper look into any given subject. Art is basically a fundamental part of human expression and hence, it is automatically an important part of education.

When students enter the class each day, they bring their own personal set of feelings, memories and thoughts that are completely different from every other student. Each student has a past that has shaped their view of the world and that influences the way they absorb information and events. If we look at this fact with enough attention, we can understand that while being in the same class and being exposed to the same learning experiences, each student will interpret them differently and give a different meaning to it. Furthermore, each student will understand and express the same ideas in a different way. Considering this diversity, and the importance of art in human life, we realize that art can be the key in providing students with tools to express knowledge, feelings, fears, dreams, etc, in their own way. In IDiverSE, this is where Personal Geography comes into play.

Personal Geography is one form of art that expresses the inner journeys, thoughts, emotions, dreams, fears, etc., of a person, with a valuable contribution to education, and can be implemented in any subject domain. It is not only an artistic expression of knowledge, but also a tool for emotional expression, linked to the learning experiences. It allows students to express what they have learned while at the same time reflecting on how they feel or felt about it, and what their further curiosities and learning plans are. It is also an amazing tool for deeper learning. Students may read, investigate, and discover a lot of knowledge throughout their learning experience. However, how often do you hear that teaching something to others is the best way of truly learning it? Why do you think that happens? It happens because to express something (for example, when teaching) we need to find a deeper and more meaningful cognitive organization of the knowledge so that it can be properly expressed in different ways. You may feel this in your practice. The more times you teach something, the better you understand it as well. The same happens when knowledge is expressed through art, or, as in IDiverSE, through Personal Geography.

Personal Geography drawing by Margarida Gonçalves, 9th grade, from Horacio Bento de Gouveia School, Madeira, Portugal, about her island and her existence in it.

Through Personal Geography, by drawing about what they have learned, students find connections between different experiences, they relate the new knowledge with their daily lives and find a much more meaningful organization of knowledge in their brains. It also allows teachers to evaluate the students' learning in any given learning experience. As such, it becomes an artistic expression of the impact of each activity which can be valuable for teachers and for students themselves.

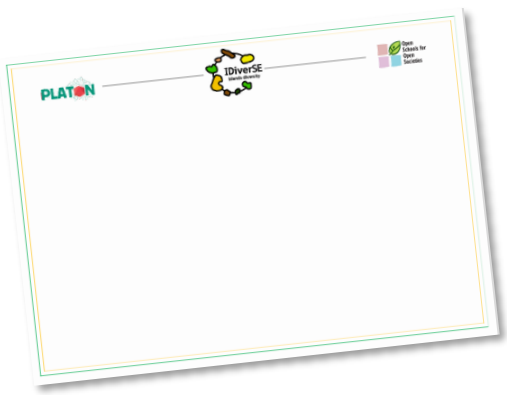
How to implement Personal Geography

Personal Geography can be implemented in many ways. Being an artistic approach to knowledge (and emotions) expression, it comes with no rules as to how to use it. It can be implemented, for example, by asking students to make an artistic expression (drawing, painting, composing, etc.) of the knowledge they acquired by the end of a given learning experience.

In IDiverSE, we used an approach that was a little bit more complex but more valuable. The approach is the following:

Phase 1

At the beginning of any project, or learning activity, challenge your students to make an artistic expression of the topic that they will learn. They can draw whatever they want, however they want, and it can be more abstract or more concrete. This activity should be free to be carried out 100% according to student's inspiration and creativity.



For this, we provide students with coloured pencils and a paper to draw. You can give them any artistic tool that you want. Then students are informed about how much time they have, and they start working on their creations. Very often, students have not drawn or done anything artistic in a while and they will complain or feel stuck in their creative process. It is very important that you show them support and motivate them to at least try. You can also tell them that they will not have to share their creations with anyone if they do not want to. In whatever case, make sure that students give it a try.

If you believe that your students need an initial push to have a base to start their creations, you can propose the creation of a mind-map with all the concepts they know about the theme they will work on. We have created a tool for this, which we have called an inspiration hive. This hive gives suggestions to students about what kind of concepts to think of, related to the subject at hand. This can be used as a 5-minute brainstorming session where they have to quickly write all the concepts they can. After this, they just have to make a drawing that represents their ideas.

After students complete their creations, they can share with each other, discuss what they have created and how similar or different each creation is. This discussion and reflection are very important as it is a preparation for what they are about to learn. By doing this, they will be preparing the mental structures to receive new knowledge with already built relevant connections to their lives.

When this is done, students (or teachers) should take a picture of the creations, one by one, and save it, as they will be built on during the learning activity.

Note: When using this approach, it is very important to take a picture of the creation and save it well. It will be used, later.

Phase 2

After the initial creations, students have already started their learning activity/project/lesson and are learning new things. Throughout this experience, students should return to their creations regularly (as frequently as you want, or they want) and add new items about the new things they are learning. They can also add new components that bring meaning about what they are feeling during the experience. Every time students add to their creations, a picture should be taken and saved.

Phase 3

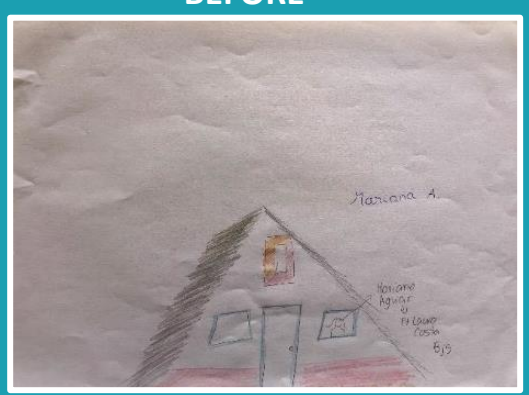
By the end of the learning experience, students should return to their creations one last time and add all the relevant components that relate to what they learned, how they feel about it and future perspectives on it. Here they can add pieces that represent connections between the new knowledge and their everyday life, with contemporary science discoveries, etc. When they finish their final version of the creation, they should take the final picture of it.

Important note: In case there is little time for this activity, students can do only an initial version of the creation and a final one and miss phase 2.

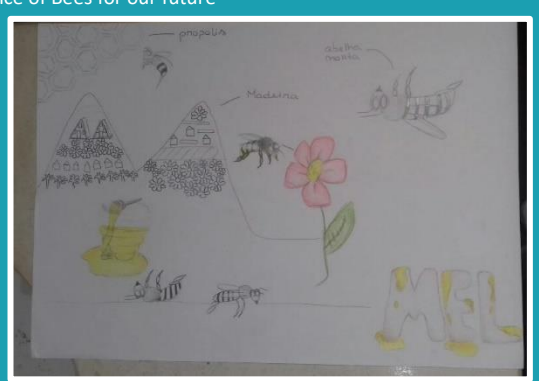
Phase 4

This is the phase where it all comes together. Using any digital photo montage app (for example "Fotor" which can be freely installed on any smartphone) students can create a montage with the picture from their initial creation, two (or more) pictures from phase 2 and the picture of their final work. In case students only have one initial picture and one final picture, they can also make a montage with both (example below). By doing this, students will have a visual expression of what they learned, their learning progress and how they felt throughout the process. This will also be a valuable visual aid to your evaluation of each students and of the impact of the learning activity as well.

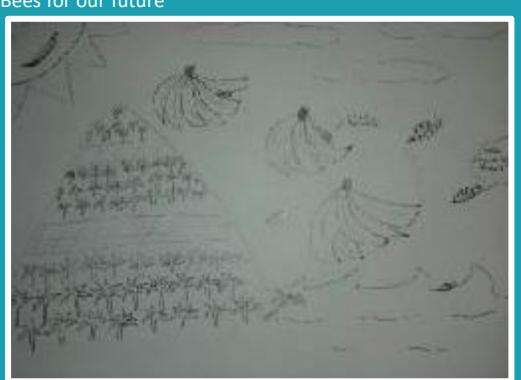
BEFORE **AFTER**



Personal Geography drawing by Mariana Aguiar, 10th 4 class from Jaime Moniz School, Madeira, Portugal, before and after learning about the importance of Bees for our future



Personal Geography drawing by Beatriz Luís, 10th 4 class from Jaime Moniz School, Madeira, Portugal, before and after learning about the importance of Bees for our future



Personal Geography drawing by Beatriz Luís, 10th 4 class from Jaime Moniz School, Madeira, Portugal, before and after learning about the importance of Bees for our future

8. Assessment of Skills: An innovative view on student assessment

Skills for the 21st century

Throughout this book we have been constantly talking about the importance of promoting the development of skills through school education. We have discussed the fact that nowadays, with all the information basically "one click away", it becomes more important to teach students how to learn, how to critically think and how to develop themselves, than to just ask them to memorize information. Whatever it is that a teacher must teach in their school curriculum, students can also find it online. So, focusing on development of skills becomes fundamental in the students' academic journey, to prepare them for the challenges of their future life.

Many projects have been focusing on four main academic skills that have been known as the 4C's of the 21st century skills and the IDiverSE Assessment of skills focused mainly on these:

The 4C's of the 21st century skills

However, in their school journey, students should develop many other emotional, academic, and social skills. They should find in school the opportunity to develop their self-esteem and self-security, to create a secure social network through the development of friendship, respect, and tolerance. Students should discover the value of diversity and adopt an inclusive behaviour towards others and accept themselves for who they are. There is a big list of skills that students can and should develop in school, further than the 4 presented above. Although many approaches exist when listing skills, in the following pages we leave a list of skills which description was adapted from the document "profile of the students when leaving compulsory schooling" (a reference document launched by the Portuguese Ministry of Education). Teachers can have these skills as a reference when creating any project/lesson/activity for their students and try to approach at least some of them at a daily basis.

LANGUAGE AND TEXTS	REASONING AND PROBLEM SOLVING
• To use different languages and symbols related to language, music, art, technology, maths, and science. • To apply these languages adequately to different communication, digital and analogic environments. • To dominate nuclear understanding abilities of expression in oral, visual, writing, and multimodal modalities.	• To interpret information, plan, and lead research. • To manage projects and make decisions to solve problems. • To develop projects that lead to the construction of products of knowledge, using diverse resources.

	
• To use and dominate diverse ways of research, describe, evaluate, validate, and mobilize information in an autonomous and critical way, verifying different sources and their credibility. • To transform information in knowledge. • To collaborate in different communication contexts, in a secure and adequate way, using different types of tools (digital and analogic), based on the conduct rules appropriate for each environment.	• To think in a deep and embracing way, in a logical perspective, observing and analysing information, experiences and ideas and arguing using implicit and explicit criteria to take a reasoned position. • To call upon different knowledge of scientific and humanistic nature, using different methodologies and tools to think critically. • To predict and evaluate the impact of personal decisions. • To develop new ideas and solutions in an imaginative and innovative way, as a result of the interaction with others or of personal reflection, applying them in different contexts and learning areas.
	
• To adequate behaviours in cooperation, sharing, collaboration and competition contexts. • To work in team and use different ways to communicate in person or in a network. • To interact with tolerance, empathy and responsibility, reason, negotiate and accept different points of view, developing new ways of being, looking and participating in society.	• To establish relations between knowledge, emotions, and behaviour. • To identify areas of interest and of need of acquiring knew competences. • To consolidate and deepen the competences they already have in a perspective of a lifetime learning. • To establish goals, make plans and implement projects with a sense of responsibility and autonomy.
	
• To adopt behaviours that promote health and wellbeing, namely in daily habits, food, consumption, physical exercise, sexuality and relationship with environment and society. • To understand unbalances and weaknesses of the natural world in the adoption of behaviours that respond to the big challenges of the global environment. • To manifest social and environmental awareness and responsibility, working collaborative for the common good, aiming for the construction of a sustainable future.	• To recognize the specificities and intentions of the different cultural manifestations. • To experience processes of different forms of art. • To critically appreciate the artistic realities, in different technological supports, by contacting with the diverse cultural universes. • To value the role of the various ways of artistic expression and of the material and immaterial heritage in life and in the culture of the communities.

	
• To understand the processes and scientific phenomena that allow decision-making and the participation in citizenship forums. • To manipulate and handle diverse materials and instruments to control, use, transform, imagine, and create products and systems. • To execute technical operations, following an adequate work methodology to achieve a goal or draw a reasoned decision or conclusion, adapting the material and technical means to the expressed idea or intention. • To adequate the action of transformation and creation of products to the different natural, technological, and sociocultural contexts in experimental activities, projects and practical applications developed in physical and digital environments.	• To preform motor, locomotor, non-locomotor, and manipulative activities, integrated in the different circumstances experienced in the relationship with the own body and with space. • To dominate the perceptual-motor capacity (body image, directionality, perceptual thinning, and spatial and temporal structuring). • To be aware of self on an emotional, cognitive, psychosocial, aesthetic, and moral level to establish with themselves and with others a harmonious and salutary relationship.

Assessing Skills instead of knowledge

When teachers adopt student centred approaches that privilege the development of skills, it is common that they end up confused about how to assess their students. The fact is that when students follow their independent learning paths, a standardized test or exam will simply not provide the necessary assessment.

But before we dive in what assessment methods can be used, lets reflect on something. Have you ever wondered, why do you assess students? Take a few seconds to reflect and choose one option:

1. To give them a final score

2. To know what they have learned

3. To support their learning and development

If you chose the first, we challenge you to think about why does it matters giving a final score? Will students be able to improve from that? What does this score say about your students? Is it a true portrait of your students' development, personality, skills, and improvements? Or is it just a final judgment of how much they were able to memorize?

If you chose the second and you value knowing what your students have learned, that can be useful for you to assess your own teaching method. This is, if your students are learning well or not may indicate that you need to change or maintain your own teaching approach. But is it really the most important thing to assess, in the perspective of the student? Does evaluating what they have learned bring a positive change to their future or present a true portrait of who they are and how much they have developed?

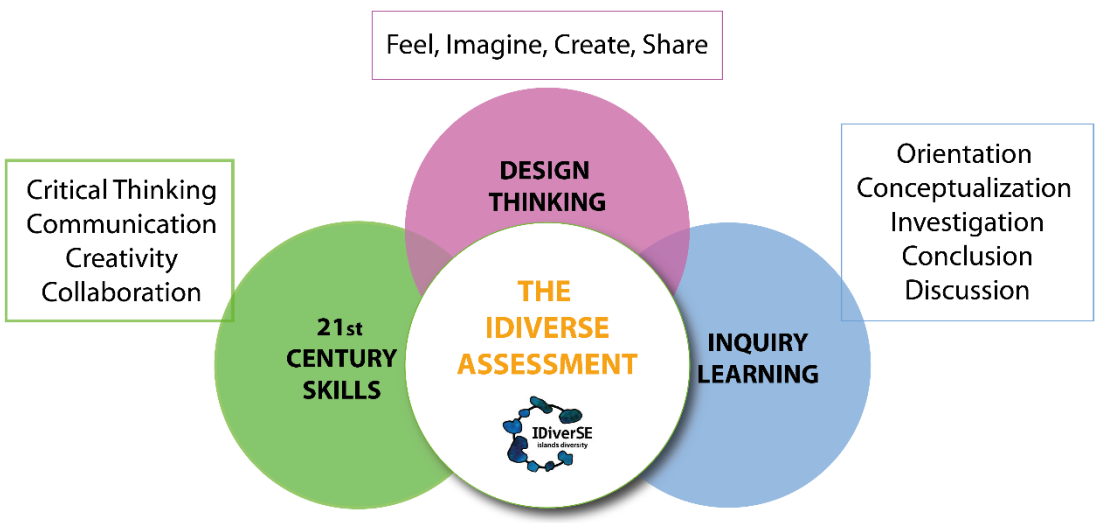
When discussing innovation in education, we often consider assessment as a powerful tool for learning and for development. Much more than just a final test and a final score, assessment can be viewed as a series of regular encounters between the teacher and the student, where both provide feedback to each other and where both can find meaningful clues for mutual development. It should be regular and dynamic, and it should never ever provide a fixed judgment of failure or success.

However, a huge shift in assessment is not possible when the education scenario in countries still requires a final score and when students need these scores to pursue higher education. As such, it is important to create methods that bring soft and gradual changes and that provide teacher the opportunity to innovate in their assessment, while also respecting the requirements they still have.

Considering this, in IDiverSE, we developed an assessment toolkit that would allow teachers to assess their students, regularly, in line with their requirements and in coherence with the learning methodologies applied.

The IDiverSE Assessment methodology

The methodological approach of IDiverSE seeks a global development of the student through the rigorous application of the scientific method (even if not in science classes), the resolution of real problems, the development of fundamental skills and the active collaboration with colleagues, students from other parts of the world and social stakeholders in their environment. As such the IDiverSE assessment focuses on assessing student learning in three fundamental areas: The **Design thinking method**, the **development of 21st century skills** and the **Inquiry learning process**. Being a versatile approach teachers can choose their focus, assessing their students in only one of these domains or in all of them if they want.



IDiverSE Assessment methodology

The aim of the IDiverSE assessment methodology is not only to measure a certain level of development or mastery in these areas, but to guide students on how to improve their learning. As such, the assessment should always be accompanied by the continuous guiding of students, providing them with the necessary tools and regular indications that will allow them to advance and develop in their learning. This **formative assessment** approach seeks to provide students with a constant feedback, so they are aware of their learning and to help them to be strategic, goal oriented and to shift their motivation towards their learning objectives.

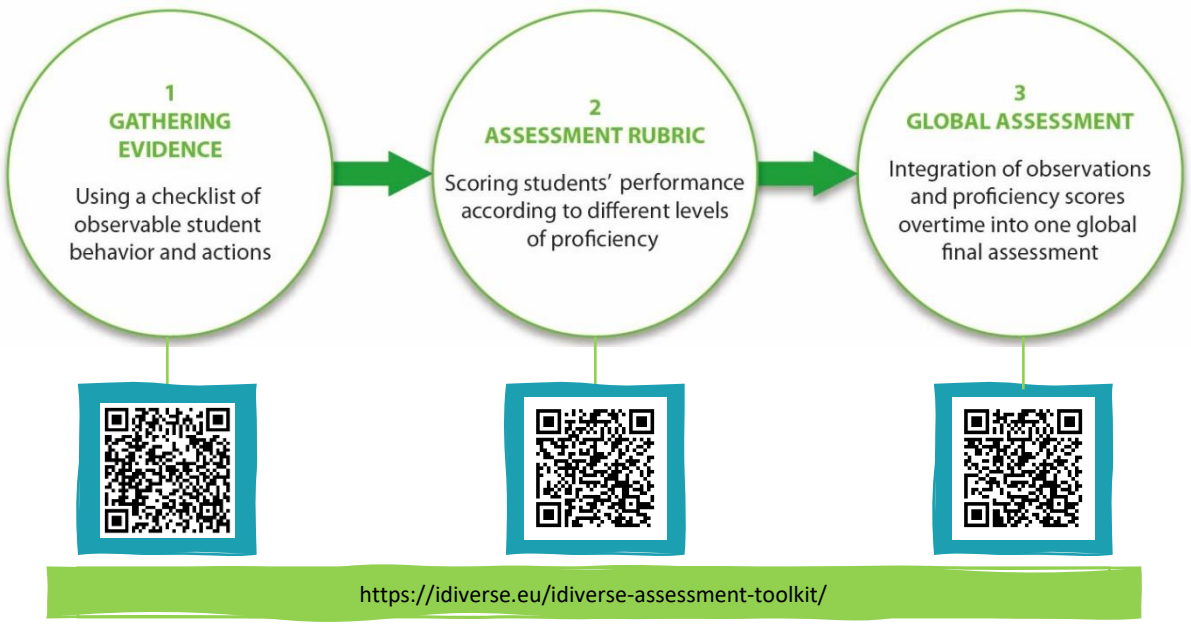
It is important to understand that in a competence-based assessment approach, skills are not observable by themselves, but can be inferred through the observation of specific student actions. In this sense, the IDiverSE methodology provides teachers with assessment criteria and tools to collect observable evidence from students and integrate it into an overall global assessment approach. Adding to this, it provides teachers with analytical and technological tools that automatically organize the data about the student performance and originate useful progress graphics and scores. By having access to such analytical tools, students can have a constant awareness of their progress and find several opportunities for improvement. Furthermore, by having access to such data, teachers can keep a constant monitoring of the effectiveness of their own methods and make the necessary adjustments in time, according to their students' needs.

In sum, assessment should be viewed as a dynamic, adjustable, and flexible approach that embraces each student's main features and personality with acceptance and inclusively. A standardized assessment that treats all students equally becomes lacking and prejudicial for the students' learning and development. Every individual is different

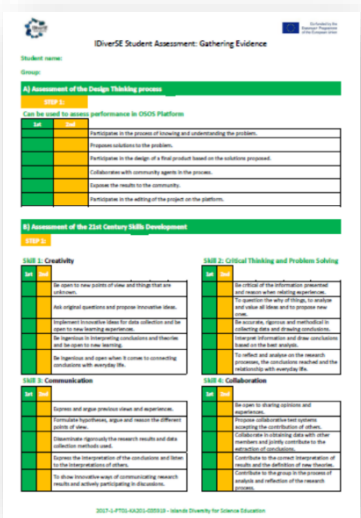
and unique, having different strengths and weaknesses. An assessment that considers this diversity and helps students make the best of their traits and with what they have at their disposal, becomes a powerful and effective aid for the students' academic journey.

How to implement the IDiverSE Assessment?

The IDiverSE Assessment methodology proposes a three-step student assessment:



1. Gathering Evidence



The most important part of assessing students is observing their behaviour in the classroom. For this, the IDiverSE assessment toolkit includes a simple checklist that teachers can use to note what each student needs to develop, improve or maintain throughout the learning experiences.

The checklist created in IDiverSE includes components of the three main assessment domains: Design Thinking, Inquiry and 21st century skills. However, teachers can choose which parts to use and edit it to be adjusted to any context.

Using this checklist, teachers can gather evidence from students in 2 different moments (or more if necessary) to be able to provide students with a regular feedback. With this feedback, students can become aware of their progress and focus on further developing their learning and their skills. On the other hand, this tool can be useful for teachers as well as it may provide them with an indication of possible necessary alterations to their teaching strategies in case students' needs are detected.

2. Assessment Rubric

Rubrics are great tools for assessment as they give us an easy-to-understand metric of development. In IDiverSE we have created a rubric that includes components of three main methodological assessment domains: Design Thinking, Inquiry and the 21st century skills. Here again, the teacher can choose which parts to use and which parts to leave out.

The rubric determines the level of proficiency of students in each domain, with a metric that goes from the most basic achievements (level 1) to the highest level of proficiency (level 4).

It is very important to note that this metric should not be seen as a static evaluation but a roadmap for development. If in a first instance a student shows a proficiency level of 1, it is important to share with him tips and tricks on how to improve and let him know what each level entails. Learning is a curve, and each student has the potential to improve, always. As such, students should also have access to this rubric and be encouraged to perform a regular self-assessment, to gain a sense of responsibility for their own learning and assessment.

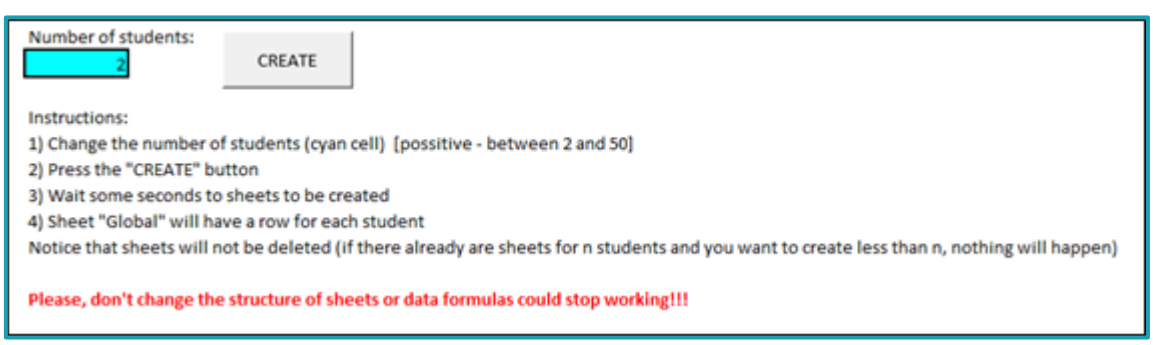
IDiverSE Rubric: Assessing Students' performance

		1	2	3	4
DESIGN THINKING	FEEL	Does not clearly understand the problem and has difficulty in identifying the factors that influence the problem.	Understands the problem but has difficulty identifying the factors that influence the problem.	Clearly understands the problem, and understands which are the factors that originate this problem.	Is empathetic with the problem and is able to understand the factors and consequences in their environment and in other contexts.
	IMAGINE	Has difficulties in proposing solutions.	Proposes several solutions but has difficulties in reflecting on the suitability and effectiveness of the solutions and in choosing one.	Is able to propose several possible solutions and to choose a solution, however in the selection process, has difficulties in evaluating the suitability and effectiveness of solutions.	Is able to propose a large number of possible solutions and to evaluate collaboratively the suitability and effectiveness of the proposed solutions until a common solution is found.
	CREATE	Has difficulties in developing a final product based on the possible solutions proposed.	Is able to develop a final product based on a solution but has not investigated whether it has served to solve the problem raised.	Is capable of developing a final product based on a solution and test it to assess whether or not the solution has served to solve the problem.	Is able to develop a final product based on a solution, test it to assess whether or not the solution has served to solve the problem and is aware of the limitations inherent in the product and the problems.
	SHARE	Does not share the problem in community.	Makes the community aware of the problem but has difficulties in generating interest and inspiring others towards change.	Makes the community aware of the problem and generates debate and awareness, but has difficulty inspiring others and involving them in change.	Is capable of Sharing the knowledge with a community, generating awareness, inspiring them and involving them in change.
		Is not open to new points of view, has	Is open to new points of view and new learning experiences, asks original	Is open to new points of view and new learning experiences, asks original	Is open to new points of view and new learning experiences, asks original

The measurements made using this rubric will then be aggregated in the Global Assessment Tool.

3. Global Assessment Tool

After teachers have used the checklist to identify the needs for improvement in the students and used the rubric to determine the level of proficiency in each different dimension, all of this can be aggregated into one final global assessment. For this, we have created an automatized global assessment tool. The first action when a teacher uses the Global Assessment tool is to identify how many students will be assessed. If the teacher has 20 students, he/she will write “20” in the blue cell of the “config” tab of the spreadsheet file (like in the image below).



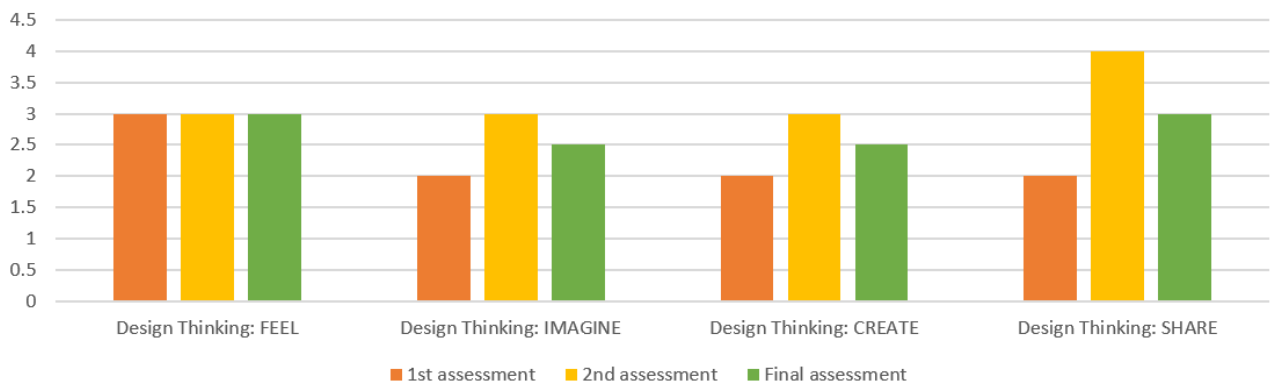
After that, by clicking in the “create” button, the tool will automatically generate one tab per student in the spreadsheet. Teachers will then use each tab to introduce the assessment of each student. This includes the evidence gathered with the checklist and the measurements gathered using the rubric for each student.

Privileging a formative assessment that allows for a regular feedback to the student, this tool is prepared for the accommodation of two different moments of assessment.

By aggregating two moments, the tool also allows for the tracking of the development of students through automatically generated development graphics. These graphics (see picture in the next page) can be used when sending follow-up reports to students.

STEP 2: Assessment Rubric

	Level 1	Level 2	Level 3	Level 4	1st assessment	2nd assessment	Final assessment
Design Thinking: FEEL	Does not clearly understand the problem and has difficulty in identifying the factors that influence the problem.	Understands the problem but has difficulty identifying the factors that influence the problem.	Clearly understands the problem, and understands which are the factors that originate this problem.	Is empathetic with the problem and is able to understand the factors and consequences in their environment and in other contexts.	3	4	3.5
Design Thinking: IMAGINE	Has difficulties in proposing solutions.	Proposes several solutions but has difficulties in reflecting on the suitability and effectiveness of the solutions and in choosing one.	Is able to propose several possible solutions and to choose a solution, however in the selection process, has difficulties in evaluating the suitability and effectiveness of solutions.	Is able to propose a large number of possible solutions and to evaluate collaboratively the suitability and effectiveness of the proposed solutions until a common solution is found.	2	3	2.5
Design Thinking: CREATE	Has difficulties in developing a final product based on the possible solutions proposed.	Is able to develop a final product based on a solution but has not investigated whether it has served to solve the problem raised.	Is capable of developing a final product based on a solution and test it to assess whether or not the solution has served to solve the problem.	Is able to develop a final product based on a solution, test it to assess whether or not the solution has served to solve the problem and is aware of the limitations inherent in the product and the problems.	3	4	3.5



Finally, after inputting the assessment for each student, the tool generates an automatic global assessment of the class in the "global" sheet to obtain the final grade.

In this global sheet, the teacher can personalize the weight assigned to each area of the IDiverSE methodology. In order to do this, it is enough to change the percentages that appear in red below the title of each assessment area. The formula will then recalculate based on the new percentage assigned. One field can be eliminated from the total by changing the percentage to 0%

Final Assessment of the IDiverSE Learning Process

STEP 3: Global Assessment

	Design thinking				21st Century Skills				Inquiry						
	40%				40%				20%						
N Student	FEEL	IMAGINE	CREATE	SHARE	S1: Creativity	S2: Critical Thinking	S3: Communica-tion	S4: Collaboration	1: Orientation	2: Conceptuali-sation	3: Investigation	4: Conclusion	5: Discussion	final grade (out of 10)	Comments
student 1	3,50	2,50	3,50	2,00	2,00	2,50	3,50	3,50	2,50	3,00	3,50	3,00	2,50	7,20	
student 2	3,00	2,50	3,50	1,50	2,50	2,00	3,50	3,00	2,50	3,50	3,50	3,50	3,00	6,98	
student 3	3,50	2,00	3,00	1,50	2,50	2,00	3,00	3,50	2,00	3,00	3,50	3,00	2,00	6,60	
Average	**3,33**	**2,33**	**3,33**	**1,67**	**2,33**	**2,17**	**3,33**	**3,33**	**2,33**	**3,17**	**3,50**	**3,17**	**2,50**	**6,93**	

9. IDiverSE Design Thinking projects

So, by now we have gone through all fundamental parts of the IDiverSE methodology. We have travelled a journey from Design Thinking to Inquiry-Based Learning, we explored Interdisciplinary learning, Personal Geography and Assessment of skills. But how does it all come together? We could leave it up to your imagination … but we will be helpful on this 😊

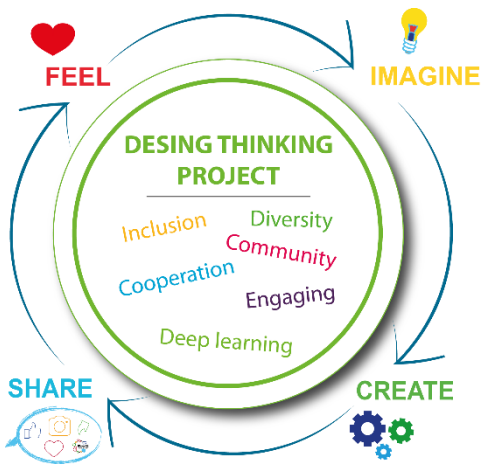
The IDiverSE team has designed a set of projects that follow the Design Thinking steps in an Inquiry and Interdisciplinary approach. The reason why the team decided to create a set of already-made projects was to support teachers in the implementation of the project and to showcase how all parts of the whole would come together in a meaningful way. The way the overall methodology was proposed to teachers was the following:

- Begin by using the Personal Geography approach to spark students' curiosity and prepare their minds for the activities ahead.
- Choose one **IDiverSE project** to develop with students (either one created by the team or one created by yourself).
- Use the assessment toolkit to provide constant feedback to students and track their progress.

In order to increase the relevance of the proposed projects, we have chosen themes related to global problems that would be relevant at a local level too. However, since only a few projects would not cover all possible topics of interest, we have also created a template with guidelines for teachers to create their own project ideas for their students. So, in this chapter we begin by providing you guidelines on how to create your own Design Thinking project as well as a few useful tips and tools to use in each phase of the project. Then, we present the projects we have designed.

How to create a Design Thinking project

If you are interested in creating your own Design Thinking project, we hope that this section of the book will be useful to you. Here we go through each phase of the Design Thinking process and explain in detail what is expected, how to deliver to students and some extra tips and tricks.



Ensuring gender balance and equality

Before jumping into the four phases of the Design Thinking, we would like to call your attention to a few general considerations that should be on your mind in all steps of any project, or any interaction with your students:

- When choosing videos, make sure they come from different backgrounds and cultures and equally represent both men and women in the job world.
- Always choose pictures with diverse people (culturally) and that portrait both genders equally in any given situation.
- Promote discussions where all genders equally participate.
- Make sure you activate different strategies to encourage the participation of all students in all discussions.
- Different people prefer different representation formats. So, for the same idea, choose multiple means of presenting it to your students (text, audio, music, video, graphs, drawings, etc).
- Ensure a positive and open environment where shy and introvert students can express their opinions and views without being interrupted or feeling judged.
- Promote an environment of tolerance, respect, and cooperation, instead of competition.
- Accept students' mistakes as a natural part of learning and allow them to correct them. It is from the mistakes that they will learn the most.
- Do not avoid groups "copying" from each other. If groups collaborate and exchange ideas, their works will be enriched.

We believe that there is no such thing a “good” or a “bad” student. We believe that all students have the potential to learn anything if their learning experience is adjusted to their own learning needs and in consideration to their interests and socio-cultural background. A student that is not engaging in class is a student that is not being challenged the right way. It is important to offer students a diverse range of opportunities and learning designs so they can explore their capabilities as well as their strengths and weaknesses. It is up to teachers to provide all students the opportunity to discover their strengths and design their learning journey from there.

Developing the project: Template

The first part of any project or activity is the basic metadata where others will quickly understand the basic idea of the proposed activities. For this we propose the following fields:

Name of project/activity:

Main topic(s) that includes:

Brief description:

Subject domain(s):

Keywords:

Duration:

Links to important resources (if relevant):

In order to facilitate interdisciplinary learning and promote a notion of the Bigger Picture around the topic, we also suggest that the project is associated to one or more Big Ideas of Science. This way, students can see how different projects are related through the selected Big Ideas of Science.

Choose the Big Ideas of Science to which this activity is related:

Although this metadata appears in the beginning of the projects, it is usually written after the whole project has been created. Below we leave guidelines specifically related to each of the four steps of Design Thinking.

FEEL

Feel is the phase where the activity begins. The first step of a successful activity is to raise your student’s curiosity for the topic. If students are curious, they will feel motivated and engaged and will want to learn more.

During the Feel moment of the Design Thinking, students should learn about what they will be working on and have the opportunity to actually “feel” what the topic is. This is, how it is related to their lives and to their community, how important it is for their community, what is the state of awareness of their community related to this topic, if there were any important events happening recently or in the past related to the topic, how does it affect their family, etc. For each different topic, different scenarios will be presented in this phase.

Begin by introducing the topic in a way that awakens students’ curiosity and interest, letting them feel the need to learn more. Try making the presentation of the topic in the most interactive way possible. Here you can use simple intriguing questions, launch a challenge or an enigma, show images or a video that introduces the topic, or you can even take your students to visit a museum or any other real-life scenario related to the topic in question. You can request the students to ask something to their parents, grandparents, neighbours, etc, promoting the interaction with the community straight away, which will allow for a more meaningful outcome of the activity.

If you are aiming to include a collaborative inquiry component, you can introduce the Globallab platform (if it makes sense).

Anytime you present a question to your students, do not give them the answers. This phase is meant to create a mystery in turn of the problem or question motivating the students to seek for the answers themselves. Give them a few minutes to discuss every question and let them discover the answers by themselves throughout the activity.

This is also the phase where you and your students will recall previous knowledge. Our knowledge is stored in our minds in an organized way. Allowing students to recall the knowledge they already have will facilitate the accommodation of the new knowledge in a way that makes sense and increases the retainment of new information. You can create a discussion where students talk about what they already know and connect concepts, or you can ask them to create real concept maps. Ask them to get creative and find connections with topics from other subject domains or topics from their daily lives.

Some tips for teachers:

- Introduction to the topic should be well contextualized in concrete situations that allow to portrait the reality of students.
- Try using videos, small documentaries, and images anytime you can, to spark students' curiosity towards the topic to be studied.
- You and your students can use the 3D Interdisciplinary map of science ideas to find connections the between concepts they are learning with previous lessons or lessons from other disciplines.

Useful tools and resources:

- Short online videos (YouTube, TED, Teacher Tube)
- Images and Interactive images (Picasa or Flickr)
- Animations and/or simulations - PowToon is a useful tool if you wish to make your own animations.
- A story or an event related to the subject and to students' memories or experience.
- Concept maps
- Virtual classroom walls (Padlet, Popplet)

IMAGINE

After having "felt" the problem/question on which the students will be working on and realizing how it relates to their community, students will begin to think about how this topic/question/issue can be worked on for the benefit of the community. This is, they will start brainstorming possible solutions.

If the topic of this activity concerns a problem that the community is facing, students can start thinking about why the problem exists, how did it originate, and imagine possible solutions to solve it.

If the topic concerns a good example that the community presents to others, students can start analysing how this example was born, who were the main stakeholders, how it benefits the community and investigate the level of development of other communities regarding this topic. In case other communities are facing an underdevelopment regarding the topic, students can imagine ways to bring good practices to those communities.

Depending on the activity, this can be a good moment to introduce Globallab, if it wasn't introduced before, in order for the students to start getting in touch with their community, evaluating how their community is behaving toward the topic that was introduced before. In case your students have already proceeded with the data collection in the "feel" phase, they can now return to the platform to look to the data collected by their colleagues from other places and compare their community to others, to reflect on whether they are different and what they can do to improve their community or contribute for the development of others.

Students can do a field trip to their community in this phase, take pictures, make drawings, write notes, make interviews to retrieve important information to help them imagine good solutions that are practicable and of great value to the own community.

Important: One major strength of the Design Thinking methodology is that the solutions are created with the collaboration of all the involved parties. This means that instead of imagining solutions without knowing the field in depth, students will be challenged to go out of the classroom environment and visit the real people that experience the topic at hands every day, listen to what they have to say, ask them of how they think the problem could be solved and then start creating solutions accordingly.

Some tips for the teacher:

- Encourage your students to register all their ideas and the conversations with their community members. They can use a recorder to record their conversations and use Padlet, or any other tool they can have access to during the whole activity to take their notes.
- Let your students come up with their own ideas but guide them into respecting and valuing the opinions and thoughts of their community members. Make key questions to make them reflect on how their plans are suitable or not for their community. Allow your students to reach conclusions for themselves.

Useful tools and resources:

- Concept Maps
- Virtual classroom walls (Padlet, Popplet)
- Calculators
- Observation sheets
- Recorder
- Camera (or smartphone camera)

Create

After having collected all the information they need related to their community and imagining possible solutions or ways of action, it is time to put hands in action and start creating the final result of their work.

This result should be the creation of something of value for the community. It can be a leaflet that they will distribute, it can be an exhibition with pictures and awareness raising materials. It can be a theatre or a song. It can be a slow motion or any other type of video. It can be the building of a station that will be permanently accessible to all community members, etc. Students can decide to create a proposal for the improvement of any given situation and deliver it to the city hall including a real budget and risk analysis, etc.

Students and teachers should be creative in this part and decide what would be the most effective product to offer to their communities or to the other communities with which they have worked.

Some tips for the teacher:

- During the creation part, students should have an active attitude always. The teacher will only be a pillar for support and guidance when needed.
- Allow your students to make mistakes and correct them. Let them be creative.
- Be patient if you note that your students are feeling insecure. They might not be used to such activities. Offer them words of confidence and support and encourage them to keep motivated and put energy into their research.

Useful tools and resources:

- Research tools (Wikipedia, Wolfram)
- Manipulating data, making graphs (Spreadsheets)
- Create programs to manipulate data or simulate models (Scratch)
- Online collaboration documents for sharing input and ideas (Google docs)
- Shared space (Dropbox)
- Managing group tools (Wiggio)
- Polling and survey tools (Doodle, Survey monkey, Mentimeter, Kahoot)

Share

This is the last phase of the activity where the students' creations will be shared with the community. The teacher should make sure that the students disseminate their work well and that the community understands that voices were heard and taken into consideration when creating the final results.

This is the moment when the whole work that students have gone through is made worth and can be shared nationally and internationally with their colleagues from other islands of the world.

Some tips for the teacher:

- Let your students know from the beginning of the activity that they will create something to share with the community.
- Allow students to present their work in whatever way they want, but with quality.

You can find a blank project template and download it on our website.

IDiverSE Activity template
idiverse.eu/idiverse-activities/

The IDiverSE projects

Create an Amazing Science Trail

Keywords: Community; Awareness; Science trail

Interdisciplinary collaboration:

All subject domains

Grades: All

Brief Summary

Students and teachers, together, identify a set of topics that are relevant for their community. Each group can work on one different topic, and as a result, create one station of the science trail. The final result will be a physical trail with different stations that the audience can visit to interact, experiment and learn about an important topic. Students will be the creators of an outcome that will change their community.

Problem: How can I open my school to the community and bring awareness?

During this activity students will be called into being innovative, creative and active. They will work together to create a science trail for their community. Teachers from the school can gather and work in an interdisciplinary way with the students. By the end of the process, the school should have created one science trail with the collaboration of all involved students. Each class or group inside the class should be responsible for one station, for example. Groups of students can be composed of students from the same class or students from different classes and grades. There is no particular rule in how this should be organized, provided the school creates 1 science trail with as many stations as desired.

Opportunities to collaborate with stakeholders:

Students will be challenged to interview, discuss, and collaborate with their families and other community members as well as to collaborate with different experts on the fields related to the topics they choose to work on.

DESIGN THINKING PHASES

FEEL  Students identify a problem and make their own research and exploration to learn about it in depth.	IMAGE  Students, teachers, experts, and community brainstorm about solutions to the problems identified.
CREATE  Students choose the best solutions and co-create with all involved the stations for the science trail, according to the solutions raised.	SHARE  The whole team gathers to launch their science trail. This can be a one-time-only exhibition or a permanent trail for the community and tourists.
Check the full activity:	

Bees for the future

Keywords: Bees, Biodiversity, Ecosystem, Pollination, Extinction

Interdisciplinary collaboration:

Biology, Mathematics, Environmental Sciences, Health, Psychology, Economy, English and Environmental Education.

Grades: Adaptable from Primary to Secondary

Brief Summary:

Students will discover what is the importance of bees for human life as well as for the whole ecosystem and will investigate how their communities and the communities that live in other islands are behaving towards bees. Bees are a major contemporary science concern, as they are necessary for the pollination and consequent reproduction of most of the plants that we eat (and that the animals that we eat use to feed as well) and their numbers have been decreasing at a fast rate.

Problem: What would happen if bees disappeared?

Well, fellow explorer, today you are going to become a scientist researching on one of the most important contemporary science research problems. Although we are used to seeing people run away from bees or associate them with the sweet tasting wonderful food we call honey, bees are so much more than that. Do you know why? Embark on this journey, play a fun game, enrol in an interactive research platform, collaborate with your community and with colleagues from different countries and you will become an expert and a very important change maker in the world. Bees will thank you … and humanity as well!

Opportunities to collaborate with stakeholders:

Students will be challenged to interview, discuss, and collaborate with different experts on the field such as beekeepers, farmers, scientists, environmental experts, etc. Teachers should allow students to invite experts to their school, to collaborate in their creations as well as family members and any other important stakeholders.

DESIGN THINKING PHASES

FEEL

Students will dive into the topic, learn about all related concepts and research their community and with the collaboration of experts.

IMAGINE

Students will brainstorm possible solutions and share this process with their families. Families' ideas will be welcomed.

CREATE

Students will be encouraged to collaborate with their families, community and important stakeholders to create valuable outcomes-

SHARE

Students will reach out to the whole community to share their work, including stakeholders who can reinforce the change-making progress.

Check the full activity:

Restless Earth

Keywords: Volcano, Earthquake, tsunami, Natural Hazards, Citizen Protection.

Interdisciplinary collaboration:

Biology, Physics, Chemistry, Geology, Mathematics, Geography, History and English.

Grades: Adaptable from Primary to Secondary

Brief Summary:

Students engage in an inquiry-based activity which will allow them to explore natural phenomena. They study the nature of these phenomena and understand the mechanisms that cause them. The activity is designed so that students will develop fundamental skills such as problem solving, critical thinking, communication, creativity and collaboration.

Problem: How important is the impact of volcanic eruptions, earthquakes and tsunamis?

Our beautiful planet is constantly under transformation. Sometimes, changes occur over a very long period and we barely notice them. Some other times however, transformations are the result of massive and devastating events. In this activity we explore some of Earth's most intense and overwhelming events, volcanic eruptions, earthquakes and tsunamis.

Opportunities to collaborate with stakeholders:

Students will be challenged to interview, discuss, and collaborate with different experts on the field such as beekeepers, farmers, scientists, environmental experts, etc. Teachers should allow students to invite experts to their school, to collaborate in their creations as well as family members and any other important stakeholders.

DESIGN THINKING - PHASES

FEEL

Students do a search on past catastrophic events and find out the impact they had on their society. They can talk to people in their community that might have lived through these events

IMAGINE

Students investigate a historic event related to a natural disaster, do some research, talk to historians and other experts. Teachers can organize a trip and contact with experts.

CREATE

Students are encouraged to collaborate with local authorities and stakeholders to design their own citizen's alert programme.

SHARE

Students will reach out to the whole community through their science trail, share their work, including stakeholders who can reinforce the change-making progress.

Check the full activity:

UV radiation: friend or foe?

Keywords: UV radiation, Sun, Health.

Interdisciplinary collaboration:

Biology, Environmental Sciences, Health, Psychology, Physics and Astronomy, Arts and English.

Grades: From 1st to 9th grade

Brief Summary

Students will learn about light and UV radiation. They will understand that UV rays are very important for human health but can also pose a threat. Upon learning this, students will discover the level of awareness of their community and create strategies to raise their awareness for the benefits and dangers of UV radiation and how to behave towards it. During the process, students will learn important concepts such as the Sun, the scales in the solar system, light spectrum, how different animals see the world in different ways, etc.

Problem: Is UV radiation dangerous? Or is it fundamental for life? Maybe both?

Explore the fun exercises suggested in this activity and discover if UV radiation is in fact a foe, a friend, or maybe both? Then, discover what your community thinks about it, how the people in your family behave regarding it and help your community to act in an informed way towards the sun.

Opportunities to collaborate with stakeholders:

Students will be challenged to interview, discuss, and collaborate with their families and other community members as well as to collaborate with different experts on the field such as researchers, doctors, medical institutions, sunscreen brand, etc.

DESIGN THINKING PHASES

FEEL 	Students will use a collaborative platform to collect data from their community and compare it with data from other communities.	IMAGINE 	Students will be encouraged to collaborate with their families, community members and important stakeholders in their creations.
CREATE 	Students will be advised into bringing the problem to their families and have discussions about the causes and solutions to the problem at hands.	SHARE 	Students will reach out to the whole community to share their work, including important stakeholder entities who can reinforce the change-making progress.
Check the full activity:			

Design Thinking with the Moon

Keywords: Astronomy, Earth-Moon System.

Interdisciplinary collaboration ideas:

Astronomy, Earth Sciences, Geography, Mathematics, English.

Age Group: all ages

Brief Summary:

Students will be invited into connecting to the Moon cycle by observing the Moon appearance and position in the sky for one month. Students will be creative and artistic, creating a Moon journal with drawing made from the moon every single day (with exception of cloudy days) and will compare their results with those of other students from different regions of the world. Throughout the process students will raise questions about the configuration of the Earth-Moon-Sun system, think about eclipses and take some conclusions about the shape of our planet.

Problem: Does the moon appear the same in all places of the world?

This activity will guide you to an observational project where you will record daily observations of our nearest neighbour in space, the Moon. While you complete your observation log, interact with your community to share knowledge about the moon.

Opportunities to collaborate with stakeholders:

Students will be challenged to interview, discuss, and collaborate with their families and other community members as well as to collaborate with participants from different regions of the world. Teachers should encourage students to share their findings in a collaborative platform as well as with family members and any other important stakeholders.

DESIGN THINKING PHASES

FEEL 	Students will use a collaborative platform to collect data and compare it with data from other communities.	IMAGINE 	Students will be advised into bringing the problem to their families and have important discussions about the causes and solutions to the problem at hands.
CREATE 	Students will be encouraged to design a realistic model of the Earth-Moon-Sun system that explains lunar phases and eclipses.	SHARE 	Students will reach out to the whole community to share their work.
Check the full activity:			

Marine Litter …. The usual suspects at my beach

Keywords: Marine ecosystems; Marine litter; Environmental Education; Monitoring; Sustainable Consumption.

Interdisciplinary collaboration:

Biology, Environmental Sciences, Health, Geology, Psychology, Arts and English.

Age Group: all ages

Brief Summary:

Through the framework of the marine litter problem, students will work on questions related to its causes and consequences on marine ecosystems contamination, learning about sustainable consumption and waste management. Considering this, students will research their local beach, collect marine waste, analyse their consumption of microbeads, and figure out solutions to improve community awareness and the implementation of measures/solutions concerning the marine litter problem.

Problem: Do you know that microplastics are serious threats to the marine environment?

Students will become detectives researching the "usual suspects" polluting their beach. These can be plastics, microplastics, cigarette buds, glass bottles, etc. Through a series of proposed exercises, students will learn about plastic pollution and pollution in general, sustainable consumption and will fight to raise awareness in their community to protect their local marine fauna and flora as well as their own health and life.

Opportunities to collaborate with stakeholders:

Students will contact the community when researching their local beach and collecting evidence related to the level of awareness and lifestyle habits of their families, neighbours and community members. Students can also contact with their municipalities in order to discuss, create and share their ideas about how to solve the problem.

DESIGN THINKING PHASES

FEEL

Students will investigate a predetermined area of their local beach and collect all the litter they can find within the area.

IMAGINE

After the sampling of the local beach, students are aware of the main sources of marine waste and beach pollution.

CREATE

After coming up with their most creative solutions for their community, students should propose a set of activities.

SHARE

The sharing can be done in the form of a fair, an exhibition or a science trail. In a science trail, each group of students can decide to present their work in a different way.

Check the full activity:

Students Study Volcanoes

Keywords: Volcano, Volcanic Eruption, Remote Labs, Citizen Protection.

Interdisciplinary collaboration ideas:

Biology, Physics, Chemistry, Geology, Mathematics, Geography, History and English.

Grades: Adaptable from Primary to Secondary

Brief Summary:

Students will learn the science behind volcano eruptions, the methodologies scientists use in order to monitor volcanoes and forecast volcano eruption probabilities, the connection between earthquakes and volcanoes.

Problem: How is science made and how does it affect everyday life?

This project focuses on the study of a physical phenomenon with great societal impact and proposes pedagogical practices based on inquiry-based methods that are more effective in science education. The objective of this combination is on one hand to increase students' interest in science, on how science is made and how it affects everyday life, and on the other to stimulate teacher motivation on up-taking innovative teaching methods, subjects and practices to enrich the science curriculum.

Opportunities to collaborate with stakeholders:

Students will analyse data from earlier volcanic eruptions and identify empirically the probability of a volcanic eruption based on evidence. Using these empirical data, they will run volcanic crisis management simulations utilizing available monitoring virtual tools to understand the decision-making process taking place in order to preserve human life.

DESIGN THINKING PHASES

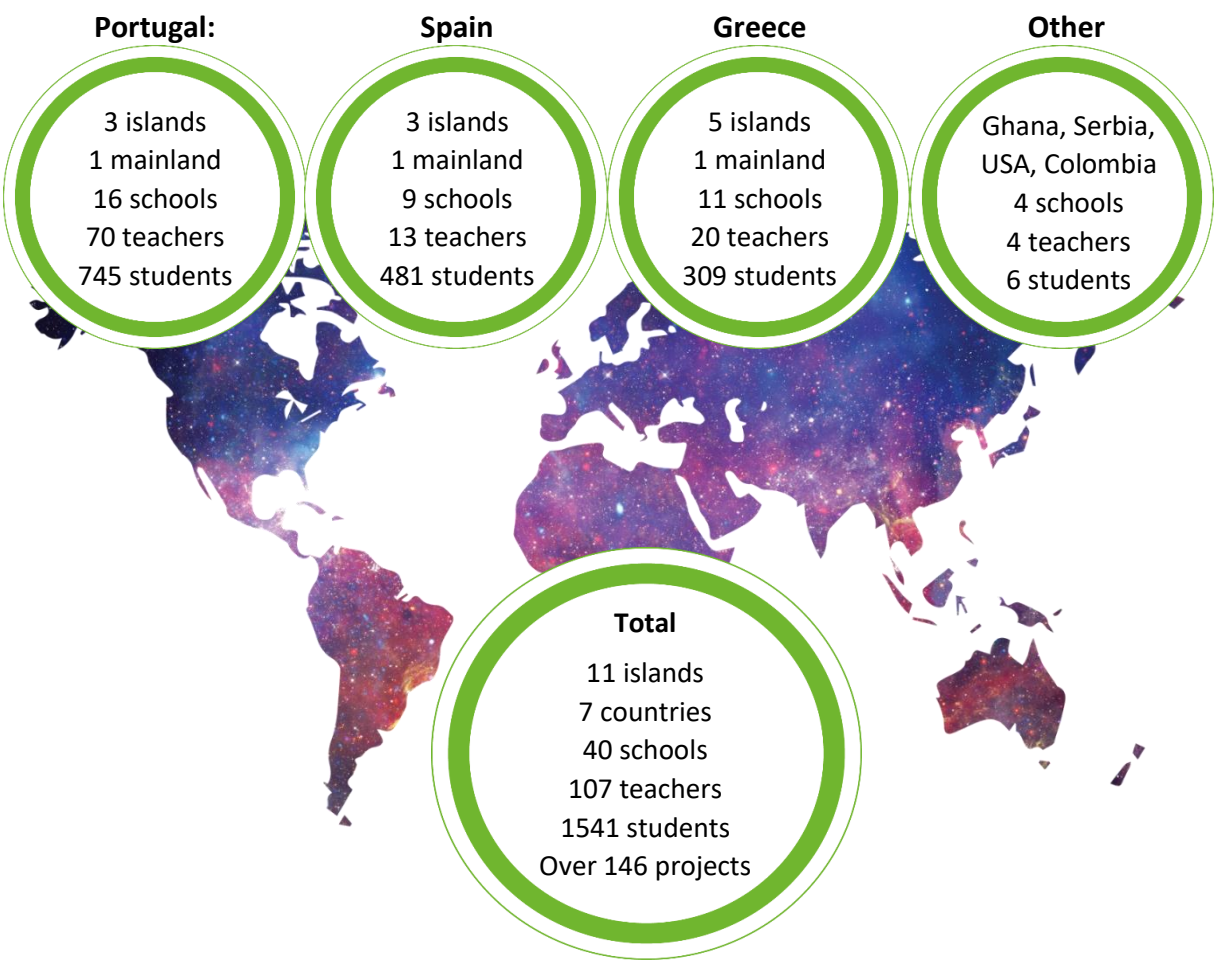
FEEL  Students get the background information on volcanoes and on the existing methodologies regarding the monitoring and forecasting of the probability of a volcanic eruption.	IMAGE  Students will be able to interact with experts on the fields of geology and volcanology in dedicated invited sessions in their schools or visits, virtual or physical.
CREATE  Students will keep an interactive logbook with which they collect material, notes, multimedia resources and keep the minutes of their virtual meetings with other schools.	SHARE  Students will organize an info day in their school to present their work regarding volcanic hazards and the role of the school in helping their community.
Check the full activity:	

10. The IDiverSE Schools, teachers, and students

IDiverSE was a project that focused mainly on the islands of Portugal, Greece, and Spain, but welcomed teachers and students in the mainland and from other parts of the world. Although our priority was the islands due to their isolation and less access to such innovations, we still wanted to bring our innovative methodology to all possible places of the world. To achieve this, our team made all efforts to disseminate the project as far as possible. As a result, the project involved over **1142** teachers through dissemination events and workshops and reached **15729** teachers and school heads through dissemination channels.

To participate in the project, teachers only needed to register. All teachers interested in being part of the IDiverSE adventure were offered training and access to all the materials of the project. Furthermore, each teacher that was part of the project, had one designated person from the IDiverSE team to provide constant support to their implementation, to accompany them and give all necessary feedback. Community building strategies were implemented to promote the collaboration of all teachers from the different locations. A Facebook group was created for all teachers to share their work and a collaborative space was designed in the projects' website. In this space, teachers could connect with each other, send personal messages, join groups of work and share pictures and ideas with each other.

It was a very interesting journey that we have travelled together with many amazing and inspiring teachers and students. The picture below presents the number of teachers and students that have joined the project and worked hard in creating amazing IDiverSE projects and making real changes in their communities:

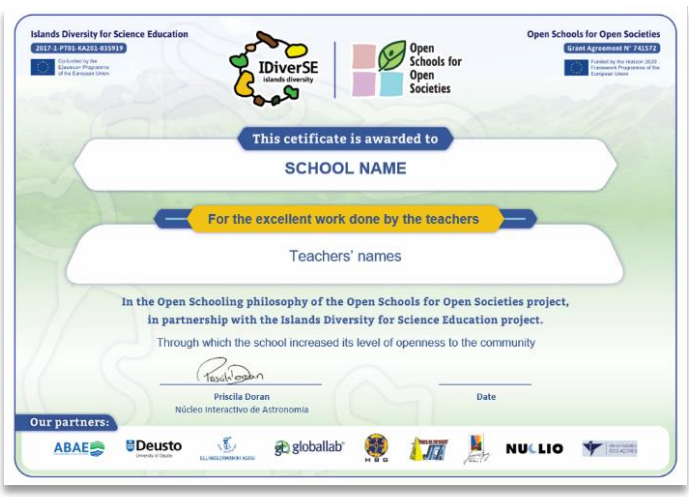


Digital Badges and Certification

By the end of the implementation, all teachers that participated in the IDiverSE project received a digital badge, according to their level of involvement and achievement in the project. Teachers were able to share these badges through their social media and to include them in their curricula. The badge system adopted in IDiverSE was the following:

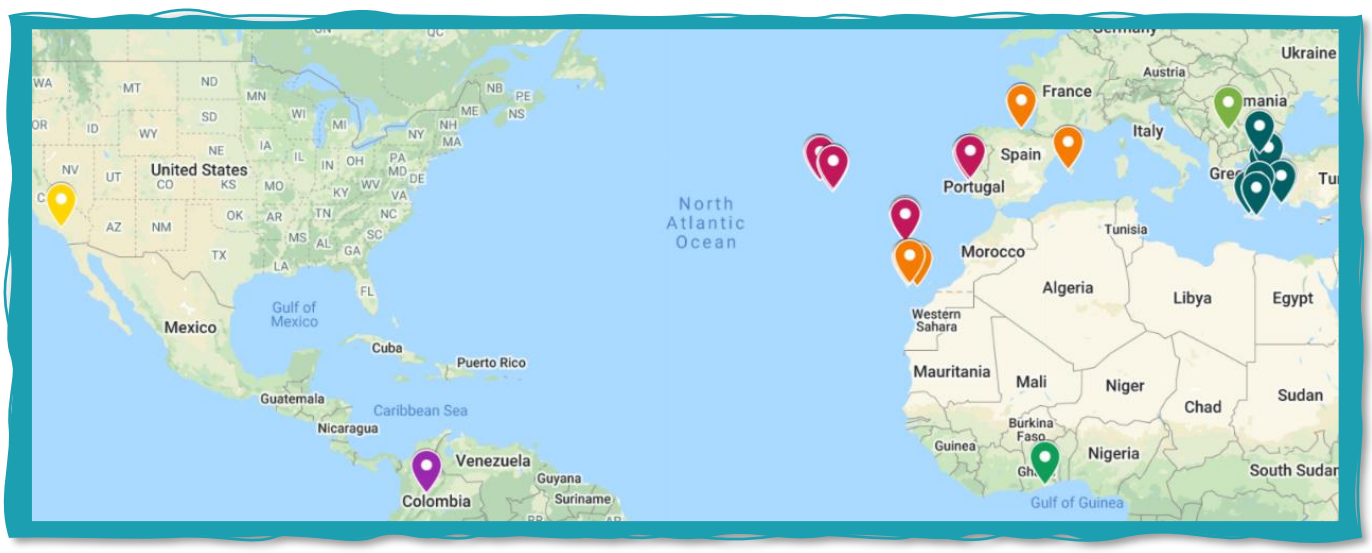
IDiverSE badge	Description
IDiverSE Teacher	Teachers who participate in IDiverSE developing a minimum of one project with their students.
IDiverSE Expert	Teachers who developed at least one project with their students over the course of 2 years or teachers that implemented more than one project.
IDiverSE Creator	Teachers who created their own projects and developed them with their students, using the IDiverSE methodology.
IDiverSE Ambassador	Teachers who supported others on the implementation of IDiverSE projects, trained other teachers on the IDiverSE methodology and / or presented the IDiverSE project to others.

Adding to these digital badges all IDiverSE schools, teachers and students received a certificate of achievement.



Inspiring cases and testimonies

Our dear teachers know how much we admire them and how proud we are of all their work. We also had the privilege of meeting some of the inspiring and hard-working students too and we did not hesitate in telling them how inspired we were by their creativity and their work. It was a privilege to work with teachers and students from so many different places and see them making a difference in their community. Below, we leave you a map with the view of the places that were "touched" by the IDiverSE teachers and students.



By the end of the project, we asked our teachers to make a collection of their best pictures and to send us some testimonies from themselves and from their students. In this book we present some of the stories we received from them and he hope that these inspire you as much as they inspired us!

Note: The testimonies that we present here have been translated to English by our team.

São Miguel Island, Azores, Portugal

Teachers

Sónia Serpa and Graça Amaral from Escola Básica e Secundária Armando Côrtes-Rodrigues

Project

How to implement reading habits in my community (developed by teachers)

Sónia and Graça really liked the IDiverSE projects, but they felt like they had discovered a better theme that they could develop together. Graça is a Portuguese teacher and Sónia is a Geography teacher. Together they decided to embark on a journey to bring awareness to their 10th grade students about the importance of reading. Through this project, students not only learned about the importance of reading but also shared their discovery with their families

Testimonies from teachers:

"This project helped me to know my students better and to interact with them in a different way"

"We had the chance of learning and implementing a new approach that makes the learning-teaching process more appealing, effective and meaningful"

"I loved developing this project and doing something that promoted the reading habits where I live"

"This course allowed us to explore the multiple relationships that we can establish between different areas of knowledge, with the teacher being responsible for managing the different contents in order to involve students in the whole process, developing young people's critical and creative thinking, as well as their capacity to interact in order to build knowledge."

Testimonies from students:

"We enjoyed working on this project because a different methodology was used other than the ones our teachers use on a daily basis."

"We learned to work in group and to know our classmates better"

"This project helped us to identify and solve a problem in a creative way"

São Miguel Island, Azores, Portugal

Teachers

Luís Veríssimo from Escola Básica e Secundária Armando Côrtes-Rodrigues and Isabel Santos from Escola Secundária de Lagoa

Project

Marine litter: "Searching for the usual suspects …at my beach" (IDiverSE project).

Luís and Isabel, from two different schools in São Miguel island worked together in the development of their IDiverSE projects. Each of them worked with different students from 6th and 7th grade, but they kept a close communication and collaboration throughout the whole process. Among other activities that make their students truly feel the problem, they promoted a beach cleaning with them, where they collected a lot of waste. Their students were moved by the amount of waste they collected and their perceptions about the problem changed.

Testimonies from teachers:

"Considering the topic at hands and the way it was approached, as a result, all students became more aware of the problem and, I think, gained a greater commitment to nature, more specifically, to the sea. It is a methodology to follow."

"A motivation and an inspiration, it is a pity that the current education system does not allow such an inspiring teaching methodology in a bigger scale."

Testimonies from students:

"This was the best class in the whole year".

"I will be angry anytime I see someone throw trash to the floor".

"I will never throw trash to the floor again. Of course, I knew I should not do it, but I didn't really care. Now I realized that I really shouldn't do it".

Terceira Island, Azores, Portugal

Teachers

Joaquina Novo, Marina Silva, Marisa Teixeira, Simone Simões, Marisa Dias and Margarida Alves from Escola Básica e Secundária Jerónimo Emiliano de Andrade

Project

UV radiation – Friend or foe (IDiverSE project)

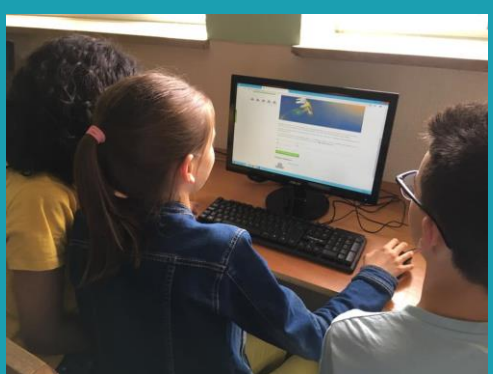
This group of teachers decided to develop a project related to UV radiation with their students. They took their students to a science centre to learn how to make home-made sunscreen, they created bracelets with UV sensitive beads that they distributed to a local kindergarten, and developed a fun theatre and a puppet show about UV radiation for younger students.

Testimonies from teachers:

"This project allowed me to develop a collaborative work with several colleagues from different disciplines, promoting interdisciplinarity and the sharing of knowledge and experiences"

"This project contributed not only to my professional enrichment and personal experience but also to my motivation in adopting new methodologies"

"Students loved the Personal Geography part and were very enthusiastic with the results achieved by the end of the project"



Madeira Island, Portugal

Teachers

Isabel Chaves from the International Sharing School of Madeira

Isabel chose not to develop any specific project with her students, but to freely explore different aspects of the IDiverSE methodology with her 8th grade foreign and local students. She introduced them to the Personal Geography artistic expression, allowing them to spend time to reflect and deeply explore the activity. She also introduced them to the UV radiation activity by engaging in the collaborative data gathering in the Globallab platform using the UV beads.

Testimonies from teachers:

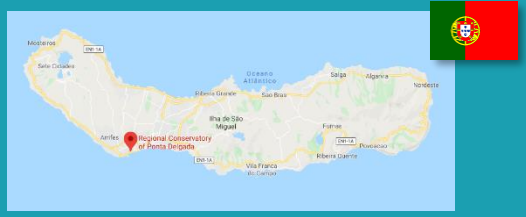
"Personal Geography is a tool to be explored with students, that presents many potentialities. It allowed students coming from other countries to look for reasons to enjoy being where they are and allowed the local students to discover "hidden" aspects of their identity."

Testimonies from students:

"I liked the activity about Personal Geography a lot. Drawing and reflecting about what I drew allowed me to discover things that I did not know about myself".

"The activity about UV radiation was nice. The change of colour in the UV beads convinced me that UV radiation really isn't always the same and can be dangerous to our health".

São Miguel Island, Azores, Portugal



Teachers

Cristiana Spadaro, Mónica Reis and Isabel Albergaria from the Regional Conservatory of Ponta Delgada and Noélia Santos from Escola Básica e Secundária Armando Côrtes Rodrigues

Project

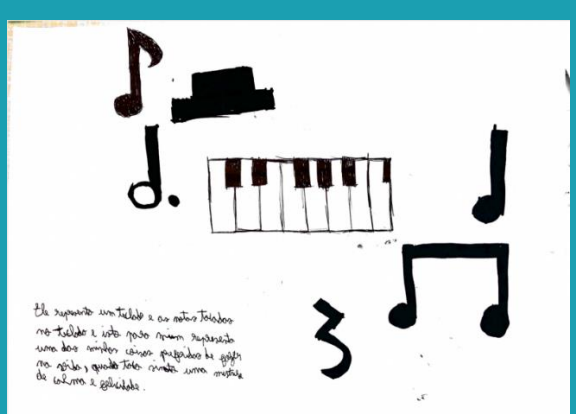
Organistic Itineraries (developed by the teachers)

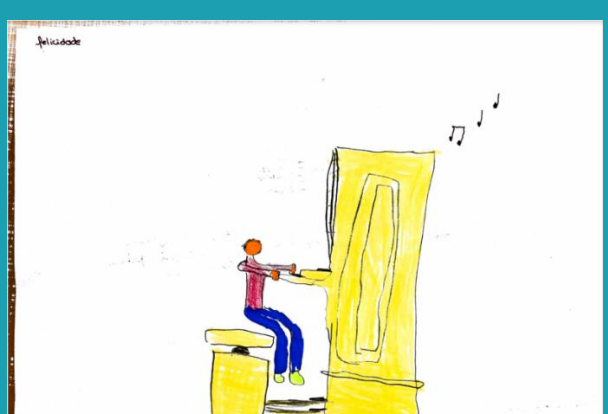
Noélia Santos and Cristiana Spadaro, together with colleagues from the Regional Musical Conservatory, involved their students in an interdisciplinary project related to music, history and science. Students explored the science of music with fun ways of creating music using tools like Arduino and oranges. They also studied the story of the organs in the Azores islands and other countries and discovered the huge musical heritage of their island.

Testimonies from teachers:

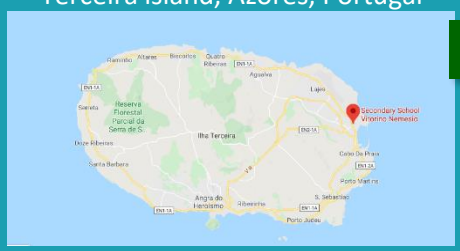
"In over 15 years of teaching practice, my students have always shown a thirst for knowledge and curiosity in relation to their surroundings, asking pertinent questions related to scientific knowledge, hence this type of initiatives are always an asset for any educator, since they allow students to get in touch with experts in the field, which also allows them to be motivated to learn repetitive and boring content, such as memorizing the multiplication tables or improving written expression."

"The students, in general, responded positively to the entire process of development of the project, even getting emotional responses, especially in the context of History. Another noteworthy reaction was the enthusiasm for the activities carried out in the field of Physics."





Terceira island, Azores, Portugal



Teacher

António Antunes from Escola Secundária Vitorino Nemésio

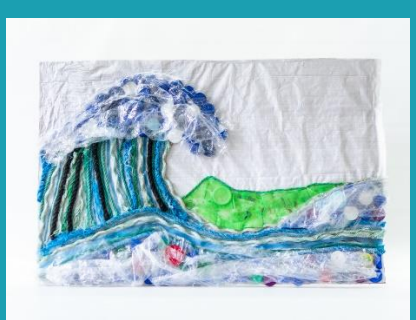
Project

Plastics in the island, an island of plastic (developed by the teacher)

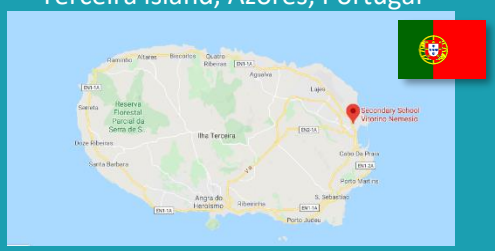
António Antunes involved his students from 10th, 11th and 12th grades in an arts project related to the plastic pollution in the island. Together they followed a trail from the mountain to the beach and collected all the plastics they could find. They then washed the plastics, separated them and created amazing artworks using only those plastics. These artworks were then exhibited in a local galery.

Testimonies from teachers:

"The teaching practice that resulted from these models of learning, with the student in the centre of the process as a decision maker in the building of knowledge for the benefit of the community, serving the school as partner for the local well-being, revealed as very effective and very gratifying for all involved. It strengthens the role of the educator as a guide and facilitator in the building of knowledge, regardless of the subject domain. It is a strong aid in the development of the ***Student competence profile for the XXI century*** *and in reaching an* ***inclusive education****."*



Terceira island, Azores, Portugal



Teacher

Augusto Vilela from Escola Secundária Vitorino Nemésio

Project

Bees for the Future (IDiverSE project)

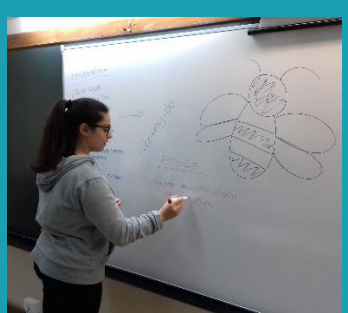
Augusto Vilela and his students from the 1st year of a technical course in Geriatrics, developed a project related to the importance of bees for our future. They visited a beekeeper and dressed up to go visit the bees themselves! What an adventure! Being moved by the tremendous importance of these insects, they decided to something to protect them. So, these students rehabilitated the school garden with pollinator friendly flowers, built a pollinator hotel and even went on a local TV channel to allert the community to the importance of bees and to share their work.

Testimonies from teacher:

"The level of engagement of the students to the activities was very high (which was also perceivable by the improvement of some students' assiduity to the classes) and the evidence illustrate an effective individual and class empowerment, as perceivable from the derived enriching actions to the community "

"The level of dedication of the students, the positive shared emotions, the results that showed up and the perception that I was rehearsing and validating practices of obvious importance to my practice, made it easier to prioritize this challenge at hands".

"After the development of the project, I realized that the students were satisfied with the path they developed and its results; they were more motivated to participate in the school's dynamic, they had a better perception of the behaviours they had to adopt to have a better school success; they had a better relationship with each other and a more positive relation with teachers and they wished to continue to participate in similar projects, based on the same methodologies."



Terceira island, Azores, Portugal

Teacher

Maria Gabriela Schwarz Martins from Escola Secundária Vitorino Nemésio

Project

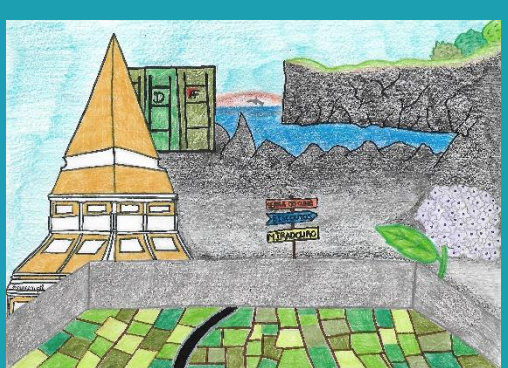
Trail in the island (developed by the teacher)

Maria Gabriela worked with her 8th grade students in the creation of a trail through the island highlighting the cultural and social aspects that they found to be relevant. For this, they had to plan ahead and to create their own maps of the village. Their final result was a trail created for any visitor to know the main important cultural values of their community in the island.

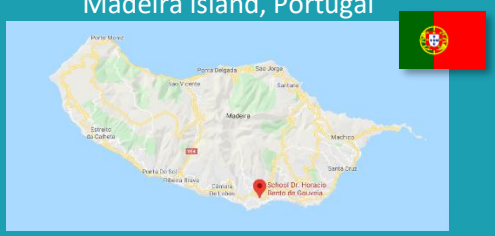
Testimonies from teachers:

"Realizing the importance of the decisions of their peers, in an interdisciplinary work focused on solving problems, was a key factor to the positive engagement of the students to the project and to the Inquiry based methodology".

"The idea of aggregating the islands spread in the world and realizing that they belong to a community is very stimulating, both for teachers and students. The possibility of communicating among themselves and confronting their realities, even between islands from the same archipelago, enhances the diversity and stimulates respect and inclusion".



Madeira island, Portugal



Teachers

Ana Lúcia Vasconcelos, Maria Claret Almeida, Orlanda Andrade, Ana Maria Velosa, Maria Cecília Pontes and Cristina Proença from Escola Escola dos 2 e 3 Ciclos Dr. Horácio Bento de Gouveia

Project

Bees for the Future (IDiverSE project)
Science Trail

These 6 teachers worked together with several 8th grade classes during 2 consecutive years. During the 1st year the students were inroduced to the Design Thinking methodology through the Bees for the Future project. They organized a conference where they invited a beekeeper, visited the beekeeper work, planted flowers in vases and distributed to their municipality, among other actions. In the second year they gathered several relevant topics like the element table, history of the island, etc., and created an amazing science trail in their school. They invited the municipality and general public to visit their trail.

Testimonies from teachers:

"With this project a different and motivating dynamic was installed between teachers and students. The teamwork was very fruitful. The effort shown by the students was high. They created, innovated, acted, sensitized and disseminated their ideas to their community".

"Being part of this project raised in students a sense of responsibility for the world they live in. They felt they could be more proactive an that their attitude was also important. It promoted a collaborative research, the sharing of ideas and the development of important competences like critical thinking and creativity. Students were able to address and minimize the lack of information in their community about the problem of the dissapearance of Bees"

"The methodology of the project included a deep vision of diversity, approaching the universe of each student as unique, promoting awareness for environmental issues and sharing with the world."

"This project brough inovation to the school environment and opened the school to the community, namely in the distribution of the awareness "kit" for the importance of the Bees."

"Developing this project allowed me to develop a bigger cumplicity and cooperation with my students and with my colleagues. It was a learning process not only for the students but also for me. It was gratifying to see them discovering, testing hypothesis, researching and discussing before reaching their conclusions"

"The interest, curiosity and commitment of my students exceeded my expectations, even the least applied ones got involved"

"This project offered a great variety of tools and methodologies, developing in students the hability to solve daily problems and to make decisions. It made known to the community a problem that is fundamental for the future of humanity and asked for their colaboration in solving it".

... continues in the next page






Madeira Island, Portugal

Teachers

Fernanda Freitas, Cecília Ferreira, Teresa Nóbrega, António Freitas, Conceição Campanario and Carlos Pontes from Escola Secundária Jaime Moniz

Project

Bees for the Future, UV Radiation: Friend or Foe and Marine litter (IDiverSE projects)

Fernanda's and Cecilia's 10th grade students contacted with experts and their community and developed a project about the importance of bees. They built a bee hotel, planted pollinator friendly flowers in the school and created posters and leaflets to share in the community. Teresa's and Carlo's students researched the variation in UV radiation levels through the day, organized and analysed the data and created pretty graphics. Their work was shared with the whole school community. In the second year, the students engaged in the problematic of plastics in the ocean, using plastics to make an artistic expression of their conclusions.

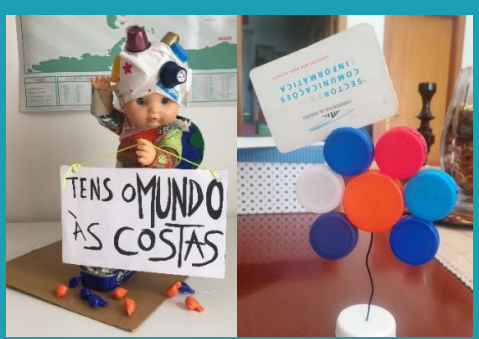
Testimonies from teachers:

"As a teacher, it is projects and activities like these that motivate me to continue in my profession. It was with great satisfaction and pride that I watched my students grow through the year, increasing their self-confidence and autonomy".

"I was proud to see that several colleagues from the education community got involved body and soul in their projects and in the presentation of their final results".

"The students learned with joy and ease, they had fun creating their final results, involved their families in the creation of the outputs and felt stimulated and valued".

"The IDiverSE project unifies teachers from different disciplines and brings all the involved teachers and students to travel outside the class, the school, the island, the country".



São Miguel Island, Açores, Portugal

Teacher

Pedro Sousa, José Alves and Maria da Conceição from Escola Secundária da Ribeira Grande

Project

Community and Ecological Masks, Promotion of Gender Equality, Importance of the Family budget (Developed by the teachers)

Pedro Sousa started involving his 10th grade students in the plastic pollution thematic, however, with the emmergence of the COVID-19 pandemics, they considered to be important to act on it to help the community. This way, they focused on creating ecological masks to distribute to those in need. José Alves and Maria da Conceição, worked with an adult class and decided to develop their own projects. These were related to the importance and "how-to" of managing family budget and about gender equality.

Testimonies from teachers:

"It was very worthy and gratifying working in this project because in these difficult times for social relations (due to COVID-19), it brought students closer to the local community through acts of volunteering and solidarity, using old materials and reusing them to this end."

"The dynamics and predisposition of students were evident, which in these projects, increases everyones' motivation, including mine. These are projects that should be a common tool in the national education system".

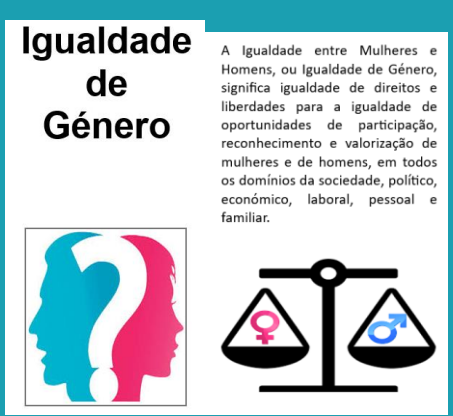
"Students were surprised by the fact that they studied two topics of great relevance to the society".

Testimonies from students:

"With this project, our group concluded that the action was gratifying, not only for contributing to the environment, but also because it was a good experience for us, contributing to the development of our skills and competences. We also think that the volunteering made this experience humble and affectionate, since offering masks was an act of humility and love for others. In sum, we all agree that we enjoyed this project."

"We like to work with this method because it allows us to think".

"This work was very gratifying due to the current pandemic situation. This action gave us the possibility of, with a small and simple gesture, making a difference, helping others, and expanding our knowledge, learning more about how to protect ourselves, namely with the usage of masks and visors".



Mainland, Portugal

Teacher

Teresa Sousa, Maria Manuela Inácio, Filipa Karas, Isabel Moreira, Lurdes Rodrigues and Helena Silva from Escola Secundária Frei Gonçalo de Azevedo

Project

Christmas in Mars (Developed by the teachers)

Teresa, Maria Manuela, Filipa, Isabel, Lurdes and Helena, involved their 11th grade students in a mission to Mars project. Their students had three challenges: 1- Send the teacher's car to space, 2-Discover if micrometeorites can fall on Earth and 3- make a prototype of a rocket. Each group worked on a different challenge, each diving deep into the physics, engineering and mathematics of the themes.

Testimonies from teachers:

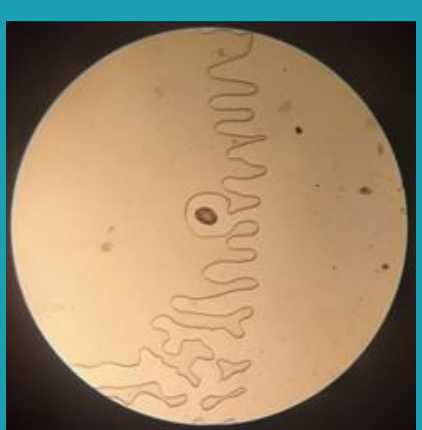
"It was gratifying watching a group of young students going from "Crazy" ideas (like launching my car to space, building a rocket, or trying to find star dust in our roofs) to taking control. They discovered information, new theories, and knowledge every day, discussed results, found solutions, and solved problems, debated and doubted, as if suddenly those very compartmentalized classes had become a research centre. It was very hard work and not everything went well, but the smiles and laughter were our best prize"

Testimonies from students:

"With this project I learned a lot more about physics, engineering and mathematics and this increased even more my wish to work in this field. I have always dreamed about working in NASA and I hope this dream comes true."

"With this research work all group members ended up knowing much more about the aerospace field. This knowledge about a scientific field was very advantageous to all, facilitating future decisions when finishing school."

"This work helped a lot in developing the reasoning skills of each member of the group and contributed to cooperation and mutual aid."



Madeira Island, Portugal

Teachers

Elisabete Chaves and Ricardo Abreu, Marco Ribeiro, Arlindo Santos and Fátima de Jesus from Escola Secundária Jaime Moniz

Project

UV Radiation: Friend or foe (IDiverSE project)

Elisabete, Ricardo and Fátima de Jesus developed a project with their 11th grade students and Marco Ribeiro with his 10th grade students, both about UV radiation. The students interviewed the community about their awareness of the dangers and the benefits of UV radiation, they researched the topic and finally they created several outputs for the community. They designed a board game, leaflets, a poster, and they composed a song and lyrics about the theme, to present to the community. Marco's students developed a scratch game and a Graasp activity about UV radiation.

Testimonies from teachers:

"Some students were excited from the beginning, with the idea of a project that would take them beyond the physical boundaries of the school, involving their families and the community around the school".

"Some students were hesitant with the idea of going through the 4 phases, feel, imagine, create and share. But they felt a great enthusiasm and joy when creating and sharing their work".

"As a teacher it was enriching to see the students' commitment in the when carrying out a collaborative work in collecting data with colleagues from the same school and from other countries. They realized that their action could have an impact in the community".

"On the exhibition day, anytime a visitor approached our station, many of the students volunteered to present the game and the poster with the Graasp activity"

Cascais, Portugal

Teacher

Ana Filipa Matos from EB1/JI Abóbora nº2 and Rui Simões, Helena Domingues and Andrea Alencar from Escola Secundária Frei Gonçalo de Azevedo

Project

Let's save our planet (Developed by the teachers)

After a walk around the school, Ana Filipa Matos and her 3rd grade students realized that the streets were full of trash and something had to be done. They discussed about possible causes and brainstormed solutions. Each group focused on a different solution to help the environment (recycling, saving water, cleaning the environment, etc). One group decided to share with the municipality a list of measures that could improve the problem. After this, the trash in the streets around the school decreased significantly. Inspired by this, Rui Simões, Helena Domingues and Andrea Alencar involved their 8th grade students in the same thematic. These students researched the recycling awareness in the school community and developed a questionnaire to investigate the level of awareness of the community.

Testimonies from teachers:

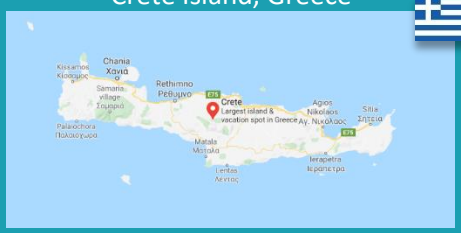
"By the end of the project, when the students verified the impact of their actions, they felt proud, confident and more motivated to continue implementing actions of improvement in the community".

"The students overcame the expectations, going further in their discoveries than initially intended".

"The involvement of the students is increased if they are more active in the decision-making process of the work they are developing. The investment is higher, hence, the learning is also more significant".

"It was a project with impact in the community, which promoted in students' civic sense and also the awareness for the importance of protecting and preserving the environment."

Crete Island, Greece



Teacher

Siligardou Fotini from the 2nd Primary School of Voutes

Project

"The city of the Sun"

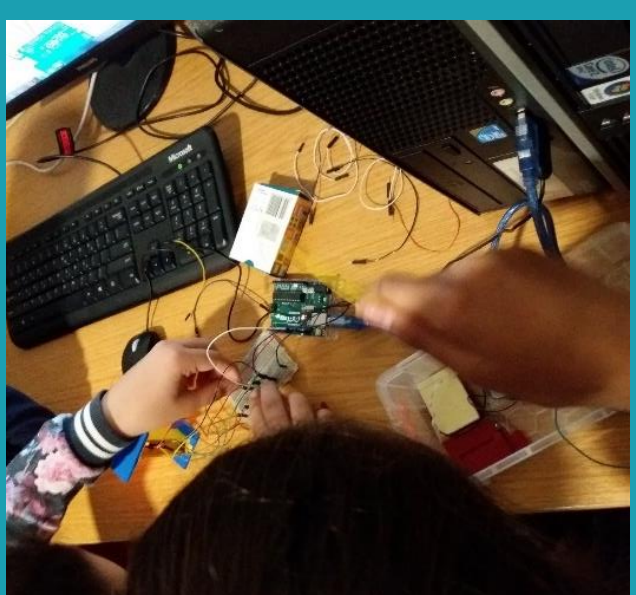
In the 2nd Primary School of Voutes teachers and students implemented a design thinking approach to discuss problems of their island (Crete) and find solutions. The project was called "The city of the Sun" and was created by students of the sixth grade in the courses of Informatics, Physics and Arts.

The students were inspired by their place and created a city that exploits the main source of life on our island, the Sun.

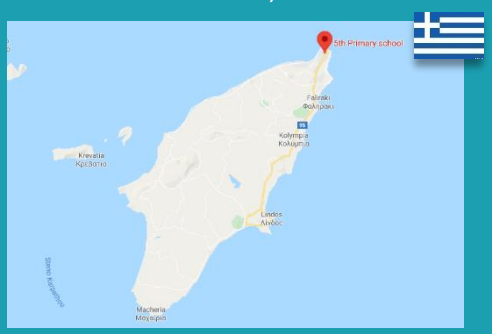
The city was designed in Tinkercad, a3D Online Tool. The students designed every part of the city, houses, parks, traffic lights, many trees and flowers. Also, a sign to inform city residents about the temperature and a car charging station. Each piece of the city was printed on the 3D printer of the school.

In order to convert solar energy into electricity, a solar collector was used. For all the automations of the city, the Arduino microcontroller and the Scratch4Arduino software (S4A) was used. For moving to the city pupils built a rechargeable vehicle using the Lego WeDo2 training package and programmed it using the WeDo2 software.

In order to sensitize the local community to the use of renewable energy sources the pupils presented their idea to the 9th Student's Digital Creation Festival and to local media.



Rhodes Island, Greece



Teacher

Papazachariou Eirini Anthi of the 5th Primary School of Rhodes

Project

"EARTHQUAKE AND VOLCANOS – I am not afraid of earthquakes, I am an Earthquake Specialist"

The students of the C2 class of the 5th Primary school of Rhodes developed a project with to raise consciousness and awareness in case of an earthquake. The project's main objective was to enable children to get to know the phenomenon of earthquakes, to confront and handle their feelings regarding earthquakes and, to learn ways to successfully protect themselves from earthquakes.

This project started with a journey in learning about earthquakes, first human beliefs about earthquakes and stories from Greek mythology. They became acquainted with scientific information about Earth's structure, the mechanism that makes the Earth tremble, the rocks of solid crust that break, the crevasses and volcanos. Subsequently they focused on preparation and the prevention measures before, during and after an earthquake. Getting to know about earthquakes mostly with an experiential way and with the use of lab experiments, urged students to have a positive disposition towards research. They acquired the appropriate information about earthquakes and volcanos and furthermore they realized that they must keep calm during an earthquake. To end with, the program was concluded with the construction of two seismographs: a) a simple seismograph from recyclable material, and b) a second seismograph which resembled more a real seismograph. The first seismograph was the motivation for the construction of the second.

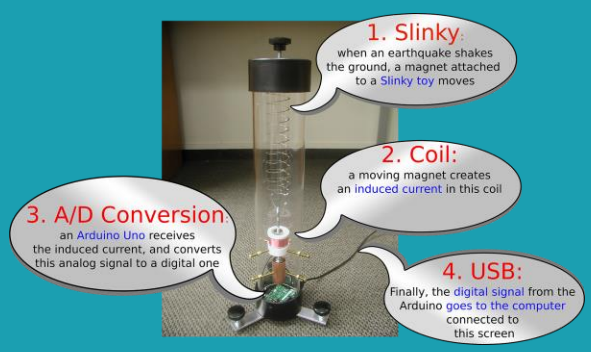
Crete Island, Greece

Teacher
Stratos Violakis from High School of Vamos

Project
"Restless Earth (IDiverSE project)"

The students implemented a project on the seismic activity of Crete and its impact on the Minoan Civilization that thrived on the island from c. 2700 to c. 1450 BC. The students studied the origin of earthquakes and their frequency, making use of a TC1 seismograph that they received from the Institute of Geodynamics of the National Observatory of Athens.

The students used the seismograph, learned how it works, and processed the data it generated during the whole year. To further understand the phenomenon, they also visited an earthquake simulator located at the Natural History Museum of Crete. Using the simulator, the students had the opportunity to feel real, large-scale earthquakes from all around the world. Through this project, students had the opportunity to better understand earthquakes as well as the role modern technology plays in preparing and monitoring them.



Testimonies from students:

"We are very happy we participated in this program. Never before did we have a chance to see and work with a seismograph or have the opportunity to feel first-hand what a really big earthquake feels like. It was a great experience and very useful to us, as we learned what we have to do if an earthquake occurs."

"Even though we have experienced many earthquakes in Crete, we always forget what we are expected to do so. By participating in this program, we had the opportunity to learn about taking precautions and how to react during an earthquake through hands-on activities. It was very interesting to work with the data from our seismograph and calculate the epicenter and the magnitude of earthquakes."

Chios Island, Greece

Teacher

Ioanna Kasampa from Primary School of Nenita

Project

“Restless Earth (IDiverSE project)”

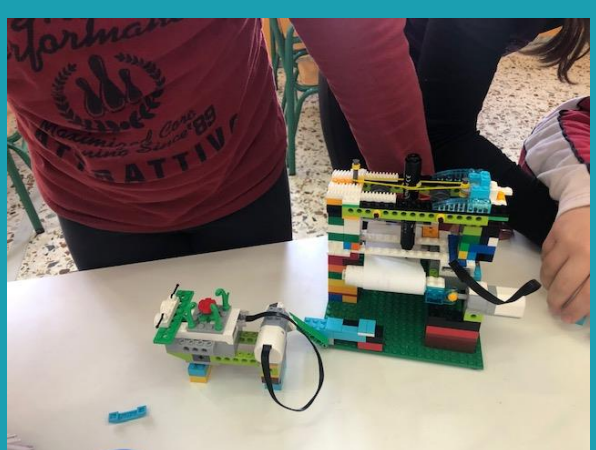
The 5th Grade of the primary school of Nenita in Chios implemented an IDiverSE project following the ‘Restless Earth’ activity to study earthquakes and underground activity.
During the project, the students had the opportunity to recall past knowledge and record their own experience with earthquakes. They studied the phenomenon through multiple viewpoints, they created their own tectonic plates models and engaged in drills to prepare for a potential earthquake.
The students used a real seismograph and they also designed their own model of a seismograph using Legos, which they presented it in the "Athens Science Festival 2019".

Testimonies from students:

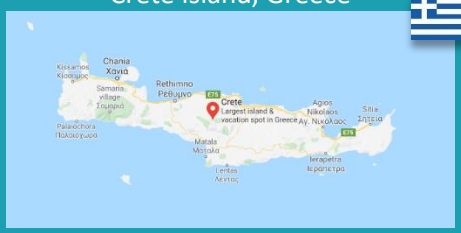
“I liked studying earthquakes and learning about how seismographs work. I particularly enjoyed creating our own seismograph with Legos.”

“Now that I know more about earthquakes, I feel I am less scared of them.”

“The experience of making our own seismograph was unique!”



Crete Island, Greece



Teachers

Alexandra Bakou, Nikolaos Psaroudakis, and Maria Eleftheriou from Experimental High School of Heraklion

Projects

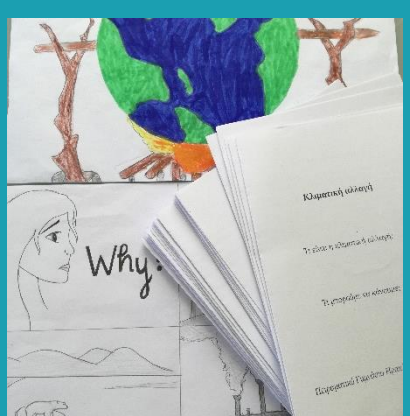
"Volcanoes and Earthquakes in Greece"
"Earth's climate and Climate Change"
"In the paths of Science"

Students developed three projects where they sought information and provided answers to scientific problems on topics not included in the school curriculum. The students also designed and performed experiments with simple materials. Their projects focused on awareness of students and the local community on issues of ecology, environmental destruction, and climate change.

Testimonies from teachers:

"My participation in the project has helped me to explore scientific issues with a creative and research mode in the classroom. Students learned to cooperate with each other and present their views with arguments. They have acquired the skills of creativity and critical thinking in scientific matters. I worked effectively with other teachers and we exchanged ideas about the project."

"IDiverSE program gave us the opportunity to work interdisciplinary and to combine different activities with our pupils. The tool of personal geography was very interesting, and pupils found it very creative. "



Santa Cruz, Tenerife, Spain

Teachers

Sonia Fleitas, María Concepción Molina, Héctor Saavedra from IES La Orotava-Manuel González Pérez

Projects

"Students study Volcanoes"
"GOC Tenerife"

Several teachers of this school engaged to the methodology of iDiverSE because of a multiplier event of the project. As soon as they knew the philosophy of the project, they thought of several ideas to carry it out in their school.

At the beginning, during the 2018-2019 academic year they implemented the IDiverSE activity STUDENTS STUDY VOLCANOES with 50 students in the 2nd year of secondary education, i.e., students aged 13-14.

During the 2019-2020 academic year, they decided to design a more concrete project with 28 students of the middle grade of tourism. The students of the superior cycle of Animation, social-cultural and tourist aimed to open the island to the outside through the creation of a WEB that contains gastronomy, leisure, and culture of Tenerife, giving to know the island in different ways, with many experiences.

The name of the project is GOC Tenerife and this is a web dedicated to tourism, culture and leisure and gastronomy in Tenerife.

Las Palmas de Gran Canaria, Canary Islands,

Spain

Teachers

Mª del Carmen Rodríguez and Angeles Zerpa from IES El Rincón

Projects

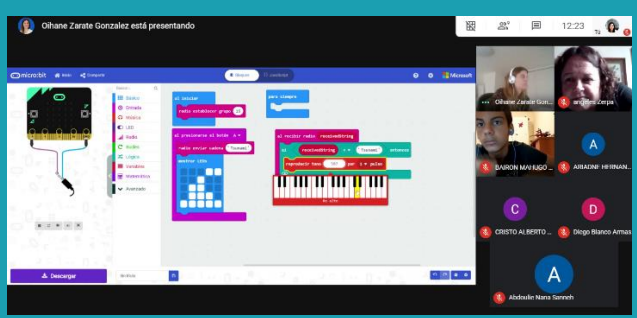
"Our Restless Earth (IDiverSE project)"

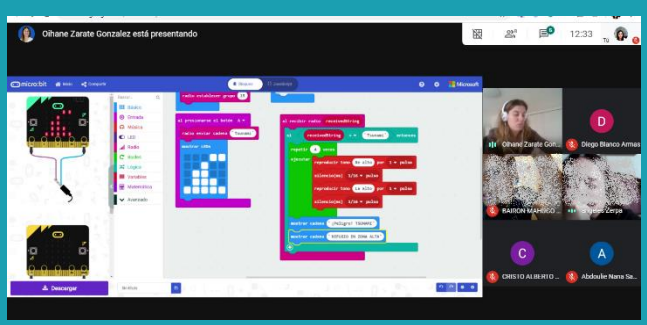
IES EL Rincón has implemented the IDiverSE activity OUR RESTLESS EARTH with 15 students in the 4th year of secondary education. The students chose this activity because of the relevance of the topic to living on a volcanic island. In the first phase of the activity the students elaborated a work of information search and research in relation to the seismic activity in their island and the existing warning systems to warn the population in case of an earthquake. In a last phase, already in the middle of the pandemic process in Spain, the students decided to create a city alert program with the Micro:bit board and its programming language MakeCode.

For this purpose, the team from the University of Deusto, partners in the IDiverSE project, offered a master session for the students through a video conference system.

In the session, students learned the basic programming fundamentals and then they, on their own, elaborated a citizen alert system in case of earthquakes with the learned knowledge. The students were very motivated throughout the activity and valued the practical Micro:bit workshop very much. Furthermore, the workshop helped them to think of new and more advanced solutions to protect society in case of earthquakes.

The teachers involved in this project where very enthusiastic with the ideas their students developed and have valued very positively the learning process they have followed through this activity.





Bilbao, Spain

Teachers

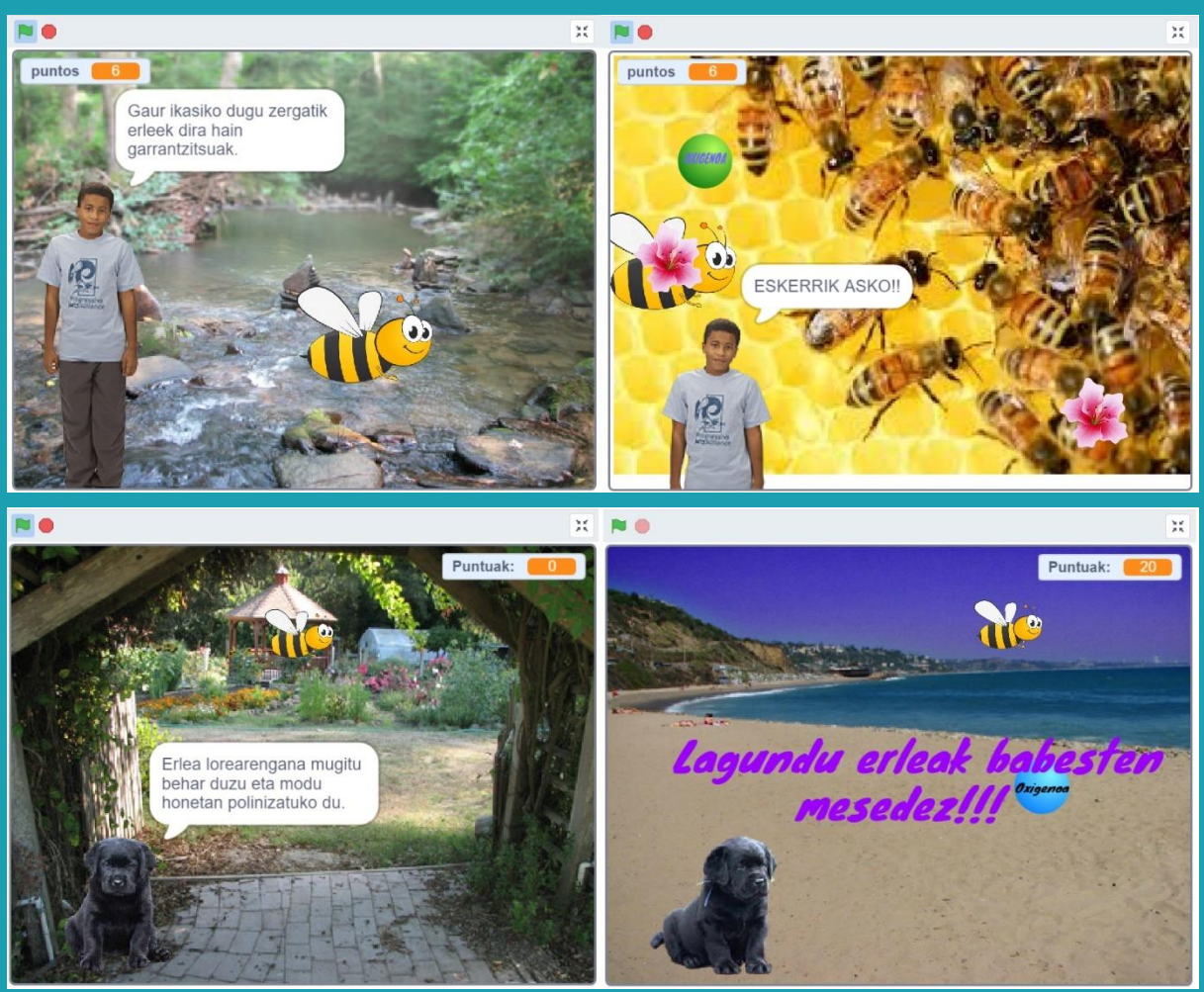
Itziar Rodríguez from Esclavas SC Fátima

Projects

"Bees for the Future (IDiverSE project)"

In this school, teachers have selected the IDiverSE activity Bees for the Future to implement with 6th grade primary school students. A total of 50 students have carried out this activity. In a first phase they have studied the importance of bees, the pollination process, they have inquired about the protection of bees in their environment and finally they have carried out a Scratch project to make society aware of the importance of protecting bees.

The students have shown great motivation in the development of the activity and several have recognized that until now, they did not see the need for bees and that from now they would try to protect them and value their role in nature more. The teachers have also been satisfied with the results of the students and with the methodology of the activity.



Ortuella, Spain

Teachers

Olaia Berinkua and Tomas Medina from San Felix de Ortuella

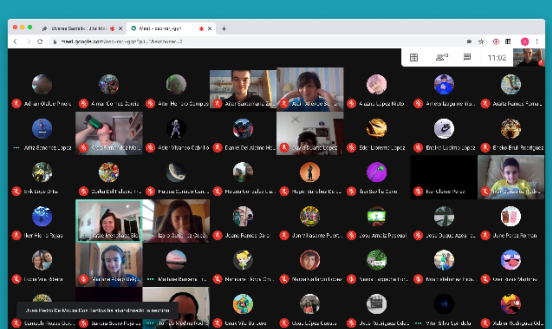
Projects

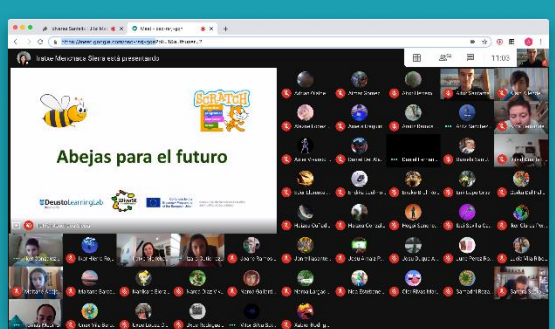
"Bees for the Future (IDiverSE project)"
"Our Restless Earth (IDiverSE project)"

In San Felix School, 2 teachers have been involved in the implementation of IDiverSE. 100 students from the 5th and 6th grades developed a project about the importance of bees. In a first phase, students studied the importance of bees, the pollination process, they have inquired about the protection of bees in their environment and finally they have carried out a Scratch. In the last phase, since we were already immersed in the pandemic and there was no face-to-face class, students from each level had a video conference session presenting their final projects with Scratch. Students were very active in the development of the activity and were enthusiastic about the proposal to create an awareness campaign with Scratch.

At the same time, secondary school students carried an IDiverSE activity about earthquakes. In the first phase of the activity students elaborated a work of information search and research in relation to the seismic activity in Spain and in other countries and the existing warning systems to warn the population in case of an earthquake. In a last phase, already in the middle of the pandemic process in Spain, the students decided to create a city alert program with the Micro:bit board and its programming language MakeCode. For this purpose, the team from the University of Deusto, partners in the IDiverSE project, offered a master session for the students through a video conference system.

After the session, the students made a video explaining the seismic activity in a specific region and the citizen alert program they have designed. Students have shown great interest during all phases of the activity and have learned new concepts applicable to their environment. The effort made by these students in carrying out the activities in English, which is not the official language, should be highlighted. The teachers involved in these activities have positively valued the adaptability of the activities to the remote teaching situation and have been able to include both activities within their teaching plan.





Palma de Mallorca, Balearic Islands, Spain

Teachers

Cristofol Jaume Tugores from IES Arxiduc Lluís Salvador de Palma

Projects

"Energy Intelligence"

This project was carried out as a strong collaboration between OSOS and IDiverSE and has involved 12 teachers, 130 students from different educational levels, 45 family members, 60 neighbours and 150 people from companies and 25 administration staff.

Most teachers were trained in the IDiverSE methodology and have made small changes in their teaching style. Finally, they decided to carry out a project at the school level where they reflected the philosophy of IDiverSE and OSOS, in a real problem of their environment. This project started from the students' knowledge with the aim to make society literate in energy saving and in the management of electricity consumption in homes. Informative talks were held, and a popular inspection has been carried out to find out the energy consumption of each home. After this, solutions were proposed for energy saving, changing installations, etc. It is was a project that started from a real need of the students' environment and from the own resources of the centre. From the knowledge acquired by the students, a better solution has been offered to the community.

As a consequence of the project, IES Arxiduc achieved a high degree of innovation and openness and established cooperation with community stakeholders. Given the success of the project they have published a paper it in the international conference EDULEARN 2019 that took place in the city of Palma de Mallorca.

11. A look into the project's impact and worldwide reach

As it has been repeatedly shown throughout this book, IDiverSE was a pilot project that brought innovative methodologies to the teachers' practice and a lot of adventurous learning experiences for students. Teachers were offered online and onsite training on the methodologies and were provided all the necessary tools and support to implement them with their students. The main focus of the implementation was for students and teachers together to develop Design Thinking projects that involved the community and raised awareness. During this journey, teachers were invited to be part of community building actions and participate in community forums and social media groups. An interactive community of teachers formed, and a lot of ideas and outcomes were shared. It was inspiring to see the mutual support between teachers from different schools and different islands and it was definitely a good surprise to see teachers and students traveling an innovative journey together. All those involved learned a lot and went out of their comfort zones to grow from the experience.

In the previous pages we have shared the overall theory, the practice, the examples, and the good practices raised from the project. We have also shared the testimonies of teachers and students, which give us a glimpse over the impact of the project in their learning and teaching experience. Adding to these, the IDiverSE team called for the support of the teachers to make a more quantitative evaluation of the results of the project and we will present the results below:

Dissemination reach of IDiverSE

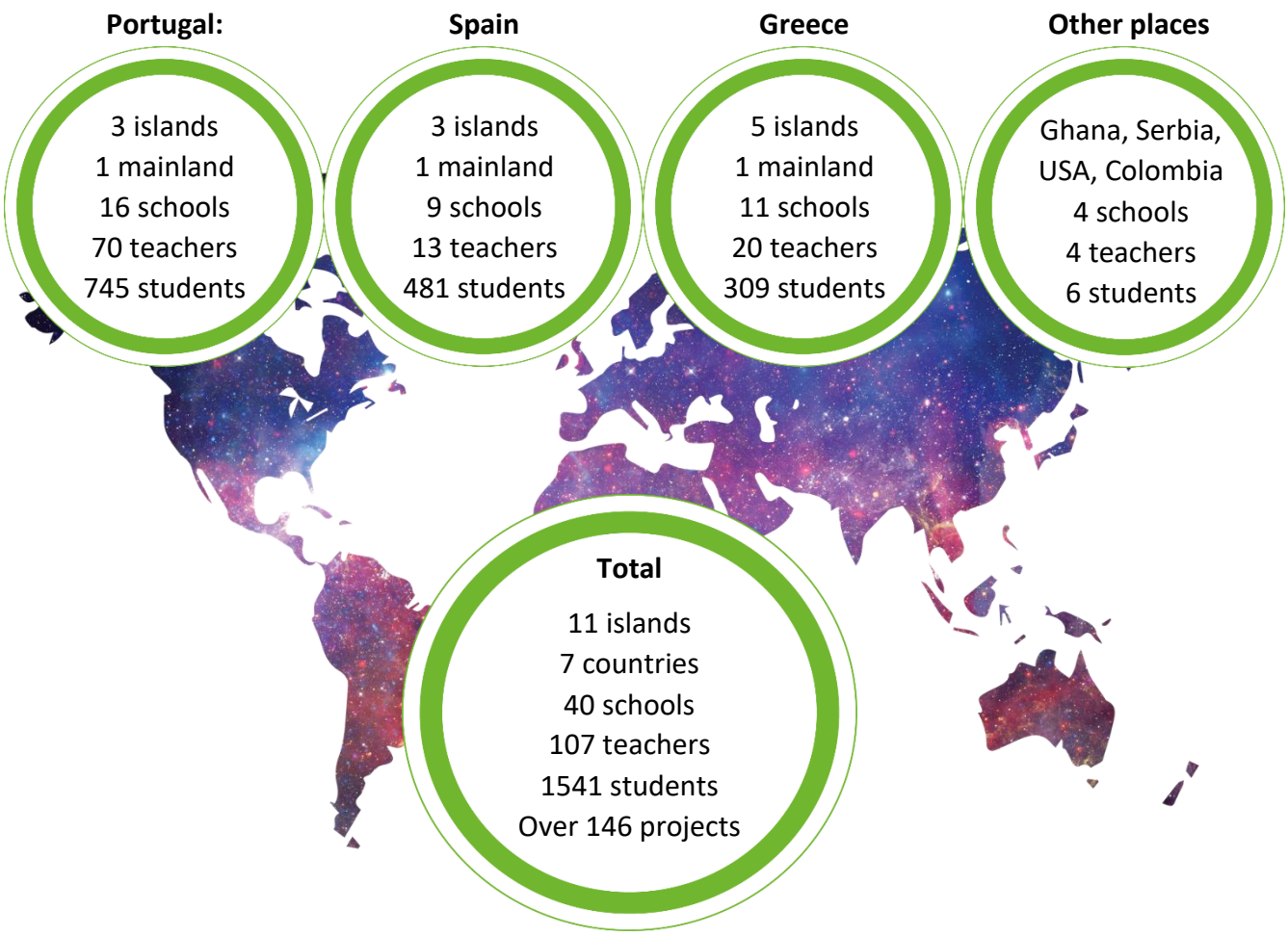
Dissemination in IDiverSE was carried out as a means to reach as many teachers and students through the world as possible. This was done through the projects' social media, project presentations, leaflet distribution, workshops, articles to local media, etc. Through these efforts, the project reached over **1 000** teachers through dissemination events and workshops, in Portugal, Greece and Spain. Furthermore, over **2 600** teachers and school heads were reached through the regular project newsletter and over **16 000** through the dissemination channels used by the partners, worldwide.

Follow the Facebook page:

Join the Facebook group:

Impact and reach of the implementation

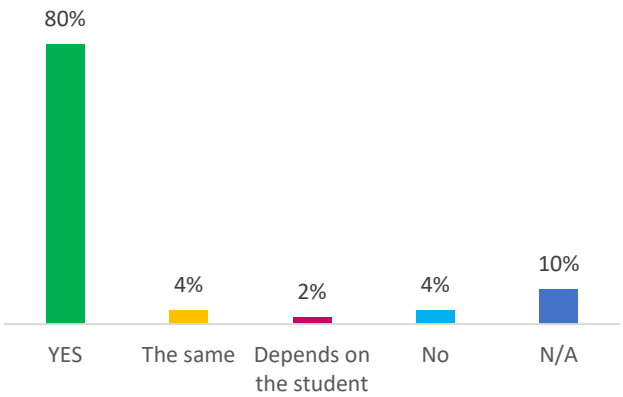
The following picture represents the global reach of the IDiverSE implementation during two school years:



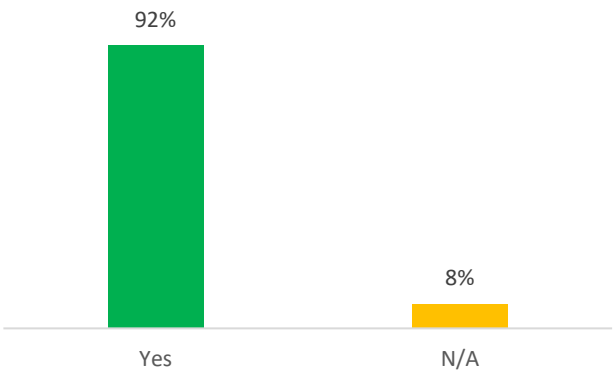
By the end of the implementation teachers were asked to answer a feedback survey in order to share their perceptions about the impact of the proposed methodologies in their practice and in their students' behaviours. In the next pages, a few graphics are presented, showcasing the perceptions of 50 respondents about the impact of the project.

Teachers perceptions about the impact of IDiverSE on their students' behaviours, attitudes, learning and skill development:

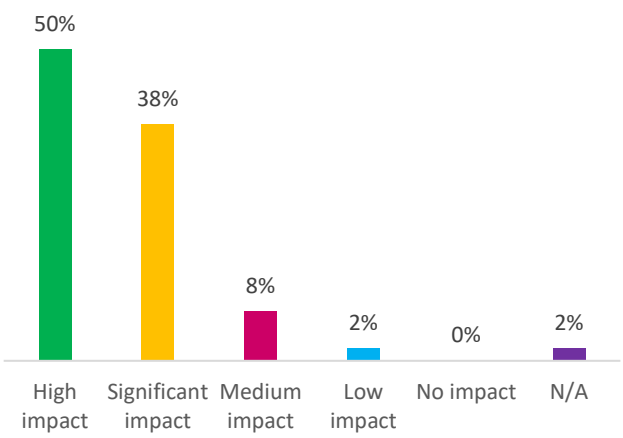
Do you think that your students learned more effectively through the IDiverSE project than through your usual methods?



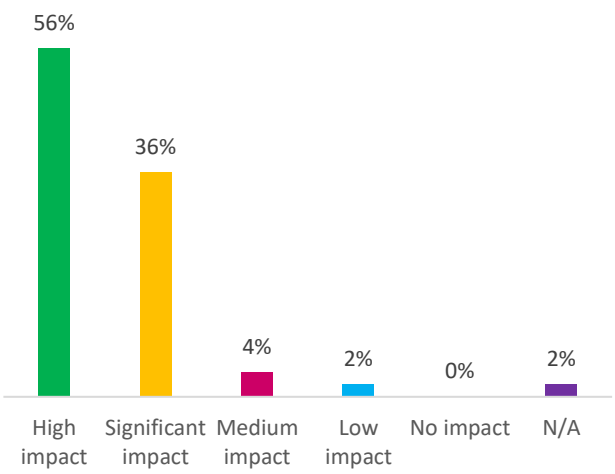
Do you feel that your students improved in terms of engagement, motivation and learning efficacy through the IDiverSE project?



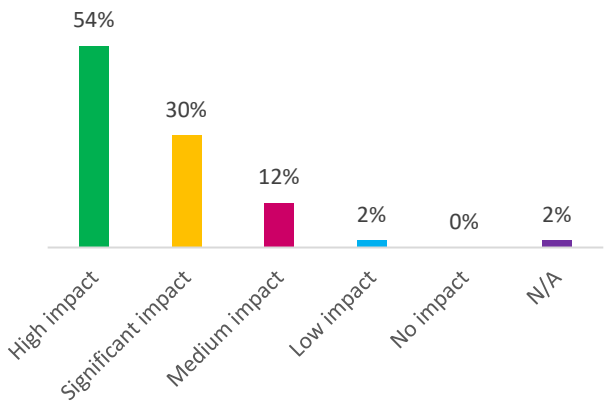
In your perspective, to what extent did the IDiverSE project positively impact your students' engagement in your class?



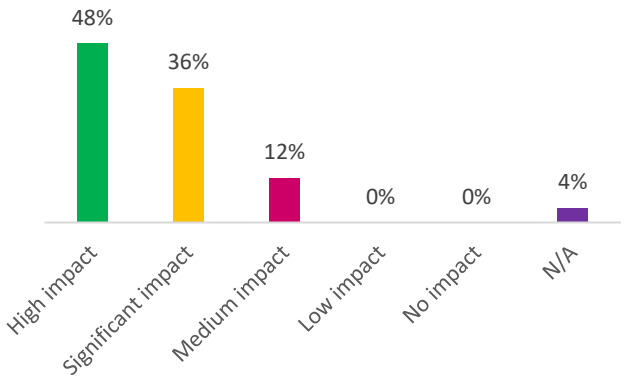
To what extent did the IDiverSE project positively impact your students' motivation for learning



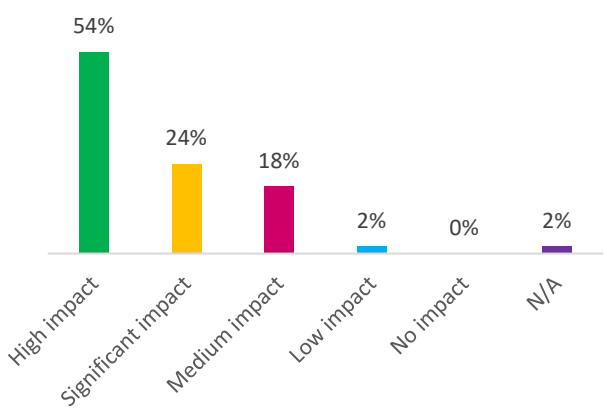
To what extent did the IDiverSE project positively impact your students'attitude towards Science



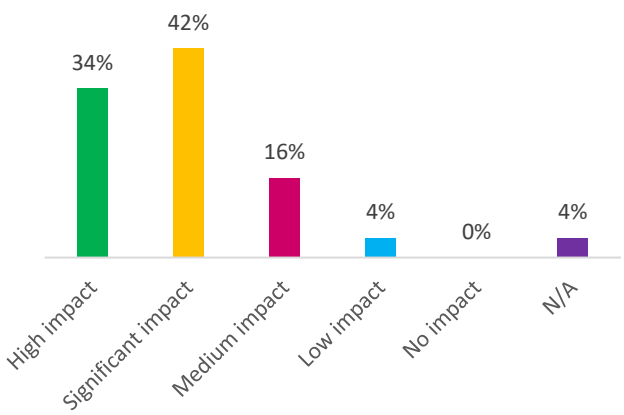
To what extent did the IDiverSE project positively impact your students' relationship with colleagues



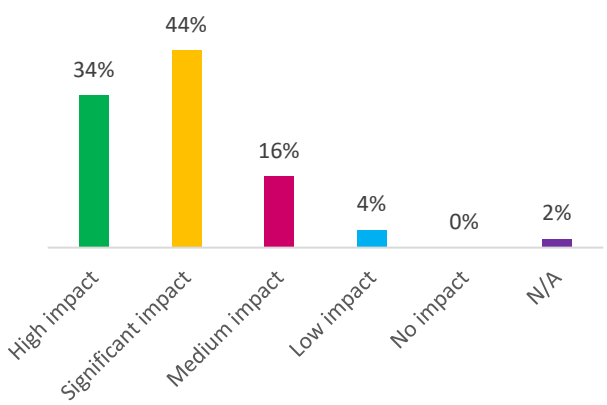
To what extent did the IDiverSE project positively impact your students' relationship with you (teacher)



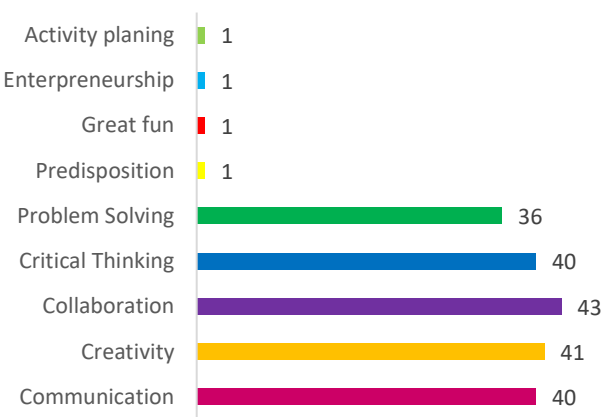
To what extent did the IDiverSE project positively impact your students' behavior in class



To what extent did the IDiverSE project positively impact your students' final grade

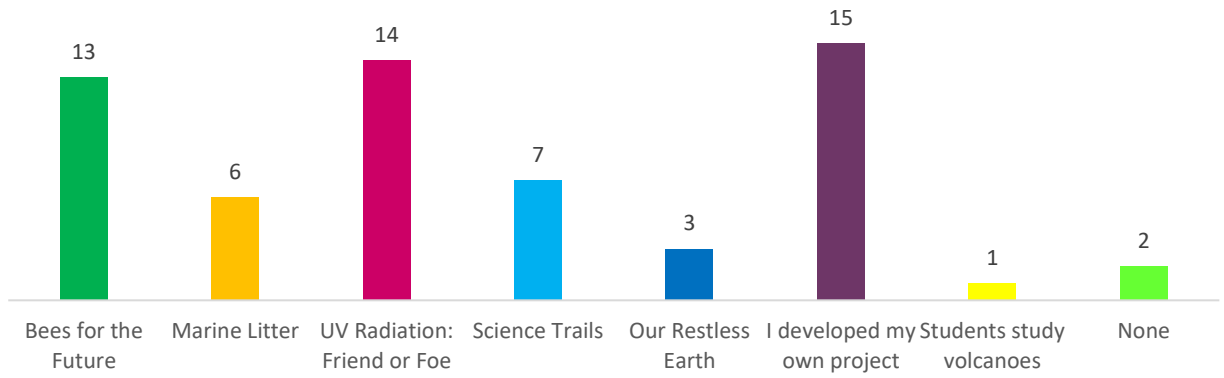


What skills did the IDiverSE project foster in your students?

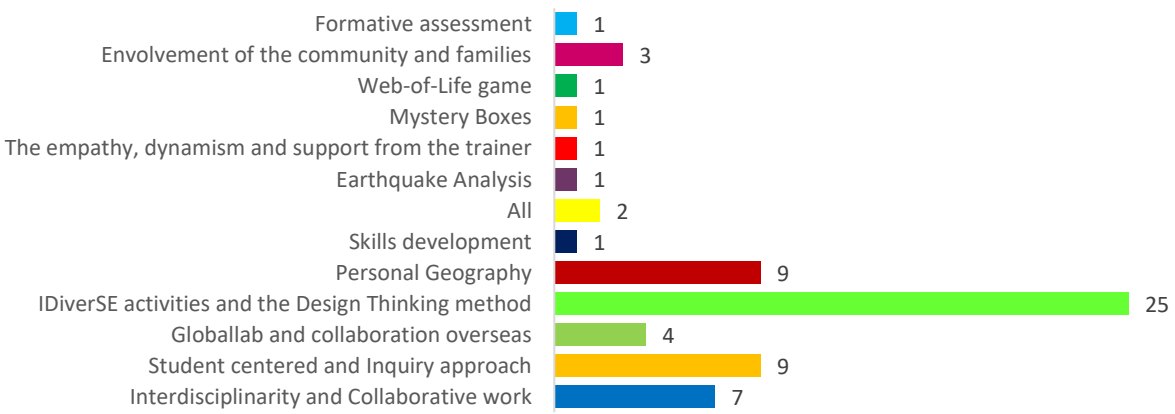


Teachers perceptions on the impact of IDiverSE in their practice

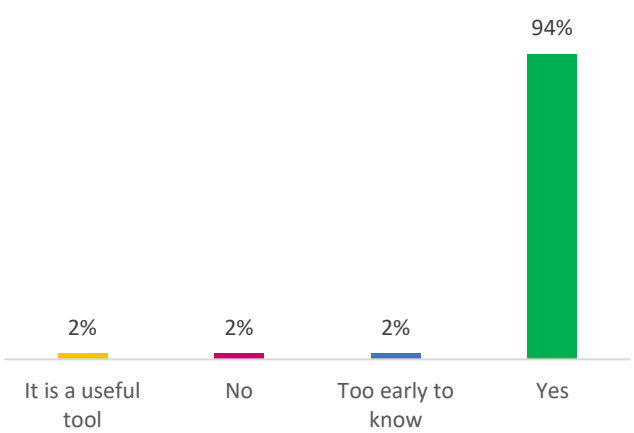
What project did you implement?



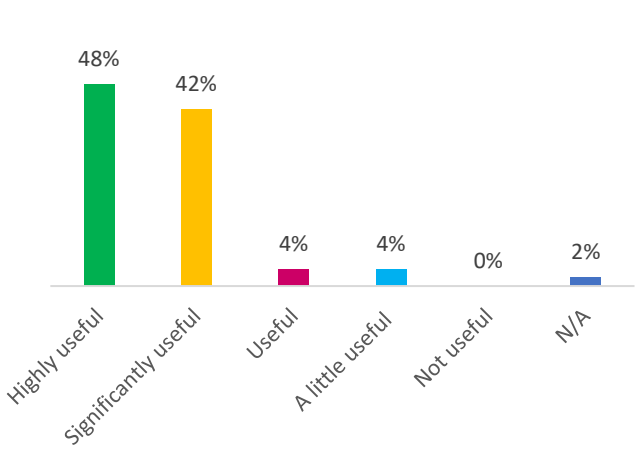
What was your favorite tool / aspect / feature of the IDiverSE project?



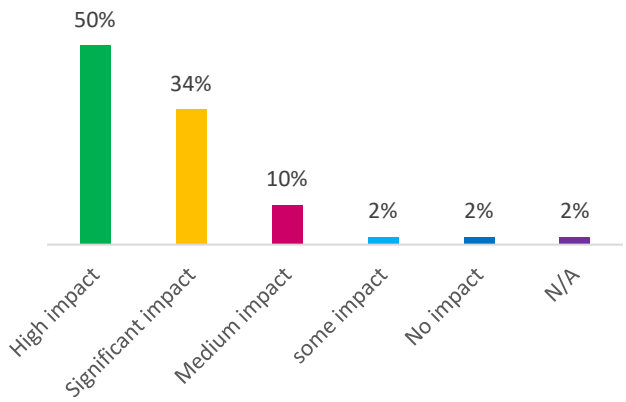
Did the IDiverSE project positively contribute to your career?



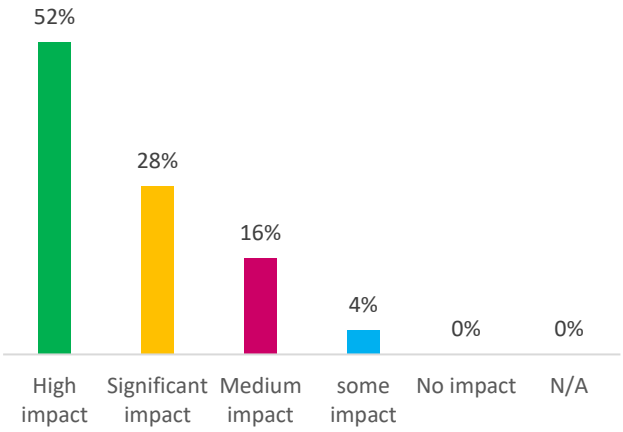
How useful were the IDiverSE activities for your practice?



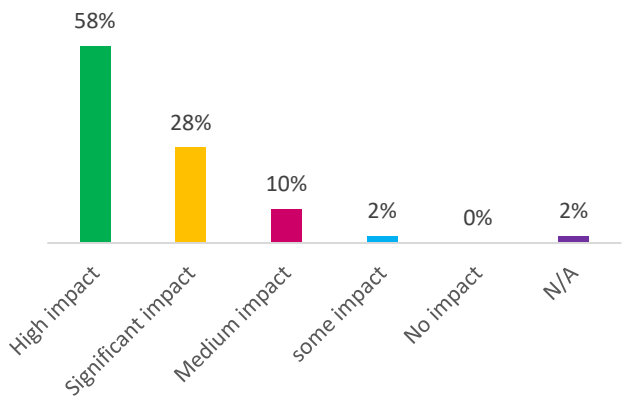
To what extent did the IDiverSE project positively impact your feeling of accomplishment in teaching



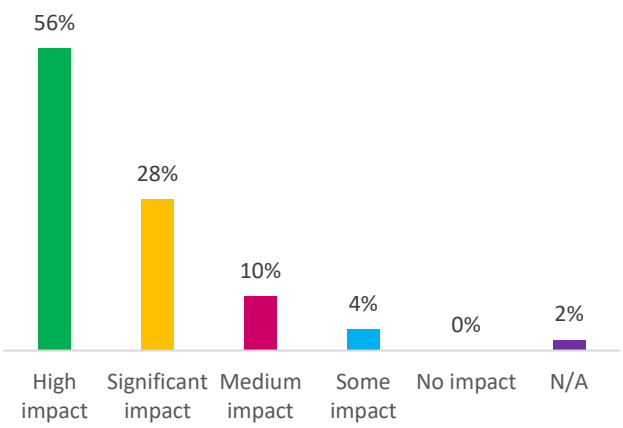
To what extent did the IDiverSE project positively impact your engagement in class



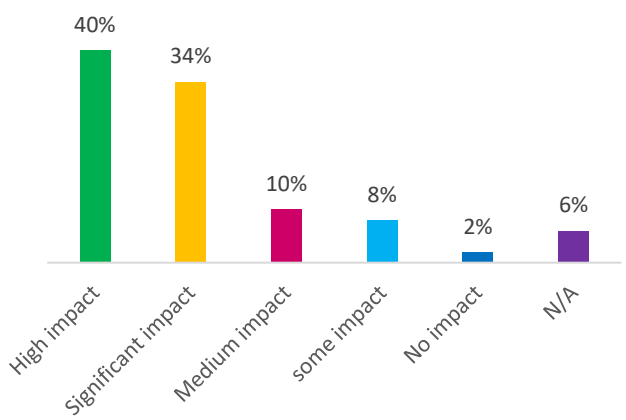
To what extent did the IDiverSE project positively impact your motivation for teaching



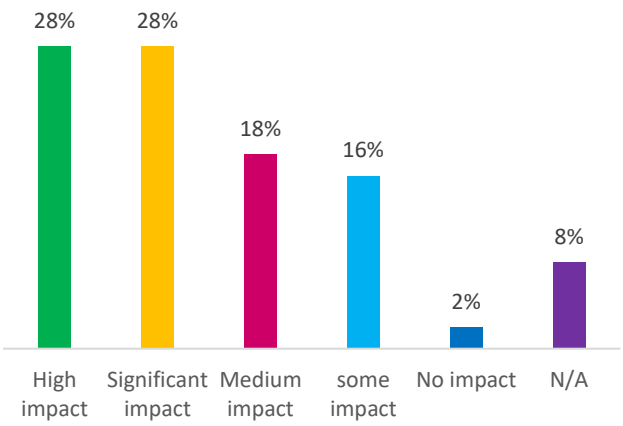
To what extent did the IDiverSE project positively impact your relationship with your students



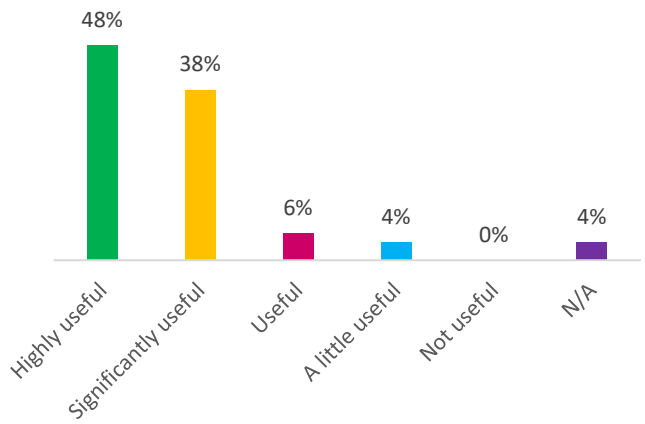
To what extent did the IDiverSE project positively impact your relationship with your colleagues



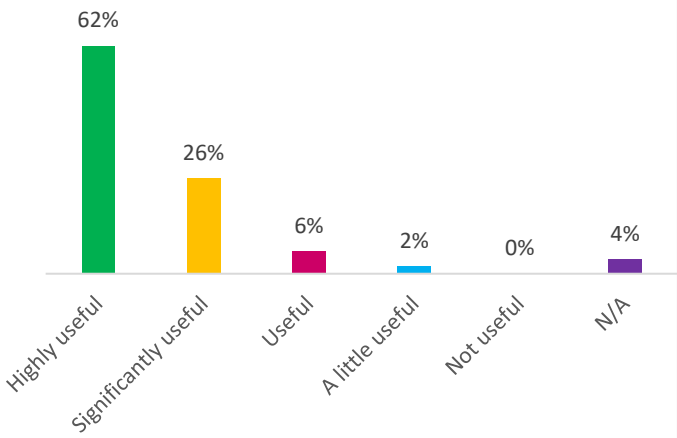
To what extent did the IDiverSE project positively impact the overall environment in your school



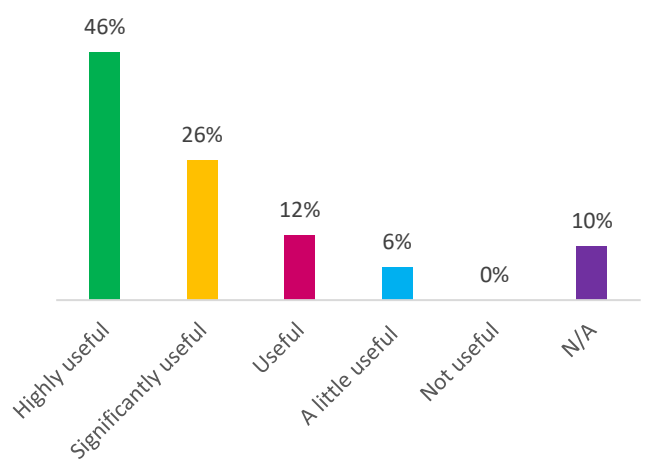
How useful was the interdisciplinary approach for your practice?



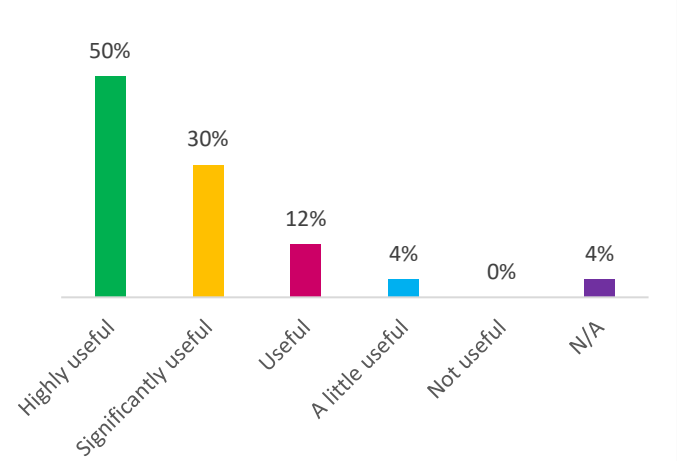
How useful was the Design Thinking method for your practice?



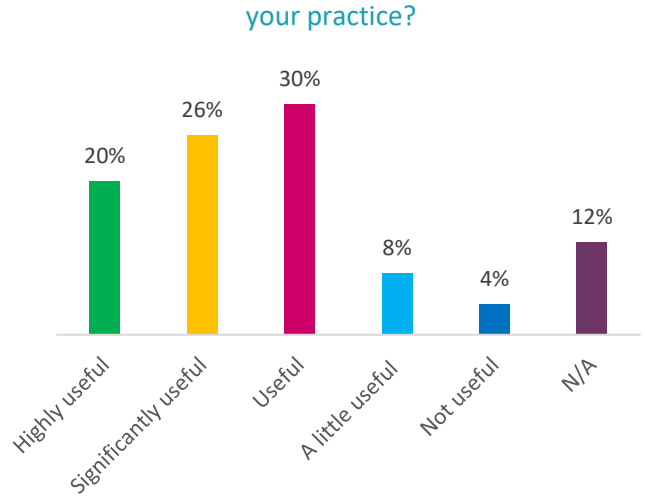
How useful was the Personal Geography for your practice?



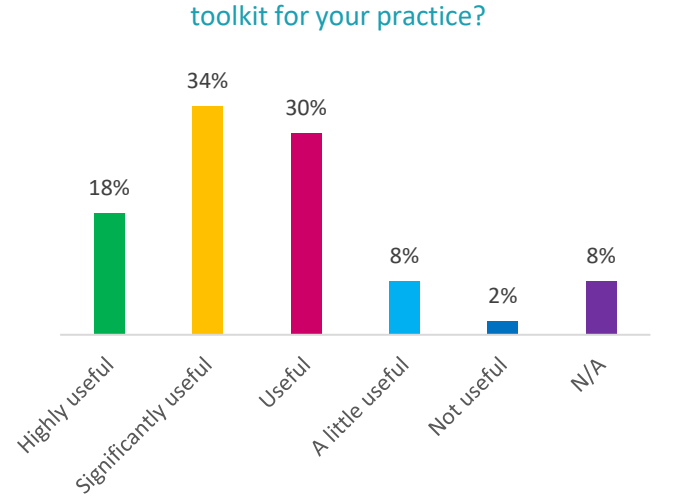
How useful was the Inquiry approach for your practice?



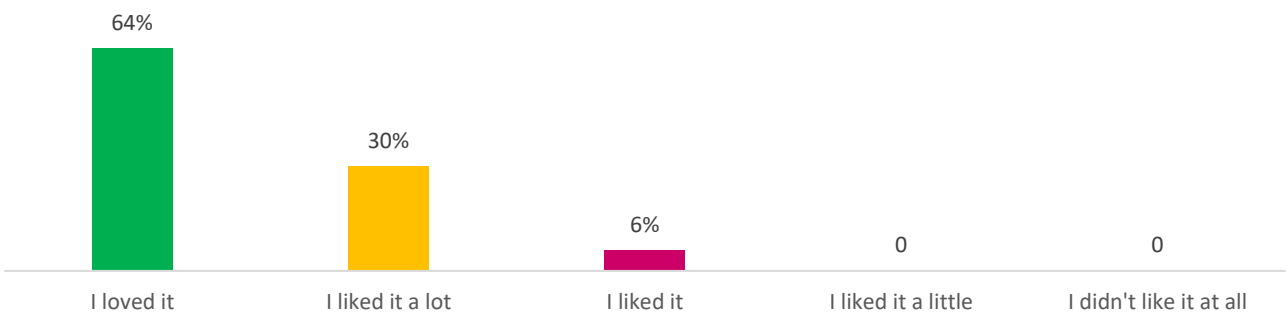
How useful were the globallab projects for your practice?



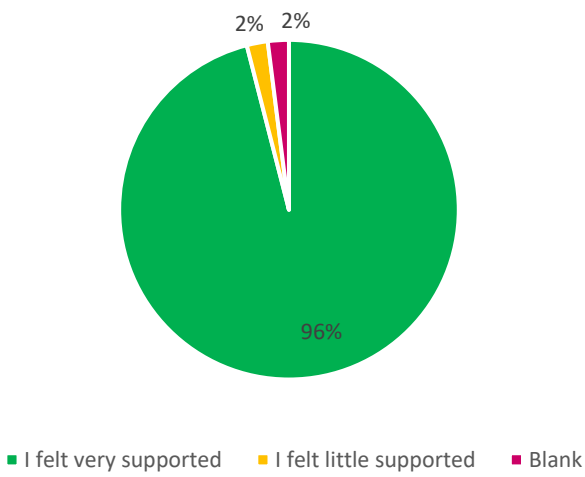
How useful was the IDiverSE assessment toolkit for your practice?



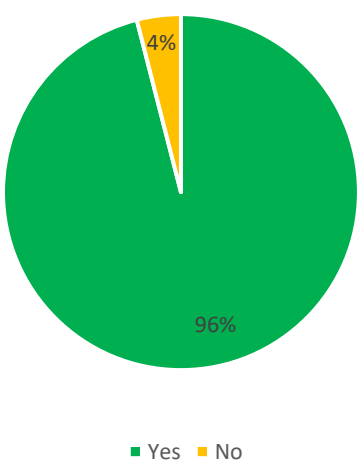
How would you evaluate your overall experience in IDiverSE?



How would you rate the support you were given by the IDiverSE team?



Would you recommend the IDiverSE project to other colleagues?



12. Conclusion

IDiverSE was an innovative project that brough openness to the schools as well as motivation, engagement, and deep learning to both teachers and students. The pages in this book describe the heart of the project and the achievements, portraits the courage, commitment and creativity of all teachers and students and builds the legacy of IDiverSE. However, it still misses one final remark, that is the impact that it had in the partners of the project, themselves. Travelling this journey along with the IDiverSE community was a very rewarding experience from which all of us grew a lot. It brought us new knowledge, know-how, experience, and it also filled our work with joy and inspiration. Through IDiverSE we all have increased our networks of educators and researchers and strengthened our bonds to those who are working to a better education, as ourselves.

IDiverSE was the beginning of an innovative journey where Design Thinking and STEAM walk hand-in-hand and we hope to see you and all our beloved teachers in our future projects.

In case you are interested in learning more about future innovation projects, you can send us an e-mail to info@idiverse.eu and we will forward you to valuable projects and to useful newsletters you can subscribe.

With this, the IDiverSE team leaves a big Thank you to all those that made this journey so special!

😊

13. References and suggested readings

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Books, reports, and other important readings

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DESIGN THINKING IN STEAM EDUCATION

A legacy from the Islands Diversity for Science Education

Education is the most powerful tool we have in our hands to ensure a sustainable, respectful, joyful, and kind future. Students may not know this yet, but they will be the change-makers our world needs and the job to prepare them for that is in the hands of some of the superheroes of our world: **their teachers!**

This book is written in a simple and fluid language and is meant to be a travel companion of any teacher, or anyone that wants to venture into the world of innovating in education. Innovation in education is not necessarily all about technology and digital tools. It is mostly about changing our perspective and our attitude toward students and offering them an engaging and meaningful learning experience. It is about seeing them as the independent, creative, and brave explorers that they are, and giving them the tools to discover their strengths and weaknesses. In sum, it is about promoting an environment where students develop their academic, cognitive, digital, physical, emotional, and social skills and become prepared for whatever future they may encounter.

This book presents an innovative approach to K-12 education where schools work together with the community and where students take the central role in their learning journey. With this innovation manual we aim to provide teachers with the know-how and the necessary awareness to innovate and give small but gradual steps into revolutionizing education itself. It is also meant to show any teacher that they are not alone, and that there is a huge network of innovative teachers out there. We hope this book will bring you an extra motivation to keep innovating and making a change in the young minds that you encounter.

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