



## WaterSTEAM Learning Methodology



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### WATERSTEAM

Landscape, water and active citizenship: a  
nature based STEAM teaching methodology

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## INTRODUCTION

The latest results of the OECD assessment program PISA for 2015 show that the issue of under-achievement of 15-year old in STEM is more pertinent in South and Eastern European countries, which score below the OECD average. Moreover, further studies reveal a gender gap regarding STEM education, where boys seem to be more engaged and perform better than girls.

Schools are on the frontline in developing basic skills and key competences related to STEM education and the European Commission has recognized that STEM subjects cannot be viewed in isolation, but need to be combined with environmental and socio-economic developments, and has adopted two policy documents on schools and higher education that expand STEM into STEAM, adding an “A” for “Art”.

The WaterSTEAM project proposes the development of an innovative and integrated learning methodology for secondary school education, adopting an inquiry-based student-centered and interactive STEAM approach integrated with social and civic awareness, encouraging students to fully participate in social and civic life. The proposed methodology requires STEAM subjects to be embedded into their social and cultural context, incorporating students' experiences with global issues like environmental concerns, developing their critical thinking skills and social responsibility. The theme chosen for pilot-testing and refining the proposed WaterSTEAM methodology is European Landscape and the role of Water in shaping it. As a reflection of European identity and diversity, the landscape is our living natural and cultural heritage. The European Landscape Convention (2000) stimulates the European states in active participation in improving the knowledge about landscapes, their characteristics and the forces transforming them. The project focuses on how water can transform the landscape, applying a multidisciplinary methodology of investigation, consistent with the Convention. The theme provides a most suitable context for STEAM learning by relating it to global issues (e.g. climate change, green economy, renewable energy). The objectives of the proposed project include:

- to help teachers acquire skills and competences necessary for applying an integrated STEAM methodology, through an inquiry-based approach combined with AR tools. Teachers will be trained in using the learning methodology, AR tools and a collaborative implementation framework, and pilot test it in school;
- to develop a teaching and learning methodology for secondary school educators, adopting the STEAM approach and linking it to promoting active civic engagement, integrating Art creative learning and citizenship education to other major school subjects, addressing at the same time the gender barrier in STEM education;
- to enhance the above methodology with features of experiential learning, by bringing the student out in nature and providing the appropriate tools for the identification and documentation of real-world phenomena;
- to develop and test Augmented Reality (AR) tools necessary for implementing the methodology, adding valuable elements to promoting civic awareness and dialogue between different groups in the community;
- to encourage teachers to collaborate with their colleagues from a wide range of disciplines (science, technology, math, engineering, art, languages) and develop a well-rounded interdisciplinary approach in teaching;



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- to raise the teachers and students' awareness about the importance of European landscape as natural and cultural heritage, the value of water and the importance of global environmental issues on a local level;
- to create a practical Handbook for teachers of secondary education with step by step guidance on applying the proposed methodology and tools, and recommendations for its optimal integration in different educational systems.

WaterSTEAM targets teachers and students in secondary education, including school ages between 12 and 18 years, and in addition the stakeholders working in organizations of the education community, decision makers at local, regional and central level, higher education institutions, and the civil society active in the fields of education and environment. This partnership contributes with innovative elements that pertain in the education system of their own country or region, and cross fertilize the products of the project with the best features of these systems.

## WATER LANDSCAPE AS TRIGGER FOR INQUIRY

WaterSTEAM aims to promote the use of innovative school teaching and students' learning in relation to the theme of the European Landscape and the role of Water in shaping it.

As a reflection of European identity and diversity, the landscape is our living natural and cultural heritage. According to the European Landscape Convention (Council of Europe, 2000), ratified by 40 member states: "*Landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors".*



*The convention applies to the entire territory and covers natural, rural, urban and peri-urban areas. It includes land, inland water and marine areas. It concerns landscapes that may be considered outstanding as well as everyday and degraded landscapes... because the landscape is an important part of the quality of life for people everywhere.*

*The landscape is a key element of individual and social well-being and its protection, management and planning entail rights and responsibilities for everyone.*

The European Landscape Convention stimulates the European states in active participation in improving the knowledge about landscapes, their characteristics and the forces transforming them.



The project focuses on how water can transform the landscape, applying a multidisciplinary methodology of investigation, consistent with the Convention.

Water is a key element in any landscape, by providing additional sense perceptions, feelings thanks to its intrinsic qualities. Water movement, noise, coolness, depth give locations distinctive character and in most cases it has a beneficial effect on the state of mind and wellbeing.

Water is always desired and appreciated in hot days of the summertime in hot climates but it also contributes to the fascination of a place (Whalley, 1988).



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Landscapes have been modeled by the flow of water, shaping the mountains and the valleys and regulating also the presence and the types of forms of life.

Therefore, water landscapes represent the best environment to perform multidisciplinary activities that aim to understand the processes behind the formation of a landscape, but also the uses and human exploitation and the threats.



*The ELC promotes the integration of landscape in school education through several disciplines, whether geography, history, the natural sciences, economics, literature, arts, architecture or engineering disciplines, or civics education. Landscape constitutes a teaching resource because, when reading it, students are brought face to face with visible signs of their surroundings that relate to spatial planning issues.*

*Landscape reading also makes it possible to understand current and historical approaches to landscape production as an expression of a community's identity.*

*Therefore, school curricula should foster an awareness of landscape themes through learning to read landscapes and through sensitisation to relations between cadre de vie and landscape, to relations between ecology and landscape problems and to social and economic questions.*



## ANALYSIS OF THE TARGET GROUPS' "STATE OF THE ART" AND NEEDS

The WaterSTEAM methodology has been developed on the basis of the results of a survey that was conducted at the beginning of the project among secondary education teachers and students of the piloting schools, as well as specific stakeholder organizations, in Greece, Hungary, Italy and Turkey.

The aim of the school survey was to define the knowledge, skills, interests and attitudes of the secondary school students and teachers in STEAM-related school subjects connected to the theme of the project: landscapes, water surfaces, global environmental issues. The stakeholder questionnaire was aiming to define their attitudes and interest towards being included as outside experts in the project. The questionnaires and the reports of results are accessible from the project website.

Therefore, the project methodology has been defined to address teachers' and students' interests and promote and encourage the application of a range of different soft and hard skills in their teaching and learning, but also effective teaching and learning methods that stimulate critical thinking, brainstorming, inquiring. More specifically, the questionnaires assessed the students' and teachers'

- attitudes and interests regarding the proposed themes of the project (landscapes, water surfaces, landscapes, the role of water in transforming landscapes, and how global environmental issues connect to their protection and management etc.)
- attitudes, former experience and interests regarding the proposed methodologies such as integrated STEAM education, collaboration, group work, fieldwork, inquiry-based learning;
- attitudes, former experience and interests regarding the use of Augmented Reality and Information and Communication Technologies, etc.;

The stakeholder questionnaire was conducted among associated partners and other stakeholders (like science associations, education authorities, research institutes, universities, NGOs, etc.) in the four involved countries with the aim to define the stakeholders' attitudes and interest towards being included as outside experts in the learning methodology promoted by the project, thus contributing to the learning process and fostering their future collaboration with the schools.

The online questionnaires were administrated from May to June 2020, and they were completed altogether by 515 respondents, mainly representative of the educational part (311 students and 82 teachers), followed by stakeholders (122). Details about the national samples' results can be found in the National Reports, however, we mainly based on international aggregated data in order to measure current and general tendencies, despite differences and similarities among participating countries were also highlighted.

The analysing of the responses, have identified the following main findings:

## ATTITUDES AND INTERESTS ON THE ENVIRONMENTAL THEMES OF THE PROJECT

Regarding the impression on landscapes, all countries have highlighted that students **tend to link landscapes primarily to natural surfaces/areas**, and usually tend not to consider urban contexts and built environments. As for teachers, a general tendency is that they have a wider understanding on the concept of landscapes (not only and exclusively containing natural elements). Especially Greek teachers tend to accept almost all of the listed options as a part of a landscape, including such elements (like bridges, roads, quays or humans) that the other respondents generally opposed. This means there are basic differences in the understanding and perception of landscapes.

The results show a high dominance of nature when it comes to assessing landscapes, and a very



strong connection was formulated between natural beauty and landscapes. However, it was interesting to see, that **almost half of the students find low or even no connection between culture/heritage and landscapes** – and this is an international tendency. This is definitely an area, which needs to be further promoted (also in formal education).

Regarding the existing knowledge about landscape-related topics, it was observed that there is **a moderate knowledge on landscape-related topics** among students and also among teachers. The top-three familiar topics for students were “human intervention affecting landscapes”, “climate change affecting landscapes” and “difference between natural and artificial landscapes”. However, even in these topics, around one third of the students only reported some or no knowledge at all. Regarding teachers, a major difference compared to the students’ results is that “climate change affecting landscapes” was not mentioned among the top three.

By looking at the per country analysis, it can be established that Greek and Italian students possess a significantly higher knowledge in several of the listed topics (also including the top-three themes). It is undeniable that **climate change is the most widely known term**. High knowledge exists also on landscape protection and sustainable development. The definition of landscape management is more or less known among respondents, except for the Hungarian students, who showed a significant gap compared to the other countries.

Although the knowledge on landscape-related issues is moderate, there is **a recognizable interest towards learning and teaching about landscapes**. The aggregated data shows a general interest



among students, especially when it comes to climate change. The least favorite topic among students is the history of water elements, however, even in this case almost half of the respondents would be moderately or very interested in learning about it. As for teachers, although they come from different disciplines, they have a great interest in climate change, problems connected to landscapes and benefits of landscape management.

The interest towards learning and teaching about landscape-related topics can also originate from the **strong environmental consciousness of the students and teachers**. Both the aggregated, as well as the per country data shows a strong interest in global environmental issues. Overwhelming understanding is that people should care about the protection of the environment more, as well as respondents personally agree that they would like to do more in order to protect the environment and landscapes. When offering an educational methodology, it is important to highlight these topics (protection of environment and global environmental issues), as these can generate a wide interest among students and teachers.

Despite the strong environmental consciousness, the **personal connection (use) of surrounding landscapes can be rather rated as low or moderate**. It is a bit surprising that only quarter of the students visit water surfaces often for nature observation. The rate is a bit higher when it comes to recreation, however even in the case almost half of the students only visits water surfaces rarely or never. Furthermore, it is also visible that only few students read about nature and science, visit a science centre or a protected area. As last on the list, visiting a water plant is clearly the activity that the majority of the students has never done. Teachers' personal connection with the surrounding landscapes was quite similar to the results of students. Generally, it can be stated that WaterSTEAM methodology should also aim to make both students and teachers know (and use) their own surroundings, their own landscape better, and show them as well as encourage them to actively use and be part of that landscape.

#### ATTITUDES AND INTERESTS TOWARDS THE EDUCATIONAL ASPECTS

When analyzing the linkages between landscapes-related topics and school subjects, the results showed **a significant presence of Geography in all of the topics**, however, there are some differences among single countries. Both in Greece and Italy, the dominance of Geography was lower, and there were topics, where Geography was only the second or even the fourth in the list. However, in Hungary the dominance of Geography is unquestionable, in all of the cases this school subject got at least half of the total votes.

It is also crucial to analyze, to what extent teachers are familiar with the STEAM approach. As it is visible, there is a **considerable knowledge gap among teachers**, especially in Hungary. Therefore, it is no surprise that very few of them have already used or implemented STEAM. Furthermore, most of the teachers do not even feel well-prepared to implement STEAM. This is an obvious drawback, however the international methodology should aim to put a serious attention to the exchange of good practices.

Even if STEAM itself is not well-known or widely used, previous experience and familiarity with other educational methods can be a good starting point for further work. As it is visible from the aggregated results, **project-based teaching and inquiry-based learning (IBL) have a better awareness** among teachers, although it is still rather moderate. It can be established, that there is a huge experience in guiding students to keep deadlines and guide students to communicate ideas verbally. Less experience was shown in guiding students to work in teams (group work), and working in collaboration with other teachers. The least expertise was presented in on doing fieldwork. This is basically in line with the students' responses with their experience on group work and fieldwork. WaterSTEAM methodology should also **put an emphasis on gathering and collecting information on site**, as fieldworks can be a very good hands-on learning experience for students.

#### ATTITUDES AND INTERESTS TOWARDS INFORMATION AND COMMUNICATION TECHNOLOGIES

Regarding the attitudes towards the proposed ICT, it can be stated that students and teachers generally have a very positive attitude. Most of the respondents agreed that they like to work as a member of a team, and they also confirmed that new technologies make school science more interesting. That means they believe that there is a growing need for new methods and technologies in education. On the other hand, there is a certain unfamiliarity with the application of the proposed tools.

As for their experience on using different ICT and Augmented Reality tools, it is visible that besides using smartphones and tablets, students are also familiar with most of the Office tools (like Word or Power Point), while teachers are mostly familiar with text processing spreadsheet and presentation software. In both cases, the **least experience exists on geographic information software (GIS) as well as location-based games (LBGs)**. Even though some of the students have already played location-based games, but there is an obvious lack of knowledge in using the available platforms to develop such games. Furthermore, when asking about the interest in learning or teaching about these tools, moderate (or even low) interest was expressed.



However, the reason for the low evaluation can be derived from the lack of familiarity with these tools (and the fear from the unknown). These tools at first glance can be categorised as something difficult and close to ICT-programming, however all of the suggested tools are easy to apply. This result confirms that **ICT tools need to be introduced in the classes in an easy and fun way**, in order to significantly increase the interest to learn the application of these tools.



## COLLABORATION WITH EXTERNAL EXPERTS

The results of the stakeholder-questionnaire investigated the **possibility to involve external experts** to the implementation of a landscape-related educational methodology at secondary schools. Although the composition of the responding stakeholders varies from country to country, it is true that generally they are involved in environmental issues (protection, planning, research and activism), and almost half of the stakeholders are interested in educational activities as well. Therefore, the positive attitude towards landscape-related issues and the offered methodology is not surprising.

As for their interest (very similarly to the school results), **climate change was rated most relevant** for stakeholder activity, followed by the role of water in shaping the landscape and benefits of landscape management. The least interest of the respondents was shown towards the history of water elements.

The results show, that involving external experts to secondary education is not a novelty, as about **half of stakeholders have already cooperated with the education system**, but this number fluctuates among countries. When stakeholders are involved in education, the most common cooperation is **organizing project-based learning courses, clubs or study classes**. Usually, these activities focus on environmental protection, but water management was also frequent.

Although there is a considerable amount of previous experience, the majority of stakeholders is not familiar with STEAM approach, and the results reveal an existing knowledge gap regarding these methodologies. However, this is not very surprising, taking into account that educators themselves also have deficient knowledge.

The main aim would be to introduce some of the stakeholders to secondary school education, allowing them to present their activities and cooperate with schools in certain topics. Stakeholders could act as external experts, giving answers and inspiration to topics that are in line with their daily routines. The results confirmed that this seems feasible: majority of stakeholders agreed that **formal education should put more emphasis on the topic of landscape management** and that experts should collaborate with secondary education and contribute to the learning process.

Based on such results, but also considering the acknowledged efficacy of well-known methodologies such as Inquiry Based Learning and the integrated approach to STEAM, WaterSTEAM has developed a methodology outline based on the following main pillars:

- landscape knowledge and protection, by providing materials and methods to dealing with landscapes from an international to a local perspective;
- investigations on local landscapes to identify the factors that have been forcing the shapes and the uses, but also the environmental threats and solutions;
- inquiry-based, student-centred and interactive STEAM approach in national contexts;
- social and civic awareness, encouraging students to fully participate in social and civic life.



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- Use of Augmented Reality (AR) tools for acquiring geo-referenced information and for knowledge transfer through innovative technological tools.

In the next chapters the pillars will be consistently described.



## INQUIRY BASED LEARNING METHODOLOGY

The WaterSTEAM project proposes the development of an innovative and integrated learning methodology for secondary school education, adopting an inquiry-based student-centred and interactive STEAM approach integrated with social and civic awareness, encouraging students to fully participate in social and civic life. The proposed methodology requires STEAM subjects to be embedded into their social and cultural context, incorporating students' experiences with global issues like environmental concerns, developing their critical thinking skills and social responsibility. The WaterSTEAM methodology includes four pillars in the context of water landscapes:

- Interactive STEAM approach;
- Inquiry-based student-centered learning;
- Use of digital tools for augmented reality games;
- Social and civic awareness.

Inquiry based learning (IBL) is a way of implementing science at school recognized as a high effective method for attracting students to science and increasing their learning. IBL places the student at the centre of an investigation, since the student should design and build the body of information, solve problems that arise and reflect on the significance of the solutions (Kaltman 2010).

Instead of listening passively to what teachers tell, IBL actively acquires new knowledge more or less directed by the teacher in the learning process. Edgar Dale, an American educator in 1946 developed the Cone of Experience, also known as the Learning Pyramid (see figure below).

From his experience, he produced a pyramid in which he listed the amount of learning people can achieve by changing the way to encounter information.

Reading and hearing are the less efficient ways since they take to remember respectively only 10 to 20% of what is read or heard. As much concrete activism is included in the experience, as much effective is learning with a maximum benefit from active lessons, such as collaborative design and performing activities and presenting something.

Doing the real thing takes people to remember up to 90%.

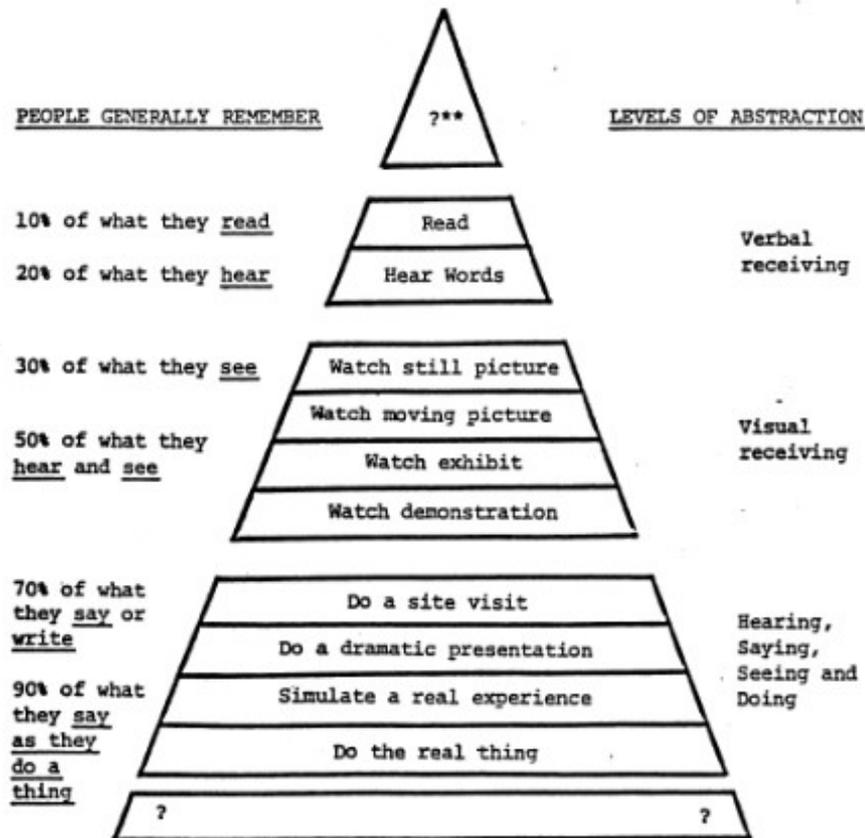
Before Dale, in 1933 Dewey the American philosopher, psychologist, and educational reformer outlined several important aspects of inquiry-based learning, and he was the first stating that content must be presented in a way that allows the student to relate the information to prior experiences, thus allowing deepening the connection with this new knowledge and he was the first who advocated for an educational structure that strikes a balance between delivering knowledge while also taking into account the interests and experiences of the student. In his opinion, the student determines both quality and quantity of learning and "if successful knowledge comes from impressions that natural objects make upon people, so students' knowledge can be successful only when objects impress their mind".

Dewey was the promoter of hands-on learning, problem based learning or experiential learning, *id est* learning by having direct experiences. These can be organized as a cyclic structure, for instance, by defining a problem, formulating a hypothesis, and conducting tests.

His arguments were further elaborated and many different theories and definitions have been formulated despite his common basis. Contemporary inquiry cycles implicitly reflect aspects of earlier frameworks. For instance, in 1998, White and Frederiksen proposed an inquiry cycle of five phases: Question, Predict, Experiment, Model, and Apply; more recently, Bybee (2006) published the 5E learning cycle model in which he proposes five inquiry phases: Engagement, Exploration, Explanation, Elaboration, and Evaluation. In 2015 Pedaste et al. gathered together different descriptions of inquiry cycles due to their similarities in naming the same concepts or objectives.

APPLICATION OF A BASIC LEARNING PRINCIPLE

An important learning principle, supported by extensive research, is that persons learn best when they are actively involved in the learning process. The "Learning Cone," in the Resource Manual on page shows various learning activities grouped by levels of abstraction. The left column indicates their relative effectiveness as training techniques. Dale's "Cone of Experience":



\* See Wiman & Mierhenry, Educational Media, Charles Merrill, 1969, for reference to Edgar Dale's "Cone of Experience."

\*\*Question marks refer to the unknown.

Source: <http://nonviolence.rutgers.edu/s/digital/item/299>

WaterSTEAM methodology is structured to build up interdisciplinarity and give students the knowledge for "reading, interpreting and knowing in depth" about the landscapes, integrating and connecting different school subjects.

Many methods can be used for the implementation of activities, combined or not, depending on the actual possibilities and opportunities of the school. However, the methods based on learning by doing, having practical outdoors experiences and teamwork are warmly suggested, being the most effective in completing the tasks and learning in more effective way.

Methods	Description
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Lectures/textbook	Lectures are oral presentations intended to present information or teach students about a particular subject. Textbooks provide extra content, exercises, answers to exercises, appendices, etc.
Coaching/Giving instructions	Coaching is non-directive and non-judgemental, the main aim of the coach is to support their coachee to find their own way forward, to help them to articulate their strengths and how they can build on them and create a learning pathway that is continuous and successful.
Seminars	The word seminar takes origin from the latin name seminarium (seed plot), being a form of talk given by an academic or professional organization or expert on specific topics. It can be a research talk and it can occur in regular series but not usually associated with any assessment or credit.
Project work/Case study	The Project Work methodology implies that the learner is operational, realizing a final product by the application of tasks. A case study is a research method involving an up-close, in-depth, and detailed examination of a particular case, in order to understand its issues, functionality and successes.
Brainstorming/Discussions	Brainstorming combines a relaxed, informal approach to problem solving with lateral thinking. Brainstorming and discussions encourage people to come up with thoughts and ideas. Some of these ideas can be crafted into original, creative solutions to a problem, while others can spark even more ideas.
Outdoor learning	Outdoor learning involves the transformation of knowledge, skills, attitudes and behaviours through direct engagement with the outdoor environment for the personal and social benefit of individuals, families, society and the planet. Examples: multi-day expeditions, woodland and coastal learning, youth or community activity courses, school residential trips, outdoor and adventure sports coaching, sail training experiences.
Visits to specific places	In general, the purpose of site visits is to collect data and make observations. Having direct experience of a real place increases the awareness of issues and stimulates possible solutions. It also allows interviewing local experts and stakeholders.
Action Learning	Action Learning is a process that involves a small group working on real problems, taking action, and learning as individuals, as a team, and as an organization. It helps organizations develop creative, flexible and successful strategies to pressing problems.
Experiential learning	Experiential learning also known as (EXL) is the process of learning through experience, and is more specifically defined as "learning through reflection on doing". Hands-on learning can be a form of experiential learning, but does not necessarily involve students reflecting on their product.
Learning by doing/hands on	It's a hands-on approach to <i>learning</i> , meaning students must interact with their environment in order to adapt and learn.
Inquiry Based Learning	Inquiry-based learning is an approach to learning that emphasizes the student's role in the learning process. Rather than the teacher telling students what they need to know, students are encouraged to explore the material, ask questions, and share ideas.
Team work	Teamwork is the collaborative effort of a group to achieve a common goal or to complete a task in the most effective and efficient way. This concept is seen within the greater framework of a team, which is a group of interdependent individuals who work together towards a common goal.
Peer to peer	<i>Peer-to-peer</i> learning is all about students <i>teaching</i> other students. It's all about people on the same level <i>teaching</i> each other what they know.



## PEDASTE'S SUMMARY MODEL FOR IBL

WaterSTEAM's main learning purpose is to encourage independent thinking, leaving room for creativity and innovation and to promote an interdisciplinary approach where all STEAM disciplines are equally important and a combination of these form the student's expertise.

This will be achieved through activities based on an inquiry-based approach where the emphasis is not only in performing and understanding environmental issues and landscape features in a scientific way, but also in applying creativity and innovation.

Students will be involved in investigating real-life concepts and issues linked to the presence, usage and quality of water in a territory and its impact on the landscape (e.g. erosion, sedimentation, the presence of vegetation, carsick phenomena, rivers and lakes, as well as impacts related to manmade interventions) fostering creative problem-solving skills with which they may even find solutions.

In addition, WaterSTEAM promotes the use of Art (e.g. design, creative writing, drawing, photography etc.) within the investigations and to express students' ideas and proposals and the use of digital tools based on Geographic Positioning Systems (GPS) which can be used either as tools for collecting data, either to communicate their research findings, ideas and proposals and sharing them with the wider public (e.g. Location-Based Games for mobile devices like smartphones and tablets). This aims to raise awareness and engage their peers, the local community, decision makers and other stakeholders in dialogue and civic participation.

WaterSTEAM methodology will be based on Pedaste's summary model of Inquiry Based Learning. Pedaste's summary model identifies five phases: Orientation, Conceptualization, Investigation, Conclusion and Discussion (figure below), that will be described more accurately in the context of WaterSTEAM.

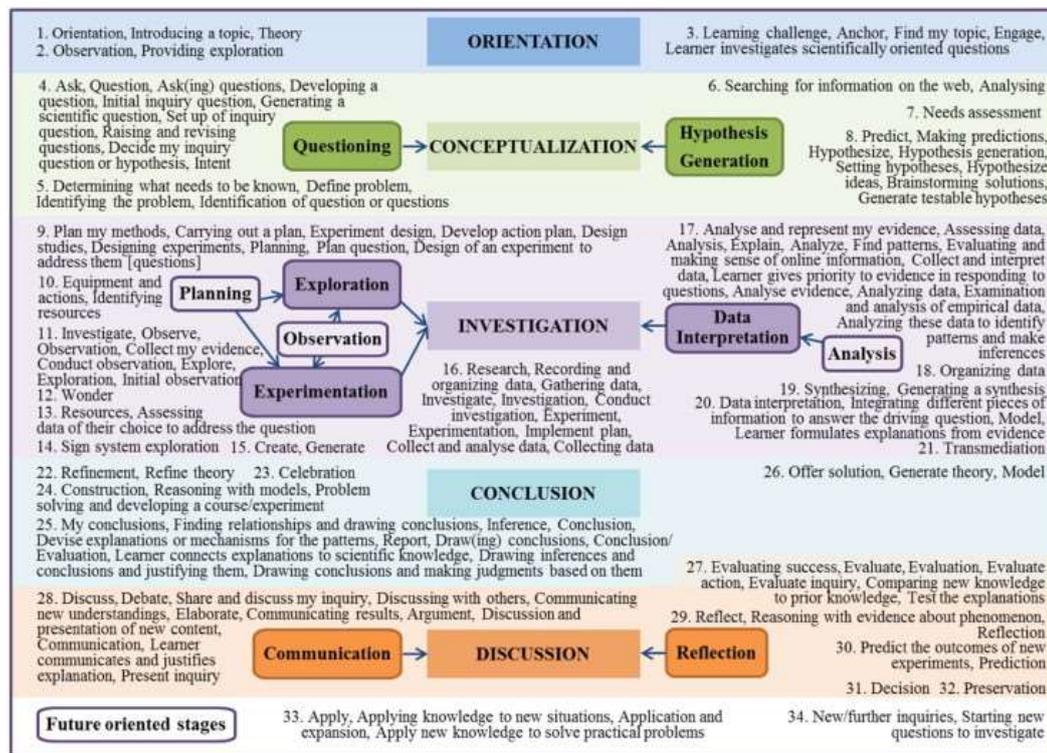
In a few words, any learning process starts with an initial *orientation phase* in which students are engaged, stimulated or challenged to know more about a topic proposed by the teachers.

The orientation generates some brainstorming that produces questions to be answered or hypothesis to be verified (*conceptualization phase*). The students together with their teachers should decide what they will investigate.

In order to answer their questions or test the hypothesis, an *investigation phase* must be organized. This includes the preparation of a plan with the definition of materials needed, methods to be applied, possibly the organization of field trips to collect data. Observation, experimentation, data collection and recording, all are possible activities that students can perform outdoors or in the classroom, or in the science laboratory. This also means that they must analyse this information and find relationships between influencing variables. To do this, data obtained from observations and experiments must be put into digital format, organized and analysed using spreadsheets, giving students the possibility to approach software for data analysis that are generally used in scientific research. The obtained results must be interpreted and the patterns should be identified. Students can find the answer to own questions, so that they can draw their conclusions.

In the *conclusion phase* students define their model and refine their answers to the initial questions. However, this may lead also to other questions that must be answered.

The final *phase* is the *discussion* which can be in the form of debate in front of the class or experts in the sector, sharing and discussing the learning experience. This includes a reflection on the topic and reasoning with evidence about a phenomenon and about what it still misses to be investigated.



*Scheme of the five phases of the summarized model described by Pedaste et al. (2015).*

## ROLE OF TEACHERS

The teachers participating as a team in the project, should support students' engagement in inquiry and in constructing meaningful understandings. The teacher encourages the students to put forward their ideas, explore and debate their point of view while using dialogic, critical and thought-provoking questions and giving students time to think and answer (Chin 2007; Maaß 2011). The teachers will direct students' activities, guiding them when needed but also giving them the responsibility to work as a team, so that the "mistake" of one would reflect on the whole team's work.

Adequate planning is necessary also to give students the time and responsibility to carry out their tasks in proper time.

Teachers should not judge ideas or opinions but they should judge the overall attitude toward the learning objectives and including hard (e.g. on school subjects, informatics, lab methodologies) and soft skills (communication, decision making, cooperation e.g.).

## WATERSTEAM METHODOLOGY

### AN INTEGRATED STEAM APPROACH

WaterSTEAM methodology fosters the application of a collaborative framework between teachers of different disciplines: the traditional STEM subjects i.e. Science, Technologies, Engineers, Math, but also **Art** (STEAM) which includes humanistic subjects (history, geography, languages etc.). In addition, it stimulates the interaction between teachers and outside experts in fields related to the theme of the project e.g. environmental management, water management, spatial planning, landscape architecture, geology, botany etc.

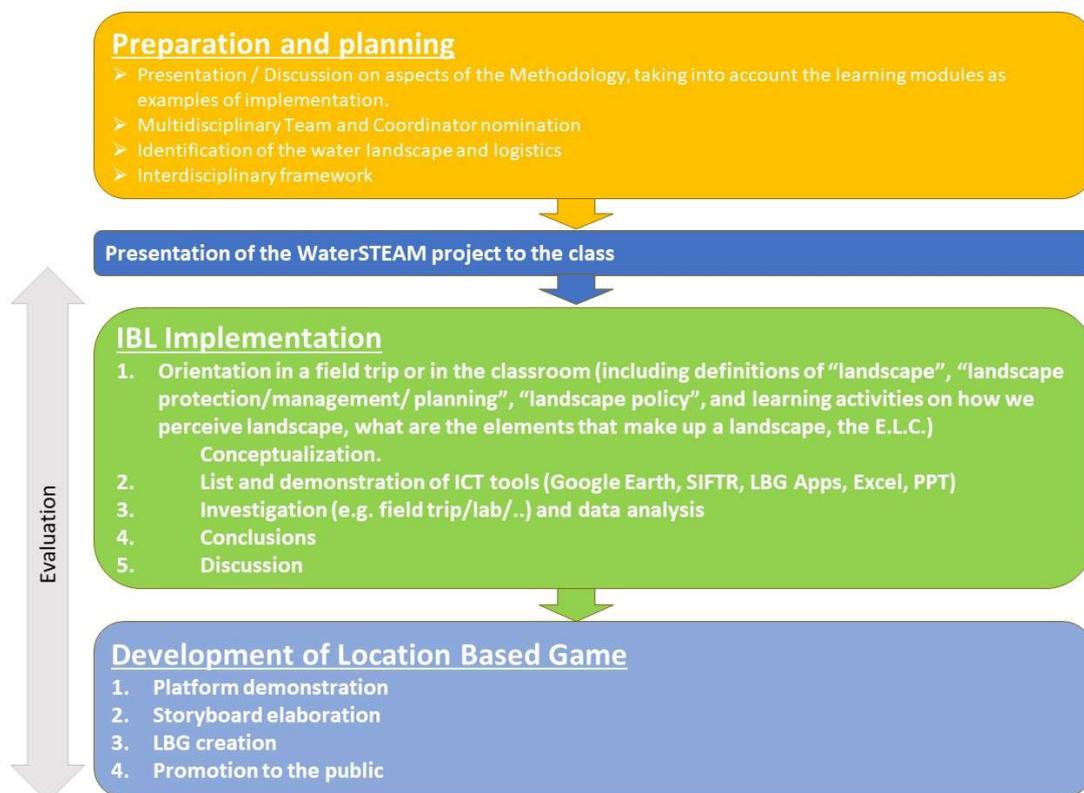
Interdisciplinary activities integrate different approaches, methods of investigations allowing a more comprehensive and coherent learning of complex issues. For instance, investigating the features of a landscape, would probably mean approaching geology, morphology, land cover and land use and environmental threats for water, biodiversity, soil erosion etc. that can be analysed in different school subjects (i.e. biology, chemistry, sciences etc.).

A good coordination between teachers of different subjects is needed in order to carry out an interdisciplinary STEAM approach.

### WATERSTEAM METHODOLOGY IN STEPS

The WaterSTEAM methodology fosters multidisciplinary learning by giving teachers the tools to be confident and familiar with it for an effective implementation.

WaterSTEAM methodology can be described in three main steps as summarized in the following figure.





## PREPARATION AND PLANNING

First of all, before starting a WaterSTEAM project, the school director or the teacher who promoted the project initiative, should identify the teachers interested to participate in the collaborative and interdisciplinary experience.

For this purpose, an introductory teachers' meeting should take place at the school. The purpose of the meeting, with the attendance of all teaching staff independently from their specialisation, is presenting the WaterSTEAM project, discussing key aspects of the Learning Methodology taking into account the learning modules available as examples, and recording the teachers' interest in participating.

This will allow a better understanding of the project purposes and commitment in the implementation, so that teachers will be aware to confirm their participation in the project.

Prior experience or familiarity with interdisciplinary learning or technologies or with the theme of landscape protection is not a prerequisite for teachers in order to participate; what matters is a positive attitude towards collaboration and interaction with other teachers, willingness and flexibility to devote some time of the school time and curriculum to the project's implementation, and stimulating their students to inquiry rather than passive instruction.

A second preparatory teachers' meeting is necessary to take organisational decisions, such as formalising the interdisciplinary **team of teachers** (namely "team") and nominating the team's **coordinator**. The team has to adopt and implement collaborative frameworks

- between teachers,
- between teachers and students, and
- between teachers/students and external experts.

The team also has to define the main general topic and the landscape(s) and location(s) that will be proposed to the students for the project implementation.

The coordinator will be responsible for the coordination of the whole project's implementation within the school, tracking the pace of the collaboration, communicating the decisions and the updates to the team of teachers and the school director, and coordinating the school's communication and arrangements with external experts that may be invited to contribute.

### Role of the team of teachers

- ❖ Teachers of different subjects **are available to students** who will be willing to investigate water landscapes and issues/challenges that raised their interest.
- ❖ The **team of teachers will gather the questions/hypotheses of interest to the students and connect them with appropriate school subjects/disciplines.**
- ❖ All teachers involved **will set the goals of the educational process that should match with the capabilities of the students** and the project's learning objectives.
- ❖ The team of teachers will collaborate in developing and monitoring/updating the project's work plan as necessary in terms of the learning activities to be included, the project's time-plan, and the teachers' contribution.



### Role of the coordinator

- ❖ Coordinate the teachers' efforts and monitor the project development (and production of expected outcomes)
- ❖ Communicate (in form of meeting minutes/email) the main steps and findings from different teachers to the team and the school director and the project manager.
- ❖ Coordinate the possible bureaucracy and logistics of activities, including the contribution of external experts.
- ❖ Coordinate the evaluation activities.

WaterSTEAM fosters experiential and interdisciplinary learning of local landscapes to better understand why, when, how these have reached their actual shape, their characteristic elements that make them "landscapes" and the challenges they face, as well as explore people's connection to landscapes and raise awareness regarding their protection, management and planning. All these aspects can be investigated in different school subjects.

The team of teachers will set up an **interdisciplinary framework** for achieving landscape's knowledge.

- ❖ *How to create the interdisciplinary framework?*
- ❖ *How to identify the connections between disciplines?*
- ❖ *How to create a collaborative atmosphere among disciplines?*

During the **preliminary meeting**, the team members will get to know each other, and they will come out with some preliminary organizational and logistic issues such as:

- Number of classes or groups (one or more) and curriculum (if the school has more than one), and students' age that will be involved in the project
- Means of communication between the members of the team (e.g. WhatsApp, Messenger group/email/other) and an optimal frequency of the team meetings (face to face or online through social platforms such as Skype, Zoom, MicrosoftTeam, Google Meet)
- Whether to carry out the project within the school curriculum or in extra hours
- Approximate number of hours to devote to the project and the period of the project implementation (i.e. a semester or a full school year, winter/spring)
- Areas of interest and water landscape(s) that will be proposed to the students for investigation. For instance, they can select different landscapes in terms of typology (urban, peri-urban, rural, industrial, agricultural, etc.) and challenges they face (e.g. degradation, threats from human intervention, etc.), and present them to the students during the orientation phase, so that the students can select the landscape to focus on.

In order to train on the **interdisciplinary framework** and build up a collaborative atmosphere, a simple exercise can be performed during the preliminary meeting of the team of teachers.



Looking at the landscape outside of the window of the meeting room, or at a picture selected online or from a personal folder, teachers of any discipline can start observing the picture and identifying the “elements of the landscape” (natural and artificial).

Then, they can start thinking about all possible questions about them

- What feelings does the landscape create?
- What are the elements that make it up?
- What do they look like?
- Why?
- Who are those for?
- If environmental issues are observed, why did they occur? What are the possible solutions?

The purpose of this phase is to:

- Discover the connections between different school subjects;
- Setting up the learning objectives of the topics/issues;
- Draft a calendar of the main steps to be carried out with the class
- Set up organizational aspects (e.g. group work, laboratory experiments, outdoor experiences, stakeholders’ involvement; field trips organization etc.)

The state of conservation, the challenges of elements and landscape, and possible solutions can be investigated with the local stakeholders’ collaboration.

Here below there are examples of topics that can be addressed in different school disciplines and that will give a general picture of the state of the art of the landscape and the possible solution to any challenge.

School subjects	Topics
Geography	<ul style="list-style-type: none"> <li>● mapping and morphology of the river basin;</li> <li>● the river flow and its tributaries;</li> <li>● human establishments and population development;</li> <li>● listing and mapping of natural and artificial elements;</li> <li>● human activities and economies; landscape transformations over the time</li> </ul>
History/Literature	<ul style="list-style-type: none"> <li>● history of the natural and artificial elements; transformation processes and conservation of landscape; history of the area</li> </ul>
Natural sciences (e.g. biology, botany)	<ul style="list-style-type: none"> <li>● description of the natural elements (e.g. ecosystems) and their issues;</li> <li>● services and benefits provided by ecosystems (e.g. biodiversity; production; water and pollutants regulation);</li> <li>● variables influencing their characteristics (e.g. climate; meteorology; land cover/use)</li> </ul>
Earth Science (e.g. Geology, Climate, Water etc.)	<ul style="list-style-type: none"> <li>● transformation of the landscape in relation to the characteristics of the rocks;</li> <li>● erosion;</li> </ul>
Chemistry	<ul style="list-style-type: none"> <li>● rocks types and weathering;</li> <li>● soil and water chemistry of the natural elements to investigate any environmental issue</li> </ul>



Physics	<ul style="list-style-type: none"> <li>• physical processes that are linked to the landscape elements and uses (e.g. water flow, erosion);</li> <li>• energy sources (water, wind etc.) etc.</li> </ul>
Technologies	<ul style="list-style-type: none"> <li>• connected to the landscape exploitation and economy (e.g. energy production)</li> <li>• tools instruments and software that can be used to implement the project</li> </ul>
Economy	<ul style="list-style-type: none"> <li>• gains and losses of productive sectors and of land conservation;</li> <li>• social and cultural and tourism value</li> </ul>
Art	<ul style="list-style-type: none"> <li>• expressing landscape values/perception of landscape</li> <li>• ..</li> </ul>

The following step is setting up a **work plan** to implement the learning process with the class of students (IBL implementation).

In the meeting the teachers have to decide which landscape and how to show them to students (as outdoor activity or as pictures/video/movies to show in the classroom) and they have to collect these materials for the orientation phase.

During the preliminary meeting(s) teachers can plan the orientation and the conceptualization phases (see chapter below), setting the calendar and the different activities they would like to perform.

The preliminary activity (orientation) can be performed within any discipline by showing pictures of different local landscapes and asking students what is the most inspiring for them, that deserve conservation and protection or which they would like to work on.

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#### IMPLEMENTATION WITH THE CLASS

During the implementation of a WaterSTEAM project, teachers act as facilitators, guiding the students in their inquiring without taking or making decisions on their behalf.

Teachers should facilitate students' understanding when the scientific language is too difficult to understand, and they should provide the appropriate learning environment (e.g. facilities but also a quiet atmosphere).

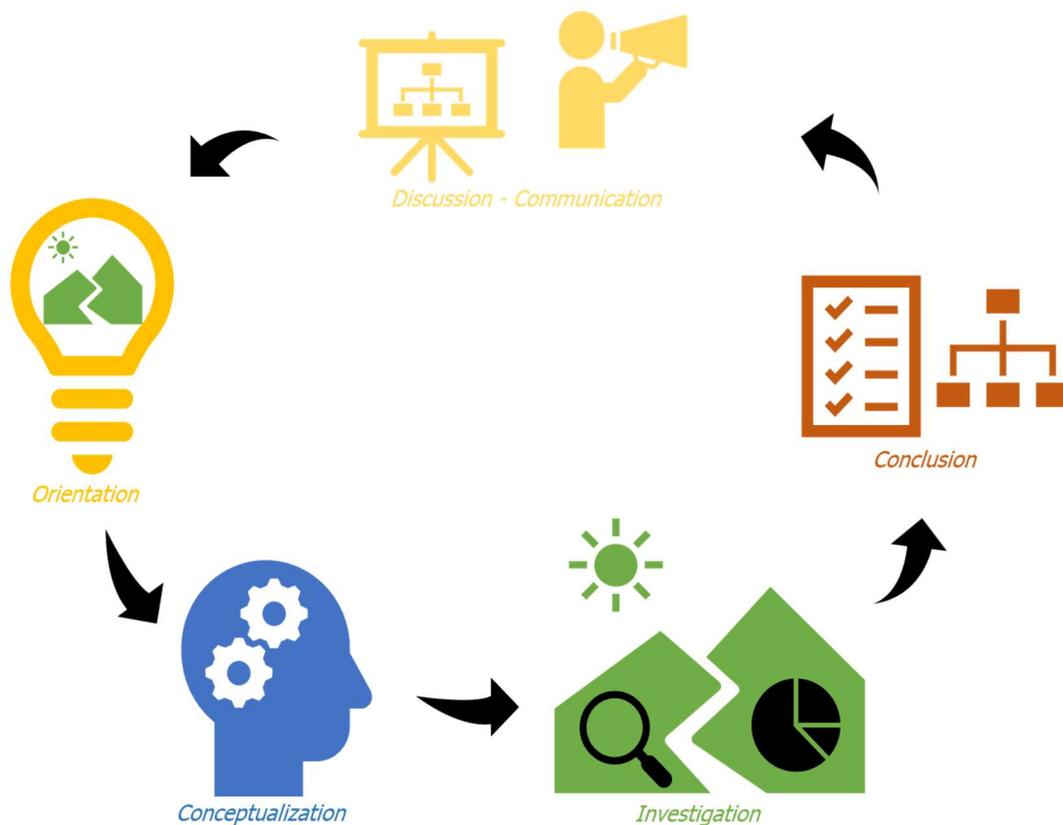
However, they also should provide adequate time for planning and implementing the activities, and the scientific methods to carry out investigations.

The WaterSTEAM methodology includes also the use of technologies and Geolocation Apps during the whole implementation, as they can be useful to collect georeferenced information and for the preparation of final innovative formats such as Location Based Games (LBG), which can be attractive tools for the younger generation. For this purpose, students have to re-elaborate the acquired knowledge and materials (e.g. photos, drawings) for the framework of the game in an attractive storyboard in order to create a stimulating narrative to be transferred into a LBG platform.

The games produced will be free and publicly accessible.

## INQUIRY BASED LEARNING IN WATERSTEAM

The implementation of the project with the class means **adopting the Inquiry Based Learning cyclic model** (see the previous chapter for details) as learning methodology in an interdisciplinary context. The diagram below presents the IBL cyclic model within the context of WaterSTEAM.



*Pedaste's summary model in WaterSTEAM.*

### ORIENTATION



*Objective: Presentation of the concept/topic; stimulation of students' interest; identification of the problem and the influencing variables/factors.*

*Orientation is the engagement phase in which the interest and curiosity of the students are stimulated in relation to the concept of landscape and the theme of landscape protection/management/planning, as well as issues or challenges related to the local water landscape(s) proposed to the students.*

**The teacher can show pictures, videos, paintings, magazine/newspaper articles, or can take the students outdoors in a field visit to raise the emotional link and the knowledge of the area:** "reading the landscape" induces students and teachers to think about the relationships between landscape parts, the transformation processes due to environmental and anthropogenic



factors, also connected to the history of the places and the human activities connected to water. In addition, in a field trip, students can really witness the landscape threats. The students think about the engagement activity identifying the variables connected to the topic or issue.

The following learning activities are offered as examples, are indicative and can be further adjusted or modified by the teachers according to the time and resources available.

**This phase can be performed by teachers of any subject by a single teacher or in pairs combining different disciplines. At the end of the phase, teachers should communicate the findings (impressions, interests, questions raised by the students) to the teachers' team in order to discuss the next steps.**

### Learning activity 1: The Landscape and how we perceive it

**Duration:** 1 teaching session

**Aim:** to introduce to the students the concept of “landscape” and demonstrate the multiple forms and complexity of landscapes.

**Learning Objectives:**

- to trace different forms and shapes of the landscape
- to raise awareness about different perceptions of the landscape held by different people
- to discuss the students' landscape perceptions
- to encourage critical thinking
- to encourage groupwork and collaboration among students

**Learning technique:** Brainstorming

**Procedure:** The teacher asks the students to write down whatever comes to their minds when he/she speaks the word “landscape”. The teacher asks the students for an immediate response, allowing them only a few minutes to think, and as soon as they put their pencils down, encourages them to read to the class what they have written, while the teacher (or a student) takes notes on a board. Then, the students try to group the writings according to certain common landscape characteristics and features. Subsequently the class discusses the different perceptions people have about different types of landscape, e.g. rural, industrial, urban, peri-urban, natural, man-made landscape etc.

The teacher tries to steer the students away from stereotyped notions of landscape based on idyllic natural scenery with forests, waterfalls, isolated beaches, sunsets etc.

The group centres its discussion on the different perception of the landscape held by different people and how important it is to create “a common language” so that we all understand the same thing when referring to the landscape. The group may then be broken down to smaller groups of students, each assigned one landscape type and given the task to collect material (photographs, videos, short texts from literature or news, animation) referring to that landscape type during homework.

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## CONCEPTUALIZATION

*Objective: Identification of the questions and hypothesis to investigate or test.*



Conceptualization is a process of understanding a concept belonging to the stated problem. It can be achieved by generating two types of outcomes: *Questions* or *Hypothesis*. Questioning generates research questions about a domain, while Hypothesizing, generates a testable hypothesis. Both contain independent and dependent variables although questioning doesn't necessarily include finding the relation between variables (Mäeots et al., 2008).

During the Conceptualization phase, through brainstorming, the students need to consider their experience during the Orientation phase, and make sure the Question or Hypothesis they formulate reflects the multifaceted character of landscapes. Landscapes may indeed connect to natural processes and/or human interventions; however, they also connect to people's perceptions in terms of aesthetic, cultural and historical value; a Question or Hypothesis, therefore, limited to examining a single aspect of a landscape (e.g. an environmental issue like eutrophication) does not tackle the theme effectively and is not in line with the proposed STEAM approach.

For instance, if students would like to investigate landscape challenges linked to environmental issues or processes (e.g. eutrophication, alien species etc.) they might think to include investigations on water chemistry and pollutants, investigate the source of pollution, observe the effects of such pollution etc. This means that they will be also committed in coordinating their questions and answers in different school subjects.

**This phase can be performed by teachers of any subject by single teacher or in pairs combining different disciplines. At the end of the phase, teachers should communicate the findings (impressions, interests, questions raised by the students) to the teachers' team in order to discuss the next steps.**

### Learning activity 2: The landscape and how it is shaped

**Duration:** 1 teaching session

**Aim:** to understand how landscapes can be transformed by nature itself or by human intervention; and identify a number of "challenges" related to the preservation of landscapes that have environmental value and/or a value for our quality of life.

**Learning Objectives:**

- to comprehend the role of nature in forming landscapes
- to assess the positive and negative human interventions in shaping landscapes
- to trace the interrelationships between human intervention in the landscape and economic, social, and cultural factors
- to trace the societal and individual values behind the human interventions in the landscape



- to discuss conflicts that may arise among different stakeholders regarding preservation and /or exploitation of the landscape for economic or social purposes
- to encourage critical thinking
- to encourage groupwork and collaboration among students

#### Learning techniques:

- Photo-documentation before and after, group discussion
- Research in the Internet
- Brainstorming

**Procedure:** Prior to the session, the students are divided in small groups and each group chooses the type of “change” in a landscape they wish to concentrate on. The teacher takes care so that a large variety of changes are covered by the groups. For homework, the students are assigned the task to find in the internet pairs of photos illustrating the situation “before and after” a major change in a landscape, either brought about by nature or by human intervention. Drastic landscape changes (before and after the change), including local/national examples provided by the teachers to reflect issues that are important for the local community or pertinent at national level, may include:

- a flood,
- a landslide or an earthquake
- covering a river or drying a lake (e.g. to produce agricultural land)
- a forest fire,
- urbanization or urban sprawl
- building infrastructure (e.g. a bridge, a dam and an artificial lake, a port etc.) .
- installing alternative sources of energy – e.g. hydroelectric power stations, wind turbines, solar panels
- touristic development, e.g. building second homes or tourist complexes in areas of great natural beauty, building ports for yachts etc.

Optionally, historical documents or ancient mythology may be used, to illustrate how landscape issues were dealt with in earlier times and antiquity.

In the class, the groups work together to identify the major “challenges” reflected in the changed landscapes. Each group creates a poster listing the identified challenges and presents the poster to the class for discussion.

The plenary discussion may try to answer the following questions:

- What features do changed landscapes have in common?
- Do these features reflect whether landscapes change due to natural phenomena or human intervention?
- What may motivate human intervention in the landscape?
- How do you feel about the changes of the landscape (personal evaluation)?
- Do you think the changes were intentional?
- Is human-led landscape change always necessary? What needs does it satisfy?
- What are the conflicts that become visible in some of these changes?
- What kind of human values emerge in some of the changes?

### Learning activity 3: The European Landscape Convention and why we need it



**Duration:** 1-2 teaching sessions (at least 2 hours in total)

**Aim:** to familiarise the students with the European Landscape Convention and understand its necessity as a “common policy framework” for the landscape among Europeans.

**Learning Objectives:**

- to learn about the European Landscape Convention
- to understand the three basic components of the European Landscape Convention (protection, management and planning)
- to become aware that the implementation of the European Landscape Convention is a duty and a right of all European citizens
- to encourage critical thinking
- to encourage groupwork and collaboration among students

**Learning techniques:** Powerpoint or Prezi or other form of presentation prepared by the teacher, followed by plenary discussion and student work in small groups.

**Procedure:** The teacher offers a short presentation on the European Landscape Convention to the students, followed by discussion in plenary. Issues to be addressed during the discussion:

- Do the students understand the European Landscape Convention?
- Can the students assign the material collected during the previous Learning Activities, and the “challenges” they illustrate, to the three categories of the ELC: protection, management or planning?
- Can the students identify around or near their school a landscape (of a small or bigger scale) that needs protection, management or planning?

Discussion in small groups: Each small group chooses a water landscape among the ones discussed (around or near their school) and identifies the action that needs to be taken in relation to planning, management and protection of this landscape.

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## INVESTIGATION



*Objective: planning the investigation activities, performing them, analysing the data collected, and interpreting the results*

The investigation is the phase in which students actively investigate the research questions or hypotheses (Scanlon et al. 2011) that have been defined in the previous phase.

The Investigation phase is performed in different steps: Planning, Performing, Data analysis and Interpretation.

In *Planning*, students and teachers design their investigation activities, for instance they decide *what to do, how to do it, when to do it, where to do it*.



According to the topic or issue chosen for investigation, the class will need to identify *what kind of actions to undertake* in terms of literature review, hands-on research activities, and it will identify the most suitable *methods* and *list the needed materials* to gather the necessary information.

Expert stakeholders from local research centres, universities and local authorities can be contacted as a valuable opportunity to access up-to-date knowledge and to make use of scientific equipment.

In *Performing* the investigation, the class implements the devised plan, and follows the steps of action along the project timeline.

Data collection can regard environmental data during a field trip, a survey on the perceptions and views of the local community, or investigations on historical and artistic documents regarding the landscape of interest. Specific materials, equipment and worksheets can be used, allowing students to approach methods and software of common use in research. Experiments can be performed to understand the reason for certain phenomena such as soil erosion.

In *Data analysis and interpretation*, the collected data are analysed and interpreted in order to understand the extent of the environmental issue (generating new knowledge) (Bruce & Casey 2012; Justice et al. 2002; Lim 2004; White & Frederiksen 1998; Wilhelm & Walters 2006) and the relations between the factors and variables that are involved in the investigation.

Since the investigations will be covering different school subjects, it is very important that all the activities will be planned and coordinated. The coordinator will have a crucial role to get updates from the teachers involved by the students in their investigations and the team of teachers will prepare a draft calendar of planned activities, identifying the learning and skills objectives in their own subject but also they will coordinate further logistics for field trips/laboratory or for inviting experts.

The coordinator will also make sure that all activities and outcomes will respect the agreed calendar.

**This phase can be performed by teachers of any subject by single teacher or in pairs combining different disciplines. At the end of the phase, teachers should communicate the findings (impressions, interests, questions raised by the students) to the teachers' team in order to discuss the next steps.**

#### **Learning activity 4: The Landscape we want to investigate**

**Duration:** 2 teaching sessions (at least 2 hours in total) in the classroom and outdoors

**Aim:** to pay a visit to the water landscape(s) chosen by the students with the guidance of teachers, to focus on during the previous Learning Activity, and verify their features on location, concentrating on the “challenges” that are posed, according to the ELC.

#### **Learning objectives:**

- To allow the students to observe the landscape(s) selected
- To examine, on location, and identify positive and negative features
- To take photos and videos of the visited landscape(s)
- To gather observations and identify “challenges”



- To encourage critical thinking
- To encourage group work and collaboration among students
- To practice observation skills

**Learning techniques:** Field study, group discussion in the class (small groups and plenary)

**Necessary equipment:** map of the area, cameras, mobile phones or tablets, computers, internet connection

**Procedure:**

The students use Google maps and Street view to locate the selected water landscape(s) and describe some of its/their essential features. The students define the “challenges” posed by the landscape(s) and collect material from the internet, local newspapers and local NGOs or neighborhood groups, in order to understand the challenges and the stance the local stakeholders take towards these challenges.

#### Learning activity 5: examples of investigation

**Duration:** N teaching sessions in the classroom and outdoors

**Examples:** students can investigate the reasons of changes in the landscape:

- river flow and sedimentation/erosion;
- people perception according to the changes and uses of the landscape;
- eutrophication;
- urbanization and soil loss; etc.

**Aim:** to have practical investigation on water landscape(s) chosen by the students with the guidance of teachers, to focus on specific aspects of their landscape through experiential learning, hands-on activities, concentrating on the questions and hypothesis that are posed.

**Learning objectives:**

- To allow the students to investigate the selected landscape(s)
- To examine specific aspects (e.g. issues)
- To take photos and videos of the visited landscape(s)
- To collect and analyse data
- To encourage critical thinking
- To encourage group work and collaboration among students
- To practice observation skills

**Learning techniques:** Field study, hands-on, experiential learning, group discussion in the class (small groups and plenary)

**Necessary equipment:** laboratory, computers, internet connection

**Procedure:**

Preparation for the study by which they will allow deeper understanding of an environmental issue or challenge. Data collection and analysis is performed in order to understand the extent of the challenge. Students will find the relationships between the factors that influence the landscape and how it looks like.

### Art activity:

Students are invited to produce a visual art product about their investigations that can be used in the Location Based Game

- Photos
- Text
- Drawing
- Meme (very short video with comment) an image, video, piece of text, etc., typically humorous in nature, that is copied and spread rapidly by Internet users, often with slight variations. <https://en.wikipedia.org/wiki/Meme>
- Patchwork/Collage

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## CONCLUSION



*Objective: draft conclusions from results and interpretations.*

The conclusion phase summarizes the results from the investigation phase and opens to interpretations of the results from the different school subjects.

Therefore, students acquire knowledge from different perspectives and find the relationships between them and between variables or the factors that imply a specific landscape or its challenges.

Students bring together all the results achieved in the former activities. These can be in form of graphs, reports, observations, etc. Brainstorming can be used to summarize all findings, sharing thoughts about the relationships and identify the most important findings or what should deserve more attention and further investigation. This also identifies any issue in the implementation of the activities.

The results can be then reported in a final outcome to be further used in peer-to-peer learning and to be used in the next phase.

### Learning activity 6: Conclusions

**Duration:** 1 teaching session (1-2 hours)

**Aim:** understanding the causes and finding the possible solutions to the challenges of faced by the water landscape(s) and representing what has been learnt in a creative way.

**Learning objectives:**

- To allow the students to understand the causes of the challenges of the landscape(s) selected
- To find the relationships between the variables investigated
- To encourage critical thinking



- To synthesize the acquired knowledge in a Powerpoint presentation
- To encourage group work and collaboration among students

**Learning techniques:** Group discussion in the class

**Necessary equipment:** Powerpoint, computers, internet

**Procedure:**

In the classroom, students' groups gather the results obtained during the previous phases.

They will prepare a summary of the findings and discuss about the relationships between landscape features, the investigated challenges and proposed solutions.

The students can prepare different outcomes to present their findings and reflections, that can be presented to other students or in open events. This means that the adopted language has to be appropriate to the outcome, such as: Powerpoint or Prezi presentations/posters / Artistic performance/product / Video / Games (Location Based Games)

### Art activity:

Students are invited to produce a visual art product or gather together all their visual art products (produced during the previous phases) that can be used in the Location Based Game but also for presenting their work.

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## DISCUSSION



Discussion - Communication

*Objective: reflections on the interdisciplinary experience and communication of the findings to others*

In the Discussion, students summarize their interdisciplinary finding, present any relationships between findings in different school subjects to others: peers, experts, general public.

Students can prepare a PowerPoint **presentation** or a **report** or a **visual art product** to present their project's findings and summarize the experience to different types of audience.

These products should deal with:

- *the worth elements needing protection in the investigated landscape*
- *the threats and relationships between environmental and anthropogenic factors/variables*
- *solutions*

Communication can be seen as an external process where students present and communicate their findings and conclusions to others, receive feedback and comments (Scanlon et al. 2011), thus articulate their own understandings (Bruce & Casey 2012).

For this purpose, the *team* can organize an event, hopefully public to the local community. New questions may also arise from the audience.



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From the inquiry point of view and learning perspectives, students can also identify problems in the implementation of the whole IBL experience.

### Learning activity 7: Verification of own learning

**Duration:** 1 teaching session (1 hour)

**Aim:** presenting the results and the conclusions to audience

**Learning objectives:**

- To encourage critical thinking
- To understand deeply what has been learnt
- To acquire and use appropriate terminology depending on the style of their outcome
- To communicate the findings to general public

**Learning techniques:** Oral presentation

**Necessary equipment:** Seminar room, public, computers, internet, Powerpoint, video-making software, artistic product etc.

**Procedure:**

The teachers organize a public event open to parents, stakeholders, students and teachers where the students will present the project's outcomes.



## EVALUATION

### EVALUATION OF EFFICACY

The project includes the evaluation of the learning experience and approaches, aiming to evaluate the success and efficacy of the project in terms of:

- Change in teachers' knowledge, skills, interest and attitude towards a collaborative STEAM teaching methodology
- Change in students' knowledge, skills, interest and attitude towards STEAM subjects learning, towards landscape, the role of water and global environmental issues, and towards civic engagement and active participation
- Enjoyability of the learning process proposed by WaterSTEAM
- Shortcomings perceived by students
- Satisfaction by teachers regarding the learning outcomes of the pilot-testing;
- Rating of the methodology and tools in terms of effectiveness, applicability and relevance to the school objectives and curriculum;
- Shortcomings perceived by teachers

In order to evaluate the learning process, a questionnaire, available in English, Hungarian, Italian and Greek, has been designed and implemented during the project in a pre-post test.



## AUGMENTED REALITY AND ICT TOOLS IN THE FRAMEWORK OF THE METHODOLOGY

The present section aims at presenting the Augmented Reality (AR) and ICT tools selected for application within the proposed WaterSTEAM learning methodology. Augmented reality is defined as the integration of digital information with the user's environment in real time. Unlike virtual reality, which creates a totally artificial environment, augmented reality uses the existing environment and overlays new information on top of it.

The series of Augmented Reality (AR) and other digital tools presented below were selected specifically for accommodating the needs and objectives of the learning methodology for secondary school education developed in the framework of the WaterSTEAM project, based on an inquiry-based, student-centred approach and incorporating the element of social and civic awareness, on the theme of landscape protection, management and planning in relation to the water as an element that shapes and transforms it.

Within the following units of the present sections, the selected tools are presented with regard to their merits, features and characteristics that qualify them for implementing the developed learning methodology. The tools' potential application within the learning methodology is also described, accompanied by instructions on how to best apply them and links for further support and information.

The proposed AR tools were selected in order to better respond to the following criteria:

- Open source and free of charge: The tools selected are open source and free of charge, at least in their proposed version for application, in order to make sure they can be easily adopted within a variety of learning frameworks, both formal and informal.
- Easy to apply: The selected tools are easy to use, without demanding any expertise in programming by the user. Although the level of complexity and available features vary from tool to tool, they all include friendly user interfaces in editor mode, inviting developers/editors to explore their capabilities and experiment. All selected tools can be applied by all target group members in different educational settings, both teachers and students.
- Great potential for learning and awareness raising: All selected AR tools have been tested in the past by WaterSTEAM project partner organisations regarding their learning and awareness raising potential, and their capabilities in this field, both in formal and non-formal educational settings, have been proven and documented. They can facilitate learning both during their application and afterwards, as finished and freely available learning tools.
- Facilitating engagement and participation of users: All suggested AR tools include a strong component of encouraging the users' engagement and active participation. Users are encouraged to engage in interactive learning through the tools' AR features, raising awareness and contributing to the protection, management and planning of their local landscapes.
- Suitability of AR features: In the last few years there are more and more tools available, offering Augmented Reality features on mobile devices. However, not all of them offer features suitable for applying the learning methodology developed within the WaterSTEAM project and pursuing the learning and awareness raising objectives outlined.



- Stability and support: The suggested tools are relatively stable in their applications, their limitations regarding different operating systems for mobile devices have been documented, and include a support centre or an active online support community.

The series of AR and ICT tools presented below aims to offer valuable options to the teachers and students who implement the WaterSTEAM learning methodology, and can be easily integrated to the different steps within the WaterSTEAM methodology, i.e. Orientation, Conceptualisation, Investigation, Conclusion and Discussion.

#### SIFTR – A PLATFORM FOR MAPPING, VISUALIZATION, COLLABORATION, INTERACTION

Siftr [www.siftr.org](http://www.siftr.org) is an open and free platform for collaborative mapping developed and supported by the Field Day Lab, a lab active in the development of educational games and digital learning resources within the University of Wisconsin in the USA, led by David Gagnon, creator of the popular Location-Based Game development platform ARIS.

Siftr is a freely available platform, accessible both from desktop devices (e.g. desktop computer) as well as from mobile devices (e.g. smartphones or tablets), that offers anyone the opportunity to develop collaborative learning activities with reference to the real world, without any particular prior digital skills. It extends learning beyond computers, books and classroom walls – facilitating learning in the real world.

#### **What does it do? Application in the framework of WaterSTEAM**

Siftr allows a facilitator (the person or organisation who creates the Siftr, defining the purpose of the collaborative mapping activity and setting the parameters of users' engagement) to create a framework for mapping input according to a certain theme, and then let either a small group or the general public use their mobile devices (i.e. smartphones or tablets) to document geographically relevant material. Siftr gathers this input in the form of photos, text and of course location, and illustrates it so that it is easy to view and discuss the data as a group on a larger display together. An additional feature of Siftr is the ability to interact by adding comments and “liking” certain input (similar to “like” on Facebook). The input is uploaded online on the spot through a smartphone or a tablet, or through a computer by uploading material online.

Siftr can have various applications in different areas and disciplines. It is not limited to this one application area, but instead is a general purpose tool that should be able to find diverse applications because there are so many ways it might help bring together people, ideas, and places. However, one distinct area of application of Siftr that looks promising is citizen science. There are many citizen science projects that wish to crowdsource data gathering. It has been one of the most attractive aspects of the internet that large numbers of people can not only find out about scientific topics, but participate in the creation of new scientific knowledge. An example of that collaborative creation of knowledge is Galaxy Zoo, where scientists created a platform for amateur astronomers to help identify interstellar objects (see *Reinventing Discovery* by Michael Nielsen). Not only was the crowd able to help identify objects of interest more quickly and accurately than a small number



of scientists who were officially running the projects or computers, their curiosity led them to document and discover [brand new astronomical phenomena](#).

Furthermore, Siftr's features for on-the-scene collaborative mapping are freely available and can be easily used by all, assuming a basic level of skills in using computers and smartphones (i.e. browsing the internet, downloading and installing apps on a mobile device, taking photos).

Finally, Siftr is a responsive web app. It is designed to be used on smartphones (both Android and iOS) as well as on desktop web browsers. There are no apps to download, just the custom URL to type in. Though it is possible to use any of the features from any browser, the basic idea is that users on phones, out in the world, will collect data. Then the group or individuals who care about the map as a whole can get together and bring up the site on a larger screen, maybe projected, to discuss or make other assessments from.

In the framework of WaterSTEAM, Siftr's features make it a valuable tool with potential application in all steps of the WaterSTEAM methodology, facilitating collaboration between the students, the teachers and external experts involved, gathering geographically related input from smaller or larger groups, as well as providing an excellent tool for discussion and presentation of ideas in class. Siftr's features can be applied in the different WaterSTEAM learning methodology steps in various ways, including – but not limited – to the following:

#### Orientation

Siftr can be used in relation to the initial field trip(s) to local water landscape(s), to introduce the landscape concept through tracing different types of landscapes, raising awareness about different perceptions of the landscape held by different persons, and discussing later in class or online, highlighting common misconceptions. Certain features of Siftr can help stimulate the interest of students and teachers about the theme of landscape at this first step of the methodology; the field trip activity acquires a digital component, inviting the participating students and teachers to document their own perceptions on landscapes visited, share with the group and discuss.

#### Conceptualisation

Siftr can be applied in the conceptualization phase to identify and document challenges connected to the landscapes visited through photos and text, comment and “like” the water landscape and the challenges they are interested in investigating. In this way, Siftr can help the students formulate their research questions or hypothesis. Furthermore, the group can use the photos taken through Siftr (photos can be downloaded or viewed online) to compare with older photos of the landscape and trace changes to the landscape. Students and teachers can also comment on the input gathered in Siftr, and raise issues for discussion in class.

#### Investigation

In the Investigation phase, Siftr can be used as a survey tool in order to gather perceptions of school students or the local community on challenges identified and/or proposals for protection/management/planning regarding the water landscape in focus. It's ability to facilitate the crowdsourcing of data gathering can also be used to gather input on other aspects of the landscape in focus by the participating students or wider groups (the school students or even



members of the local community). The location and timestamp for every input is recorded automatically, while the data gathered on Siftr can be exported in CSV format so it can be further processed in Spreadsheet applications like Excel. Moreover, Siftr can be applied as a collaboration platform during the investigation phase, facilitating information sharing between the students, teachers and external experts who may be invited to contribute in the investigation activities.

### Conclusion

In Siftr all input (location, photos, text, responses to multiple choice questions etc.) is available online and can be presented on the Siftr map together, facilitating the formulation of conclusions.

### Discussion

Siftr can be a valuable presentation tool, facilitating discussion and participation of the whole school and the wider local community, raising awareness on landscape challenges and proposals for protection, management or planning.

### **How Siftr works**

Siftr is very simple for authors, mappers, and viewers. Below there is a brief description for each activity.

#### Authoring a siftr

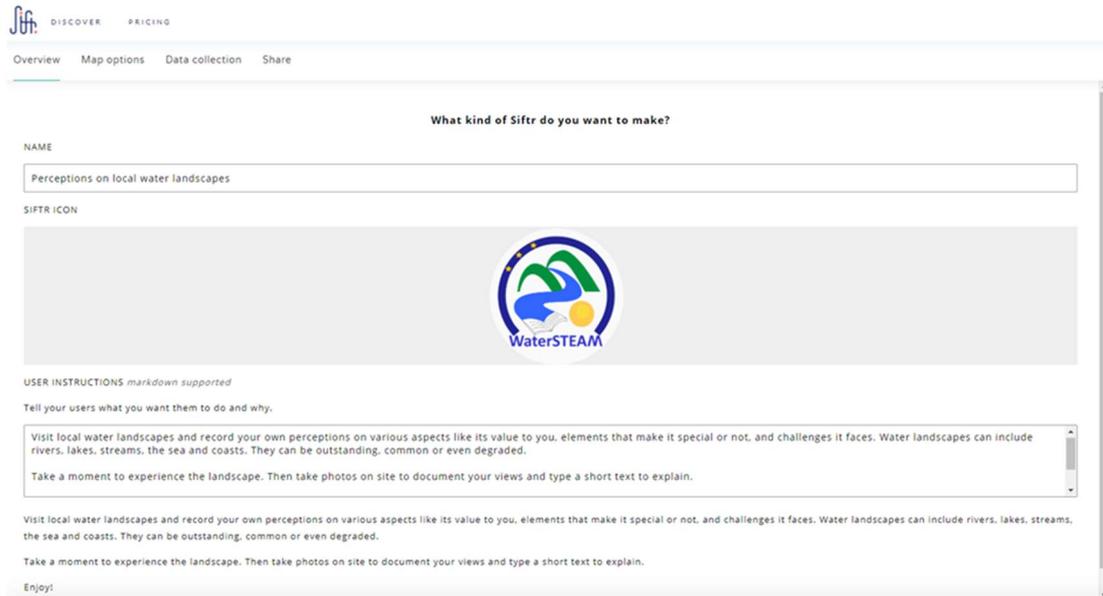
Authors or facilitators create an account (or use their ARIS account credentials) at [www.siftr.org](http://www.siftr.org). Then, the author creates a

- Name for the siftr. For example “Perceptions on local water landscapes”.
- URL. For example, <https://siftr.org/watersteam>
- Description of what to do with the siftr, i.e. instructions for the mappers. For example:

“Visit local water landscapes and record your own perceptions on various aspects like its value to you, elements that make it special or not, and challenges it faces. Water landscapes can include rivers, lakes, streams, the sea and coasts. They can be outstanding, common or even degraded.

Take a moment to experience the landscape. Then take photos on site to document your views and type a short text to explain.

Enjoy!”



The screenshot shows the 'Overview' screen for creating a Siftr. At the top, there is a navigation bar with 'Overview', 'Map options', 'Data collection', and 'Share'. Below this, a title asks 'What kind of Siftr do you want to make?'. The form includes a 'NAME' field with the text 'Perceptions on local water landscapes', a 'SIFTR ICON' field containing the WaterSTEAM logo, and a 'USER INSTRUCTIONS' field with the text: 'Visit local water landscapes and record your own perceptions on various aspects like its value to you, elements that make it special or not, and challenges it faces. Water landscapes can include rivers, lakes, streams, the sea and coasts. They can be outstanding, common or even degraded. Take a moment to experience the landscape. Then take photos on site to document your views and type a short text to explain.' The instructions are repeated in a smaller font below.

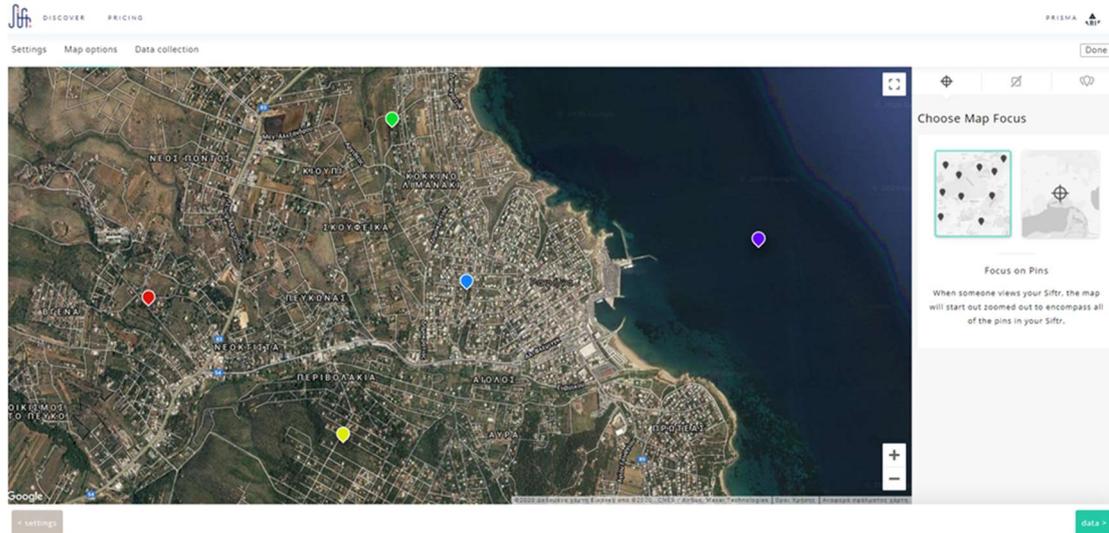
*Screenshot 1: The "Overview" screen in creating a Siftr*

Then the author of the siftr:

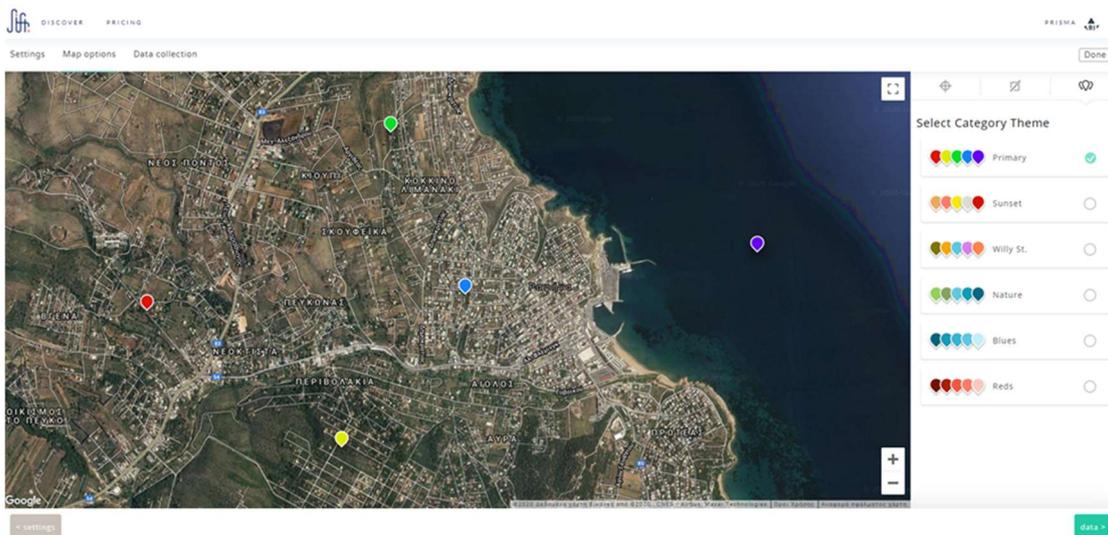
- Selects the optimum map settings like the map focus, the map appearance theme (there are currently 5 themes to choose from, i.e. silver, retro, aubergine, classic, and satellite), and the colour palette for the map pins. (see Screenshots 2 and 3)
- Customizes the categories of data collection and the colours that represent these categories. For example regarding the landscape type, the author can insert "Urban landscape", "Agricultural landscape", "Natural landscape" and "Industrial landscape" (see Screenshot 4)
- Selects additional data collection formats (optional). The standard formats are the main photo, the caption and the categories. The optional available formats are single choice question, multiple choice question, small text field, large text field, and an additional photo. Attention: Every time a data collection format is set, the author must Save the field (button at the right bottom corner) otherwise the field will be lost (see Screenshot 4)
- Decides basic permissions regarding viewing and contributing to the map (see Screenshot 5)

The siftr is ready. It's fast, easy and powerful. Once a siftr is there, and depending on the permissions the author chooses, anyone can both view it in a browser and add data to the siftr using a mobile device or a computer with internet connection.

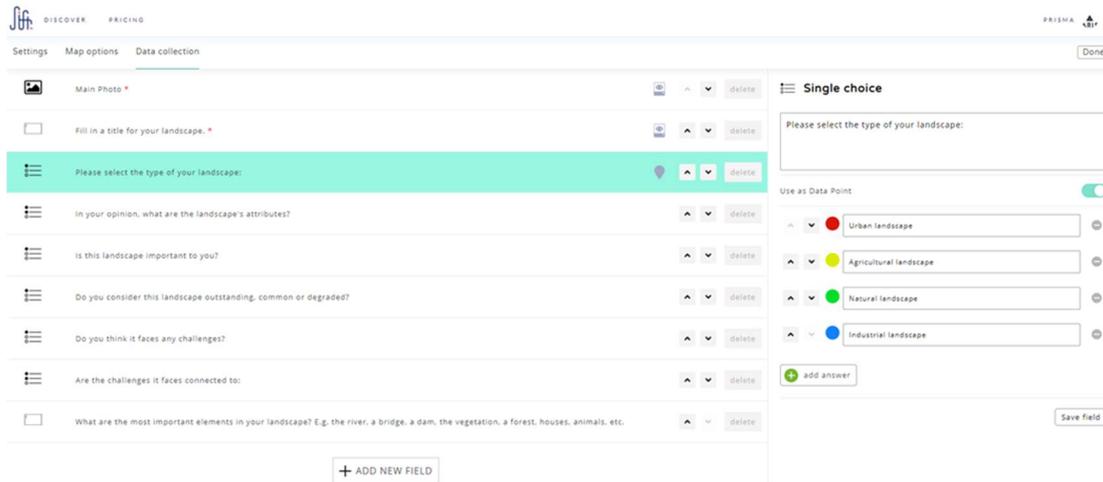
The siftr author can Edit or Delete the siftr at any time, moderate input and download the data in CSV format for processing.



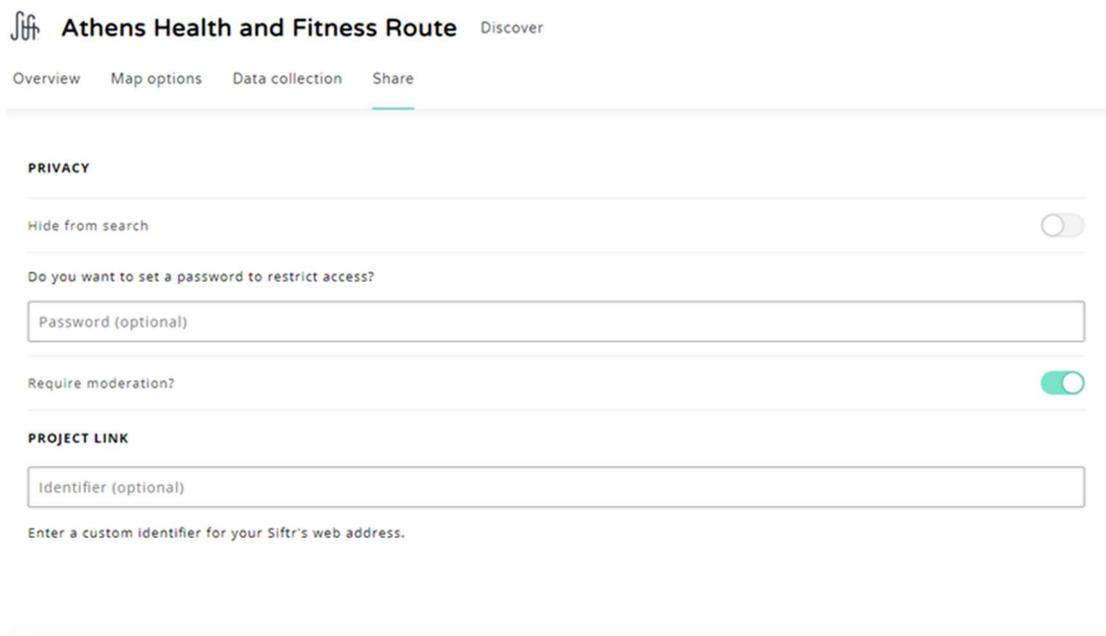
Screenshot 2: Selecting the map focus



Screenshot 3: Selecting the category theme, i.e. the pins' colour palette.



*Screenshot 4: Selecting the different categories and assigning colour. Also selecting additional data collection formats (optional).*



*Screenshot 5: Selecting basic permission and privacy settings, and publishing!*

## Mapping

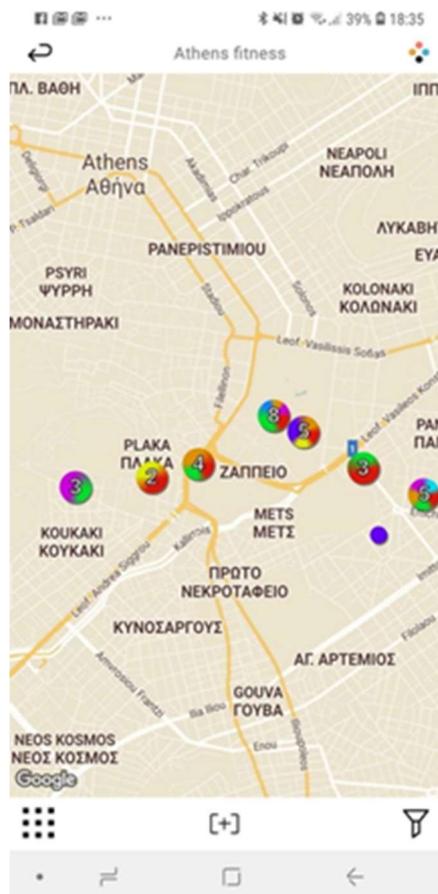
The users with access to the siftr can then download and install the siftr app on their smartphones or tablets (Android and IOs), create an account or login using their account details, explore and find the siftr they are interested in, and visit the area in the siftr map or walk through the itinerary described in the siftr.

The users who add a pin on the map on location by going through the data collection sequence, i.e. taking the main photo, adding a caption, selecting a category (and colour) and filling in any of the additional data collection formats, are called “mappers”.

Adding a pin on a siftr map is fast and easy. Siftr automatically registers the mapper’s location and places the pin there, and links all the data filled in by the mapper to that specific pin. That pin is then visible to all other mappers and viewers who can either “like” it or comment on it.

As mentioned above, each pin also is the root for a comment thread. Mappers and viewers can ask each other questions right there in siftr, add additional information, and even share the post (it is after all just a special webpage) via social media. However, note that audio and video are not currently supported.

When a mapper creates a map pin, the default assumption is to use the mapper’s current GPS coordinates, but the point can be manually moved as well.



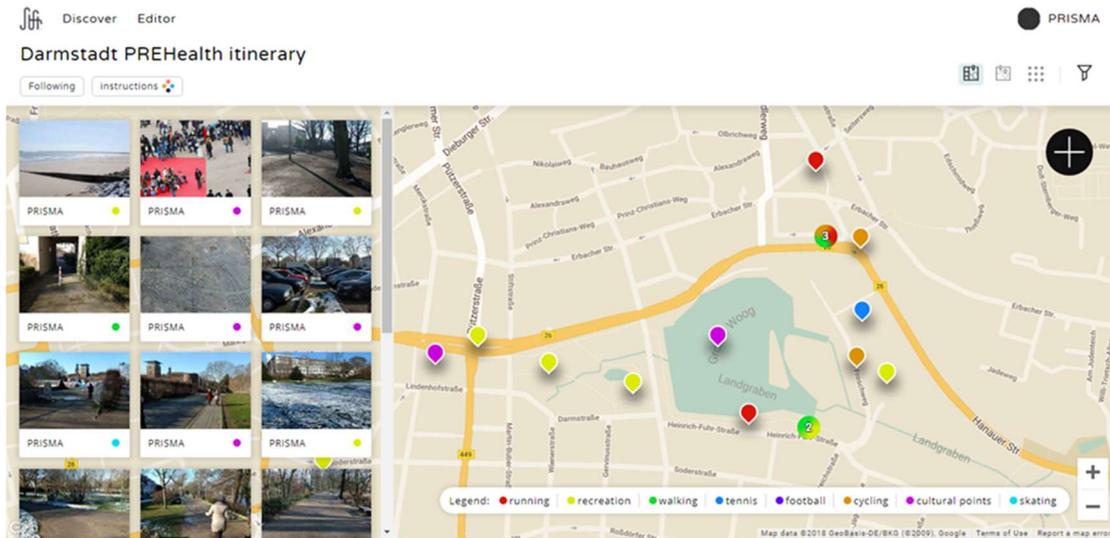
Screenshot 6: A siftr on a smartphone. Note the big plus at the bottom of the screen for adding a new pin and the purple dot (that is the position of the user while taking this screenshot).

### Viewing

As a responsive web app, siftr looks a bit different on a bigger screen, giving viewers more ways to look at what has been collected. There are map-based views, image-based views, and ways to filter by category or search for users and text. This is a nice way to review a collection with a group. Note too, that you can also add pins right here - you don’t need to be on the mobile device.

On Screenshot 7 below you can see what a siftr looks like on a computer browser.

For a tutorial on Siftr please visit the following link: <https://fielddaylab.org/courses/siftr>



Screenshot 7: A siftr as seen on a desktop browser. Easy to see and filter your collections, but you can still map if you want to.

#### AR AND LOCATION-BASED GAMES TOOLS



Augmented Reality is a way to enhance natural environments or situations and offer perceptually enriched experiences. The information about the surrounding real world of the user becomes interactive and digitally manipulated.

Accessing additional (augmented) information that can be accessed online about the environment while being onsite, means experiencing and using AR.

The most common and easy way to experience AR is through the QR code. The code, that can be scanned through the appropriate application on the smartphone, accesses to a website or a document from which the user can read additional information about what he is seeing.

In terms of educational objectives, working in natural environment with the use of GPS-based technologies allows student to approach geographical information in a way that stimulates to:

- Inquiry on the landscape and environment around
- Identify the data and information to answer the question or test the hypothesis formulated
- Explore, analyze the data and find the connections and relationships between geographical and other environmental variables
- Analyze the geographical information to answer the initial question through geographic software to locate the relationships and provide an alternative way of communicating the results



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## WHAT ARE LOCATION-BASED GAMES

Hide and seek, I-Spy, police and thieves, role playing games and capture-the-flag have all been popular real-life location-based games that have been played in different versions across the globe. These games allow the players to refer to physical objects and location(s) and use their creativity and imagination in order to interact meaningfully with others, as well as with the location(s). In recent years there has been a rise in the number of creative games, interactive narratives and playful activities that are facilitated by mobile devices in such a way that the game activity follows the players' location. A term used to describe such games is "mobile location-based games" (Avouris & Yannoutsou, 2012).

The advent of mobile devices, such as smartphones and tablets, and the fast evolution of game technology, provide great opportunities to develop place-based games that encourage participants to become immersed in playful and meaningful interactions, using different layers of information. These products also offer real opportunity for learning and storytelling about specific locations and routes, introducing the natural or built environment as a participant in the players' interaction and experience.

In recent years, advanced mobile devices (smartphones and tablets) have made the use of location-based services very convenient (Ku et al., 2008). Location-based Services (LBSs) are IT services for providing information that has been created, compiled, selected, or filtered taking into consideration the current location of the users or those of other persons or mobile devices (Küpper, 2005). With the expansion of location-based services, location-based games have also gained in popularity and become more widespread.

Many applications for modern smartphones and tablets incorporate LBSs to provide location-based information. This information can be used to give location-based advice, navigation directions, to track movement and conveniently communicate one's current location to friends, etc. However, it can be also used in the fields of entertainment and learning, to create games that makes the position of the player an essential part of the gaming process (Lehmann, 2012).

A location-based game (LBG) is defined as a form of play designed to evolve on a device in motion, directly linking the game experience with the location of the player. To create a location-based experience, usually a connection to other devices, e.g. a server or other players, is necessary. However, it is also possible to run single player games, provided that all required information is stored in the player's device. In this case, a connection to other devices is not necessary to run a LBG, as long as the game follows the changing locations of the player's device (Lehmann, 2012).

A useful classification (Lehmann, 2012) of potential game patterns in LBGs is outlined below:

### **A. Search-and-Find**

In Search-and-Find games the player has to search for a specific geolocation in order to progress in the game. This can be made possible either by suggesting the rough location to be visited using a map in the game interface; or by giving a clue referring to the surroundings e.g. a building, a road feature or a landmark. In such games the player can choose from a range of proposed locations or move towards the single location suggested. Reaching a destination is the main objective behind Search-and Find Games.



An example of this game-pattern is *Geocaching* (<https://www.geocaching.com>) in which the player moves to a specific location in order to find a hidden physical object, usually a box containing items, then takes one item out of the box and leaves back another item in replacement to the one the player removed. GPS coordinates provide the location for the next “geocache” to be discovered.

### **B. Follow-the-Path**

A Follow-the-Path game is quite similar to a Search-and-Find game with the only difference being that a destination is not the goal, but the sequence of destinations is, and how the player reaches them. Any deviation from the defined route can result in penalties for the player i.e. missing a reward/item/clue. *Treasure Hunt* is one of the most popular Follow-the-Path games.

### **C. Chase-and-Catch**

In Chase-and-Catch games the players try to find a moving virtual target and claim it: this target can refer to the actual location of another player or the changing locations of a moving virtual object that exists only in the game world. The player is informed about the location of the target via the game interface/ interactive map and the aim of the game is to approach the target quickly to “catch” it. This game-pattern promotes strategy building and physical activity while it can involve a single player or be a multiplayer gameplay. *Ingress* (<https://www.geocaching.com>) is an augmented reality territorial version of the Chase-and-Catch game type.

### **D. Change-of-Distance**

Change-of-Distance games use the notions of proximity or remoteness between the player’s location and several geolocations within the game; the location itself or the direction of the player’s movement are not as important as the movement of the player. The player’s goal is to either move towards a location or move further away. An example of this pattern is *The Journey*: in this game the actual location of the player does not influence the plot, however the movement and the journey of the player are tracked, as well as the locations already visited.

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## APPLICATION OF LBGs IN THE FRAMEWORK OF WATERSTEAM

Location-based gaming offers great educational possibilities, as it allows educators and facilitators of learning to create constructivist experiences rich in educational content. The proliferation of LBGs is due to the widespread use of mobile devices, like smartphones and tablets, with advanced location sensing capabilities like GPS satellite positioning. LBGs can be compelling for young players as well as adults (Montola et al.,2009). Video games are, by their very nature, built around interaction and participation. Therefore, they provide a tool for designing curricula that offer more than mere exposure to content, aiming to enrich student experience through active participation (Squire, 2006, Gee, 2004, Dewey, 1938, Gagnon, 2010). LBGs offer an additional level of experience: due to the fuzzy border between games and real world activities, and because of the resulting changes in the game experience, players become involved and associate with the LBG, thus gaining stronger emotions and satisfaction from well-designed LBGs (Lehmann, 2012).



Mobile games are particularly suited to creating educational experiences in informal settings. Mobile media and augmented reality can fruitfully combine the advantages of educational video games with place-based learning (Squire et al., 2007).

LBGs offer great opportunities to include educational content in the playful experience by using context-aware learning tactics and content generation mechanisms like augmented reality, embedded in a mobile device game or triggered by simple technologies such as QR codes and RFID.

An important feature that makes LBGs suitable for education in the framework of WaterSTEAM is that they connect places with stories. In an LBG, it is possible to embed extra layers of information and narratives about, for example, the development of local water landscapes and the reasons (historical, environmental, etc.) behind their change over time and/or the challenges they face nowadays, thus transferring knowledge as well as promoting desirable attitudes and behaviours. By visiting real landscapes, the story becomes a personal experience linking physical elements with learning content. This conveys to the player location-specific knowledge and promotes behaviours through experiential learning, exploiting the connection between the real world and the game (Lehmann, 2012).

Moreover, Location-Based Games are platforms that can effectively merge knowledge from different disciplines through the development of the game narrative, and enrich gameplay with multimedia (images, photos, drawings, audio and video) that upgrade the players' gaming and educational experience. Students can use the material they collect through the different phases of the WaterSTEAM methodology, from all disciplines included, to build the game narrative and the game material.

Based on the above, the adoption of LBGs as AR tools to implement the WaterSTEAM learning methodology is most appropriate. The educational capabilities of the LBGs that combine game-based learning and experiential learning, as well as their distinct features for raising awareness and encouraging active participation in the theme of landscape protection, management and planning, through connecting real places to narratives and learning content, offer great potential in pursuing the learning objectives of the WaterSTEAM learning methodology.

The LBGs to be developed in the framework of the WaterSTEAM methodology will aim at connecting:

- Water landscapes,
- Observations and information concerning these landscapes,
- Personal experiences and
- Learning content.

Within the framework of the WaterSTEAM Learning Methodology, the development of the LBG is foreseen to take place in the last phase "Discussion", aiming to synthetically present the findings and proposals developed throughout the WaterSTEAM school project on the theme of protection/management/planning of a local water landscape to the wider school education community as well as the local community and local authority. The game narrative will be connected to the students' findings and proposals, and the game material (e.g. photos, designs, artwork,



videos, etc.) will be drawn from the material collected throughout the project activities within the different phases of the WaterSTEAM Methodology.

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## THE PROCESS OF GAME-DESIGN AND DEVELOPMENT

A set of key points to be considered by participants during the process of game design and development is presented below:

### ***Field trips***

Prior to commencing the game-design process, foreseen to take place during the Discussion phase of the learning methodology, as well as throughout the completion of your game design, you will have the opportunity to visit the local landscape in focus several times.

- Take advantage of your visits at the selected landscape.
- Observe and document (e.g. through photos, videos, sketches, drawings etc.) the elements that make up the landscape, the changes in the landscape due to natural processes or human interventions, the challenges it faces, and your proposals for the landscape's protection, management or planning.

### ***Game genres and narrative***

People sometimes feel demotivated to play the LBG alone or get easily bored when playing by themselves. A cooperative or competitive game between teams can provide a solution to this problem. The LBG you will develop has a clear educational and awareness raising objective, however it is still a game, so make sure it is engaging and fun to play. Take the player(s) along an itinerary that will reveal interesting information about the landscape, while also placing challenges along the way and including twists in your plot, which will keep the player engaged. Learn about game types, ways to motivate the player and storytelling by examining video, street, traditional games and interactive storytelling experiences.

- Think about the players
- Choose solo games or team games
- Game mechanics can motivate players

### ***Game mechanics***

Think of all the simple but truly beautiful games you have experienced and you will understand that the fun in the game does not lie in its complexity. Think as a player when you design the game and avoid long texts and excessive information. Concentrate on the story and the message you want to get through and try to use as few game mechanics as possible. Get inspired by the story itself and games that you love and create a new experience for your users.

- Simple is beautiful!
- Don't use many mechanics or too much text.
- Try to design an interactive and engaging or challenging system/game/story.
- An intriguing story by itself requires less game mechanics.



### ***Storyboarding***

Plan First, Play Later! Paper prototypes are an easy way to get feedback on multiple ideas. A script is always useful when trying to get a story through. Share your ideas with friends and classmates and check if it makes sense and keeps them interested before implementing your game.

- Prepare your plot by writing a scenario
- Use paper prototypes before digitally designing your game
- An easy way to get feedback on multiple ideas

### ***Implementation***

Use the tutorials, forums and contact details of the game-design platforms. Don't be afraid to ask others and make mistakes. Remember that the platform is free and might contain bugs. Don't lose heart! Creating a piece of software and debugging it, even in such a simple and user-friendly way, requires patience.

- Read the manuals and tutorials available.
- Use the support services available in the different game-design platforms and don't hesitate to post your questions or comments in the platform fora or online communities where possible.

### ***Playtesting***

Playtesting is the most important phase of game design. This is where a game shows its potential and ideas are tested in action. Do not be afraid to fail. Fail fast and try to fix the problematic points or redesign. Run the game within its actual context on site if possible. Test out core mechanics before emulating the final game.

- Test the game in the actual environment
- Emulate the final game
- Test out core mechanics

### ***Environment***

The game you have to design has a significant feature that you cannot ignore: it is set in the real world, and connected to a landscape you have focused on and investigated. This will give you several extra parameters to take into consideration during the design process. IN general, you have to keep in mind the following points:

- Respect the character of the different spaces along your game area and their current uses
- Take into account any existing rules or conditions of your game area (e.g. areas not open to the public or with opening hours, proximity to conflicting uses, quiet hours etc.)
- Take safety issues into consideration – certain features of water elements change throughout the year (e.g. water volume and flow of rivers, water level, etc.)
- Remember to integrate rules in your game design, if necessary

### ***Technology***

Technology failure happens. You should keep in mind technology inefficiency and breakdowns. Be prepared for low-tech alternatives or game mechanics interventions to favour the game flow.



- Mind potential 4G coverage issues and GPS inaccuracy
- Be prepared for low-tech alternatives or game mechanics
- Software and hardware may break down- have a plan B and do not panic!

### *Enjoy your game design process*

The most important part of the game process is to remember that it is supposed to be fun! Enjoy it!

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## PLATFORMS FOR LOCATION BASED GAME (LBG) DESIGN

In order to create a location-based (LBG) mobile game you have to make use of game-design platform. There are many free platforms available online, however in the framework of the WaterSTEAM project three platforms have been selected as most suitable for implementing the WaterSTEAM Learning Methodology:

ARIS	<a href="http://www.arisgames.org">www.arisgames.org</a>
Enigmapp	<a href="http://www.enigmapp.fr">www.enigmapp.fr</a>
TaleBlazer	<a href="http://www.taleblazer.org">www.taleblazer.org</a>

Platforms include a mobile application, a web editor, and they also provide a server to store the data:

- The mobile application is used by the player in order to play the game. The player needs to download the application from the website of the platform or a digital distribution platform for mobile devices such as iTunes, the App Store for iOS or Google Play Store for Android operating system (OS).
- An editor is usually a web-based interface that is used by the game-designer in order to create the game.
- A server is where all the information of the game is being stored and accessed.

Each of the proposed platforms has a different structure for their editors' interface, however, there are many common characteristics among them:

- One of the core features in location-based games platforms is a dynamic map field. This is where a designer sets the action of the game by "pinning" the locations of the game components. When players of a location-based game approach the specified locations in the physical world, actions are triggered in the game, in the digital world.
- Games often incorporate different roles for the player. These roles can be either assigned or chosen by the player when such an option exists in the game scenario.
- An LBG player can interact with virtual characters – i.e. non-player characters (NPCs). The player can interact with them by having a conversation, by exchanging items or even gaining attributes such as fame, experience etc.



- Virtual items can be collected during a game in the player's inventory. The items can be used as score indicators, they can often be "dropped" for another player to collect, and they can be traded with other items among players or even be taken out from the player's inventory.
- Components that provide information are often incorporated in the game scenario. Information nodes can include text, audio, video or even online content.
- A game scenario may have plot twists and may depend on the player's choices. The course of action can be set by adjusting the game components' parameters of appearance on the game interface. A game designer can be compared to a director staging a play; the turn of appearance of each game component can be defined by a set of rules, decided by the designer in order for the narrative of the game to advance.
- Players should have a clear idea of what their objective is during the game. The players' mission and progress can be clarified using various mechanics such as updating the players' status, history or quests tabs. Moreover, the designer should provide the player with an experience of closure, a reward or a word of encouragement to try again - depending on the game's genre - so that the game benefits from a clear ending. In some cases it is not necessary to set an ending, for example in time-limited games, travel guides and more open playful experiences.

This is a basic outline of some of the core features included in the design and development process of location based games across platforms. As platforms have their own requirements in terms of structure, use, terms and scope, it is suggested to game-designers to refer to manuals, tutorials and documentation available by each provider before they start developing their games.

#### **Location-Based Game design platforms**

The game design platforms suggested (ARIS, Enigmapp, TaleBlazer) were selected on the basis of their free and unrestricted use, their availability in different operational systems of mobile devices (i.e. Android and iOS), the features they offer, the support or online community available, and their stability and ease of use. Out of the three platforms recommended for the WaterSTEAM requirements, ARIS is regarded as the most elaborate and offering the most options for the design and development of a LBG, however its full range of features is still only available for IOs devices. Enigmapp is considered as the easiest to use out of the three, however offering only linear game designs. TaleBlazer lies somewhere in between, easy to set up and able to offer an elaborate AR experience if based on a grasping narrative.

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ARIS

[www.arisgames.org](http://www.arisgames.org)



ARIS is an open-source, easy to use platform for creating and playing augmented reality experiences on iOS devices (primarily) and Android devices (beta version with limited features). These experiences include but are not limited to Interactive Stories, Scavenger Hunts, Tours, Data Collection Activities etc. Learning is at the core of ARIS applications, combining the benefits of game-based learning and situated learning.

ARIS is developed and supported by the Field Day Lab, a lab active in the development of educational games and digital learning resources within the University of Wisconsin in the USA, led by David Gagnon, the creator of ARIS.

The use of ARIS is related to educational purposes and spans from classrooms to museums, school clubs and community action groups. Although some of its advanced features require some degree of knowledge and practice, its friendly editor interface and the learning material and support available through online video or text tutorials and through an active online community, help users quickly get to speed with creating their own AR experiences.

The basic conceptual model for ARIS authoring involves **objects**, **triggers**, and **scenes**.

- Media content = **objects**
- How a player accesses content = **triggers**
- Organizational units for triggers = **scenes**

Objects, triggers, and a scene as seen in the Scenes tab of the ARIS Editor

## Objects and Triggers

**Objects** in ARIS are containers for the content you'd like your players to see and interact with. There are many types of object, but they are each a format of media. The text areas are actually html fields capable of executing arbitrary javascript as well. You can make these pretty fancy by looking up a few common html tags and how to use them. The media asset can typically be an image, video, or audio clip.

For the actual settings for each object see their pages:

- Plaque
- Item/Attribute
- Conversation
- Webpage
- Factory (a meta-object)

And for media specifications, look here.

You can create objects and see them in the left sidebar of the main (Scenes) tab of the Editor.

*To make your **object** available to players, you must also create at least one **trigger** to point to that object. Each trigger lives in a scene.*

**Triggers** are what connect the game world to the physical world and to itself. In a very basic sense, a trigger is how a player gets to an object. If you want a plaque at one specific place on earth, you would use a location trigger to point to that plaque, and move that trigger to the intended place. But that is just the beginning. There are many different types of triggers. Below, there is a basic description but for details see the [Trigger Types](#) page.



- **Location** (AKA GPS) - ARIS places a trigger at a location in the world using geospatial coordinates. A player can access the object pointed to by being close enough to this location.
- **QR code** - Players can scan an image to access an object in ARIS using their scanner (in ARIS). Alternatively, they can enter a corresponding string into their decoder.
- **Locks** - Internal game logic. Things that a player has done before, not yet done, their current state, or the state of their team or the game world as a whole (that's a lot of options) alone can trigger further interactions. No action in the physical world is needed.
- **Timer** - A self-refreshing timer that triggers an object each time it counts down to 0.
- **Beacon** - Another form of location detection. Instead of GPS coordinates, this trigger works on player proximity to small devices called i Beacons or Bluetooth beacons.

### How to add triggers to scenes

You add a trigger to a scene using the (+) button in the upper right corner of a scene. There are many types of triggers, each of which is an action in relation to a game object:

- **Start Conversation**
- **View Plaque**
- **Inspect Item**
- **Visit webpage**
- **Switch scene**
- **Run event**

More on the details for each of these basic types of trigger below, after notes on scenes.

### What Are Scenes?

The Scenes tab is the main tab in the Editor. It is a visual interface to design stories in ARIS. It helps you organize your objects, quests, and moments of player interaction. Instead of a long list of objects, you can see the structure of your games and stories directly in this window. This should help authors think about the progression of their creations, right in ARIS.

*Every game needs at least one scene. Every object needs at least one trigger to provide the player access. A trigger is created within a scene.*

Objectively, scenes are containers for collections of game objects (plaques, conversations, etc.). But the metaphor is with cinema/theater. A scene is a basic organizational unit of design to help you think about the different parts of the story/game you're making as separate productions that are linked together. A story will typically be made up of several connected scenes, and the branching connections between scenes could become quite complex if you want.

Scenes are about helping you to tell stories more efficiently using ARIS. They are likely more useful for larger, more important games. When you're just getting started, it may be best to use a single scene, and simply add all your triggers to that.

### How to Use Scenes

You create one or more **scenes**, and add **triggers** to these scenes to move action along within them. Every moment of the experience you're creating for a player will take place within one of your scenes.



Every game needs at least one **scene**. Add a new one by clicking the big, “add scene” button when you are in the Scenes tab of the Editor.

- Scenes can be titled, and moved around within the main window of the editor.
- A player can only be in one scene at a time. Triggers in other scenes will not be available to players regardless of the locks you put on them. Scenes can be a convenient way to segment your games, but you need to learn how to use locks to move players in and out of scenes.

***Pro-tip:** Until you are indeed a pro, or have a real need, just use one scene for everything. Switching scenes is a bit tricky to set up and not immediately obvious to players so it is easy to break your game (and have a hard time seeing it) when you have multiple scenes.*

### Switching Scenes

One special type of trigger is the one you use to send the player to another scene. By default, the player starts in the first scene you create. You can change which scene is your first scene in game settings. If you want them to see your objects whose triggers are in other scenes, you need to send them out of their initial scene and into another one. You do this with a **switch scene** trigger.

Using multiple scenes may help you organize your storytelling

### Using Triggers

Each trigger has many options for when and how the player can access it. You edit them by clicking on the trigger within the scene.

A scene with a bunch of triggers. Notice the custom icons for each type of object.

In the left sidebar, you will see the available options, grouped into three categories:

1. **Edit Object** - Details about what the player sees and does once they are looking at or using your object.
2. **Locks** - This replaces the former notion of requirements in ARIS. If you are familiar with requirements, this is the same, just with a better name. If not, Locks are what allow you to not have your objects show up at the same time for the player. You lock an object, and by doing certain things in the game, the player can unlock it.
3. **Trigger Type** - Various mechanisms for a player to actually go about getting to your object. It could be being in a specific place, scanning a QR code, etc.

### Edit Object

The first section of buttons you’ll see is “edit item” (or edit plaque, etc.). Clicking on the button brings up a small window where you can change the media, text, etc. for the object itself.

### Locks

Clicking on **Locks** brings up the Locks Editor, where the big plus button adds new locks. Locks prevent players from triggering objects. This is a powerful and intuitive approach to the AND’s and OR’s



involved in logically connecting complex chains of game objects. You can read more about locks at the link below, but the short version is:

Grouped locks need to ALL be unlocked by the player to unlock the object, and satisfying ANY of the ungrouped locks will unlock the object.

[All about Locks](#)

### Trigger Type

There are several ways that a player can gain access to the objects you create in ARIS. You can choose among them here.

**Location** (AKA GPS) - ARIS places a trigger at a location in the world using geospatial coordinates. A player can access the object pointed to by being close enough to this location.

**QR code** - Players can scan an image to access an object in ARIS using their scanner (in ARIS). Alternatively, they can enter a corresponding string into their decoder.

**Locks** - Internal game logic. Things that a player has done before, not yet done, their current state, or the state of their team or the game world as a whole (that's a lot of options) alone can trigger further interactions. No action in the physical world is needed.

**Timer** - A self-refreshing timer that triggers an object each time it counts down to 0.

**Beacon** - Another form of location detection. Instead of GPS coordinates, this trigger works on player proximity to small devices called i Beacons or Bluetooth beacons.

Notice, you need to *hit enter or click save* after selecting any of the toggles to make them active. You will be able to tell which is active from the small blue icon next to the object's icon in the scene window (place marker for location, mini QR code for QR code, chain link for sequence).

For details on how each type of trigger works, see the [Trigger Types](#) page.

Below you can find useful links for the help, training and documentation sections of ARIS:

- Training and Links: <http://arisgames.org/make/training/>
- Manual: <http://manual.arisgames.org/>
- Forum: <https://groups.google.com/forum/#!forum/arisgames>

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ENIGMAPP

[www.enigmapp.fr](http://www.enigmapp.fr)

Enigmapp is a platform developed by a French company, winner of the Réseau Entreprendre award, created by tourism professionals for tourism professionals. Its main focus being on tourism, the



platform was built with the mission to encourage the design and development of AR location-based games (called courses) which enable visitors discover different destinations, ranging from sites of cultural heritage to areas of natural beauty and urban neighbourhoods.

### What it offers

The games offered by Enigmapp are based on a design concept that uses a linear narrative development and challenges the player on a quest. The player is encouraged through a narrative to navigate in the physical space and through the mobile device's GPS interact with the game objects, i.e. either get information about certain aspects, interact with the game characters or overcome challenges in order to advance. The challenges can take the form of mini-games of various difficulty levels. These mini-games can either be:

- A question the player needs to answer correctly. The question can take the format of a:
  - Free answer question
  - Multiple choice question
  - Turning wheel
  - Text with gaps that the player needs to fill in
- A puzzle the player has to solve. Any image or photo can be turned into a puzzle easily through the platform.
- A clickable image that the player will be asked to place on a specific position on the map in order to advance. Any image or photo can be used.
- Geo-location. A question or taunt encourages the player to navigate to a specific location in order to solve the mini-game and advance.
- NFC – Near Field Communication.
- QR code. The player must locate and scan a QR code that will prompt him/her for a right answer.

Enigmapp also offers options for different visualisation themes, with backgrounds and characters appropriate for different course themes, e.g. heritage tour or tour in nature. The game content that can be uploaded by the game developer ranges from texts, images, sounds, videos and mini-games. The resulting games are freely available to potential players around the globe located within a maximum distance of 100 km from the game location. Players can either play the game on location ideally, or browse through it from their own location.

An advantage of Enigmapp is that it is available to both Android and iOS operating systems for mobile devices, offering in both cases the full range of features. Also, its initial focus being on tourism and aiming at encouraging tourism service providers or locals to develop a game themselves without any requirements for prior technical expertise or special knowledge on programming, makes it easy to get familiar with and use. In addition, the games developed can be edited and made available at any time. Finally, expert services, such as tailored design of a game, are available from the Enigmapp team, but at a cost.

### How to create a course (game)

The first step is creating an Enigmapp account at [www.enigmapp.fr](http://www.enigmapp.fr) by filling in an e-mail address and a password. If the website appears in French, it is possible to translate it in English or any other



language through your browser's translator (e.g. in Google Chrome by selecting the translate tool on the right of the address bar).

Then, login and by selecting "My page / Courses" on the top right you navigate to your page where you can create a new course or edit an existing course of yours. For creating a new course you click on the plus sign (+) and enter the Editor. Depending on the course you want to create, you can give a personality to your creation by selecting a theme: adventure book, medieval atmosphere or museum guide and more. Will you have a narrator or not? What will it look like? You have a choice. If you aren't happy with the existing proposed themes, you can create your own.

On the next step, you can create your game by adding your "Introduction" and different steps along the route you've selected. By dragging and dropping the pins corresponding to your different steps on the map, the route is created automatically. You can guide players on your own maps, decide whether to drive them inside a building or force them to navigate with a map of the sixteenth century.

At each step, write the text that your users will discover. Do you have a lot to say about a lot of topics? Add information sheets on the themes you want, accessible at any time to give additional information to those you guide without cluttering the main frame. You can easily add multimedia content like images, audio, videos to enrich the players' experience.

Add mini-games to make the experience more fun: find a detail on an image, reconstruct a puzzle, decode an inscription, solve an enigma, etc. Indicate the difficulty of the mini-game so that it yields more or less points, give clues for those who would get stuck, and indicate what will be displayed in case of a correct answer.

Don't forget to save your progress. At the end and after you've created all steps and inserted all content, you just have to publish your creation. In private mode so that the course is only available by invitation and you can test it or share it only with your friends, or in public mode so that the whole community has free access to it.

Overall, Enigmapp is an easy to use platform for creating location-based games with player-friendly interfaces and fun activities. Similar to the other two platforms presented here, it includes a web-based editor platform and an application for mobile devices, available for Android and iOS operating systems. However, it can only offer games based on a linear scenario development, i.e. following a linear sequence: The players are only taken from the game introduction to Step 1, Step 2 etc. until they reach the game epilogue. This characteristic is due to the fact the platform was created in order to build AR location-based visit tours. This means that, unlike the 2 other platforms, in Enigmapp the game designer cannot create different paths for the players according to their responses or performance in the game. This should be taken into account when selecting the LBG platform to use in the frame of the WaterSTEAM activities.

Below you can find useful links for the help and documentation sections of Enigmapp:

- Create: <http://www.enigmapp.fr/index/maptrois>
- Contact: <http://www.enigmapp.fr/index/contact>

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TALEBLAZER

[www.taleblazer.org](http://www.taleblazer.org)



TaleBlazer is an augmented reality (AR) software platform for creating location-based games, developed by the MIT Scheller Teacher Education Program (STEP) lab in the USA. TaleBlazer was developed to allow users to play and make their own location-based mobile games.

TaleBlazer games take place in the real world. Players interact with virtual characters, objects, and data as they move around their real location. TaleBlazer games can be played on most GPS-enabled Android and iOS smartphones and tablets. Moreover, once a game is downloaded to your mobile device, you don't need an internet connection to play your games! Only your device's GPS.

TaleBlazer consists of four software components: an online game *Editor* which allows the designer to create/edit/save games, a game *Repository* server which stores the games, a multi-player server (currently under development) which maintains a shared game universe for multi-player games, and an installed mobile application which is used to play the games on iOS or Android devices.

The TaleBlazer editor is browser-based, with no local installation required. The TaleBlazer editor uses a visual blocks-based scripting language - which makes it easy to create rich interactivity, while helping users avoid syntax errors. Users create accounts allowing them to save game files to the cloud, which can then be downloaded directly to a player's smartphone. TaleBlazer game designers have instant access to TaleBlazer games from any computer attached to the Internet.

### How to make a Taleblazer game

To make a TaleBlazer game, the game designer specifies one or more *regions* – real-world locations where the game takes place. Then the game designer adds *agents* – representing items, characters, or whatever the designer wants – to the region. When the player's location comes close enough to the agent's location, the player is said to *bump* into the agent. When bumping an agent, the *agent dashboard* comes up by default, displaying the agent's name, description and image. The designer can also specify *traits* (variables) displayed as a list, and *actions* displayed as a row of buttons on the agent dashboard.

More functionality can be achieved by configuring *scenarios* and *roles*. Just as the player can interact with the agent via the agent dashboard, the player can also interact with the world dashboard, the player dashboard, and the team dashboard (coming soon to multi-player). Complex game mechanics can be specified by means of a blocks-based programming language.

The editor software is used by the game designer to create a TaleBlazer game. Across the top of the page are the tabs that organize the game content and the game control panel. Use the buttons in the control panel to *Save* or create a *New Game*. Note that TaleBlazer does not automatically save, so make sure to save your work. A drop-down from the game control panel allows the game designer to modify the name, image, and description of the game. These settings are visible on the *game page* when the player chooses to start playing the game.

The tabs separate the content into five areas, in more detail below.

### WORLD

The world tab includes all the settings that are relevant to the entire game world:

#### Mobile Tabs

The game designer specifies which tabs are visible in the mobile software when the game is played:



- **Game** – displays meta information about the game itself such as the name, image, and description of the game, the game code, as well as a *Leave Game* button which closes the game and turns off the GPS.
- **World** – shows the world dashboard, including name, description, image, as well as world traits and actions.
- **Map** – shows the current location of the player as an icon on the game map along with the icons for the visible agents. If the player is close enough, as specified by the *bump settings*, the player can tap on agent icons to bump the agents.
- **Player** – shows the player dashboard, including the name, description, image, as well as player-specific traits and actions.
- **Clue Code** – here the player can enter a *clue code* which allows the player to interact with a *clue code* agent ‘anytime, anywhere’ – ie regardless of the player’s GPS location
- **Heads Up** – uses the compass and GPS readings of the device to show nearby agents as markers overlaid onto the video camera display. If the player is close enough, as specified by the *bump settings*, the player can tap on these markers to bump the agents.
- **Inventory** – shows the contents of the player’s inventory
- **History** – shows a list of agents that the player has previously encountered in the game
- **Log** – shows a list of all the things the player has done in the game.
- **Settings** – allows the designer to access debugging functionality such as turning ON tap to visit, and changing the bump radii

### Introduction

The *introduction* comes up when the player first starts to play the game. The game designer can use the introduction to orient the player to the game in some way - set up the narrative, give the player a quest, or provide help on how to use the software or how to play this game.

### Mobile Settings

Certain advanced settings for the mobile software can be found here. The game designer can specify which key pad is presented to the player for entering passwords and clue codes, and whether the player must enter a password to show the *Settings* tab. The TaleBlazer mobile software allows the player to turn on *tap to bump* via the *Settings* tab. *Tap to bump* allows the player to tap on the map icons to visit the agents regardless of the player’s location. This is important functionality for the game designer to be able to test their game when not on location. The experienced TaleBlazer mobile user can include the *Settings* tab for any game by tapping the *Show settings* checkbox in the *About* box (accessible by tapping the *About* button on the *Game* tab. Experienced game designers can protect this functionality by designating a password so that players cannot turn on the *tap to bump* setting unless they have the password.

### Bump Settings

These game-wide settings allow the designer to control how hard or easy it is for a player to *bump into* an agent. The designer specifies:

- Whether *bumping* into an agent
  - shows the agent dashboard AND runs the *bump script(s)* OR



- just runs the *bump script*
- How close the player must get to the agents in order to *bump* into them.
- Whether the agents can be *re-bumped*
  - How far the player must get from the agents in order to allow them to be *re-bumped*
  - By default, once an agent has been encountered, the player does not *re-bump* the same agent later in the game. If the *re-bump* option is checked, then agents can be *re-bumped* if the player leaves the immediate area and returns. This distance is enforced to prevent the agent from continuously popping up when the player is standing in one place.
- Whether the agent's map icon is
  - Hidden on the map
  - Visible on the map
  - Only visible when the player is within a specified distance
- Whether the player can *bump* the agent by tapping on its map icon in the map view.
  - Regardless of how far the player is from the player
  - Only when the player is within a specified distance from the agent
- Whether the agent's marker in the Heads Up View is
  - Hidden
  - Visible
  - Only visible when the player is within a specified distance
- Whether the player can *bump* the agent by tapping on its marker in the Heads Up View.
  - Regardless of how far the player is from the player
  - Only when the player is within a specified distance from the agent

### Scenarios

*Scenarios* allow the game designer to specify different 'versions' of the same game that the players can pick from when they start the game. For example, the player might be asked to pick between 'Easy' and 'Hard' or between 'Short' and 'Long' or even 'Start at Main Entrance' and 'Start at Side Entrance'.

### Actions

*Actions* appear as buttons on a dashboard. Actions can be:

**Text** – displays rich formatted text

**Video** – plays an uploaded video or (under development) a YouTube video

**Built-in** – performs built-in functionality, such as the *pick up* and *drop* actions.

**Script** – executes a designer created script. See the section on *Scripting* later in this document.

The name, type, contents, and visibility of an action can be changed in the Editor via the relevant *Actions* box. The name of the action appears as the text on the action button. The visibility of the action determines whether the button will be visible to the player on the relevant dashboard. The designer can also specify the sort order of the buttons across the dashboard. The visibility of an action can also be changed at run-time (during game play) by means of the blocks-based programming language.

### Traits



*Traits* are variables that the game designer can specify for agents, roles (ie players), teams, and for the world itself. The game designer declares and initializes a trait by pressing the *Add Trait* button and then using the *trait dialog* to add a trait to the given object (agent, role, team, world). When adding a trait, the designer specifies the name, the initial value, and the initial visibility of the trait. The visibility of the trait determines whether it will be visible to the player on the relevant dashboard. The name, value, and visibility of a trait can be changed in the Editor via the relevant *Traits* box, as well as the sort order of the traits. The value and visibility of a trait can also be changed at run-time (during game play) by means of the blocks-based programming language. When creating a new trait the designer must also specify the following attributes of the trait that cannot later be modified:

- **Scope** – which object(s) can use this trait (not applicable to world traits since there is only one world)
  - Common for all objects of the same type (agent, role, or team)
  - Only for the current object (agent, role, or team)

World traits are global settings shared by all players in a game. For example, the designer can use a world trait to specify and display the current temperature in the virtual world etc. All player traits should be created as common traits. This will allow maximum flexibility in accessing the traits from all scripts in the game.

## MAP

On this tab, the game designer specifies a location in the real world where the game will take place. In order to play the game, the player needs to physically be in this location. The TaleBlazer *Map* tab shows a Google Maps view of the world which can be searched via a search bar. The designer can pan and zoom this view, and then can use the *Move Game To Here* button to move the *game boundaries* to the area visible in the map view. Alternatively, the designer can change the game boundaries by clicking and dragging on the blue square markers in the map view or by typing new latitude/longitude values for the boundaries in the property box on the left side of the screen. To prevent the unwary designer from accidentally changing the game boundaries, the map is *locked* by default once the boundaries have been set. To change the boundaries of the game at any time after this point, unlock the *map* by unchecking the *Lock Map* checkbox.

The agents are visible in the map view as map icons. The game designer can edit the agents by clicking on them or (if the *Lock Agents* checkbox is unchecked) can move them by dragging. To keep the agents in their real world location and tweak the boundaries of the map – perhaps to include a larger or smaller area or to move the map slightly – use the *Preserve Agents' Lat/Lng* setting. To move the entire map to a new place, use the *Preserve Agents' X/Y* setting. The game designer may also want to specify more complex map features:

*Custom Map*: By default the mobile software uses the Google Maps API to display the player's position in the real world during the game. This API requires the player to remain within Wi-Fi or cell tower coverage to display the game map properly because the map is updated dynamically during game play as the player moves about the real world. In order to create a game that can be played without a data plan or in an area with poor Wi-Fi and cell tower coverage, the designer can upload a *custom map* – a jpg or png file which is displayed on the background during game play in



lieu of the Google Map. A custom map can also be used to show custom details on the map during game play, such as pedestrian paths, parks and open spaces, enhanced color, historical or geographic data, or even a fictional landscape.

## AGENTS

The game designer creates agents in a region and gives each agent a name, description, and image. The designer can also specify the agent's icon, which is displayed when the agent is visible on the map tab and alongside the agent's name in other places in the mobile software.

Settings for Agents:

### Clue Codes

Agents can be configured to be located as a *clue code* instead of at a coordinate in a specific region. A clue code agent is bumped when the player types in the correct clue code on the clue code tab. The game designer can use clue codes to implement the same functionality as an audio tour in a museum in which the player searches for signage and then types in a number. Clue code agents can be accessed anytime, anywhere.

### Password Protection

The designer can opt to password protect the dashboard so that the player must enter a password in order to see the traits and actions on the agent's dashboard.

### Excluded Agents

Excluded agents are inert and inaccessible by the player. When an agent is excluded, players cannot see the agent, *bump* the agent, or interact with it. An excluded agent, however, can be referenced by the scripting language. The traits of an excluded agent can still be accessed and/or changed via scripting. An excluded agent can be included via the *include agent* block; likewise, an included agent can be excluded via the *exclude agent* block.

### Bumping Agents

When the player encounters or meets an agent in the TaleBlazer software it is called *bumping* the agent. *Bumping* an agent can happen in one of five ways:

1. GPS proximity - when the player is "close enough" to the location of the agent
2. Map icon tap – when the player taps on the agent's map icon in the *Map* view
3. Heads Up tap – when the player taps on the agent *marker* in the *Heads Up* tab
4. Inventory tap – when the player taps on an agent in their inventory tab
5. Clue Code - when the player enters the correct *clue code* (for 'clue code' agents only) on the *clue code* tab.

When the player *bumps* the agent, the agent *dashboard* pops up by default, showing the agent's name, description, image, and visible traits and actions.

### Once finished designing the game

Name your game so you will be able to identify it again easily. Then click the *Save Game* button. On the mobile device, find the game either by logging into your account and tapping on it in the *My Games* area or by entering the game code. Once you have found your game, tap on the *Download and Play* button. To invite others to play your game, give them the game code.

Below you can find a useful link for the documentation section of TaleBlazer:

- Documentation: <http://taleblazer.org/Support/documentation>



## COMPLEMENTARY DIGITAL TOOLS

The digital tools listed below are proposed as complementary in implementing the WaterSTEAM Learning Methodology. In their majority they are open and free to use, or are commonly available in the computer facilities of schools in Europe (e.g. office software). They aim to facilitate different aspects of the proposed learning methodology, i.e. online mapping, file sharing and online collaboration, text processing, spreadsheet and presentation, digital media processing, and online survey development.

### Mapping software

**Google Earth** is designed to be a simple and easy mapping tool, enabling the user to place a marker on the satellite map (the marker can have an image, title, and description), measure distance and surface (by approximation), and draw an itinerary or a polygon on the map. Google Earth Pro is a free desktop application that uses Google maps and offers the features above. To access Google Earth for mobile devices and Google Earth Pro for desktop computers click on the following link:

<https://www.google.com/earth/versions/>

### Sharing spaces for team work

You can use a sharing space for collecting the groups' digital material online. Google Drive and Dropbox could prove quite useful for putting all material together and sharing.

<https://drive.google.com>

<https://www.dropbox.com>

### Office software

Word processing, spreadsheet and presentation software are valuable tools throughout the WaterSTEAM learning methodology.

Text processing software like Microsoft Word are useful for expressing and sharing findings, ideas and proposals in writing.

Spreadsheet software like Microsoft Excel are useful for analyzing and presenting numerical data through creating tables and graphs.

Presentation software like Microsoft Powerpoint or Prezi are useful for presenting findings and proposals to a wider audience.

Especially with regard to the needs of the WaterSTEAM methodology, it is recommended to use the online Google office applications – Google Docs for text processing, Google Sheets for spreadsheet and Google Slides for presentations – because the files are stored online on Google Drive and can be accessed at all times by all participants, who can comment or work on them from home or at school.

### Online survey tools

Software like Google Forms or SurveyMonkey are free, easy to use tools that facilitate online surveys through creating an online questionnaire and sharing a link to your target audience. The responses are then automatically organized and presented.



In the framework of the WaterSTEAM project at school, the students may wish to gather input from the public (e.g. their fellow school students, or the local community) on their perception regarding landscape attributes, challenges, and proposals related to their protection, management or planning. An online survey tool would be of great help in this sense, because the survey participant does not need to visit the landscape area, but just click on the link and start filling the questionnaire. For access to the online survey tools recommended, please click on the links below:

<https://www.google.com/forms/about/>

<https://www.surveymonkey.com/>

#### Working with digital media

You can find many on-line resources for digital media processing. Video editing and photo editing tools can prove helpful for visualising the game contents.

<https://popcorn.webmaker.org>

<http://pixlr.com/editor/>

#### Working with mobile devices

Mobile applications can be very useful during the location-based game design process. Taking pictures via a mobile appliance can provide useful geolocation data and this can help you associate the photographs with specific locations. Route tracking is also important for setting a location-based game site. These processes are made very easy through mobile phone/tablet applications such as the following:

- maps and [navigation](#)
- digital media association with geospatial data ([geotagging](#))
- route [mapping](#)

(Click on the icons when using a handheld device)



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## ANNEX

### WATERSTEAM – TEACHERS' QUESTIONNAIRE

This questionnaire has been formulated in the framework of the WaterSTEAM Erasmus+ project. WaterSTEAM proposes an innovative and integrated learning methodology for secondary school education, centering around an inclusive and collaborative STEAM approach in education. STEAM Education is an approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking. Landscape values and the role of water in shaping it is the core topic of the educational project. "Landscape" means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.

We would kindly invite you to fill in the following questionnaire, where we would like to measure your level of knowledge, skills, interests and attitudes regarding issues related to landscapes, the role of water, global environmental issues and the methodology offered by the project. Please, remember that there are no right or wrong answers, and this is not a test!

Filling the questionnaire will take approximately 20 minutes.

An online version is available at <http://surveyor.rkk.hu/index.php>

To get the results of your online survey, you have to contact the Hungarian partner.

Thank you for your time!

#### Part I: General questions

1. Please fill in your gender
  - Male
  - Female
  
2. Please select your age group
  - below 25
  - 25-35
  - 36-45
  - 46-55
  - 56-65
  - above 65
  
3. Please fill in your specialization (i.e. Maths, Chemistry, Physics, etc):
  
4. Name of your school:
  
5. Town (where your school is located):



**Part II: Knowledge**

In this section we would like to measure the level of knowledge regarding issues related to landscapes, the role of water, and global environmental issues. Remember, this is not a test!

6. Where do you think you can find a landscape? In: (You can mark more than one.)

- A forest
- A city/urban environment
- A village
- Agricultural fields
- Rivers and lakes
- The sea
- A coastline
- A painting

7. Which of the following do you think can be considered as part of a “landscape”? (You can mark more than one.)

- Water elements (sea, rivers, streams, lakes, etc.)
- Forests/trees
- Coastlines
- Mountains, hills
- Railways
- Roads/streets
- Bridges
- Quays
- Humans
- Animals
- Dam
- Water reservoirs

8. Which of the following terms would you connect to the term “landscape”?

	No connection with landscapes	Low connection with landscapes	Moderate connection with landscapes	High connection with landscapes
Culture				
Heritage				
Natural beauty				
Cities				
Villages				
Flora and fauna				
Water surfaces (sea, lakes, rivers etc.)				
Agriculture				
Industry				



9. How would you rate your knowledge on the issues below?

	I have no knowledge at all	I have some knowledge	I have sufficient knowledge	I know a great deal
The history of natural water systems (rivers, lakes, the sea, etc.) in my region.				
Degradation of natural landscapes (causes and what it consists of)				
Pollution of water surfaces (causes and what it consists of)				
Ecology of landscapes in your surrounding (animals, birds, plants, fish, etc)				
How has climate change affected the landscapes around you				
How has human intervention affected the landscapes around you				
The difference between natural and artificial landscapes				
History of irrigation systems and aqueducts				

10. Do you know the meaning of the following terms?

	Yes	No
Blue infrastructure		
Green infrastructure		
Landscape management		
Landscape protection		
Sustainable development		
Climate change		

11. Which of the school subjects would you relate to the issues below? (You can mark more than one per row!)

	Biology	Physics	Geography	Information Technology	Maths	Chemistry	Art	History	Literature	English (foreign language)
Attributes of landscapes										
Landscape protection										
Climate change										
Water elements (sea, rivers, lakes, etc.)										



12. Please mark, to what extent do the following statements express your opinion or knowledge or practice?

	Not at all	Not enough	Rather enough	Very much	I have no opinion
I know the meaning and applications of STEAM educational approach.					
I have already used and am engaged in STEAM educational approach.					
I have taken part in project-based teaching.					
I would like to take part in project-based teaching.					
I feel well-prepared to implement the STEAM educational approach.					
STEAM skills are increasingly necessary to engage in a knowledge-based economy.					
STEAM educational approach is useful					
The implementation of STEAM educational approach has many limitations in our school.					
Teachers should be better prepared for cooperation among them and project-based learning.					
I often work together with the teachers of other curriculum subjects on a common topic.					
I often do project-work with my students in the school curriculum.					
I am familiar with the Inquiry-Based Learning approach in education					
I have implemented the Inquiry-Based Learning approach in class					

13. What do you think are the limitations/obstacles of implementing an integrated STEAM education in your school?

	Strongly disagree	Disagree	Agree	Strongly agree	I have no opinion
There is no interest among teachers.					
There is no interest among students.					
There are knowledge gaps about the methodology among teachers.					
There is no time to implement such a methodology.					
It is impossible to integrate STEAM into the school curricula.					
There is no sufficient equipment to integrate STEAM into the school curricula.					



The national regulatory system is not prepared to include STEAM methodology.					
The organization of lectures makes it very hard to implement the STEAM methodology.					

### Part III: Skills

In this section we would like to measure the levels of skills related to the methodology proposed by the project.

14. Please rate, how often you have performed the following activities.

	I have never done that	I have done it once or twice	I do it regularly	I do it very often
Guiding my students to work in teams.				
Guiding my students to do fieldwork to gather information.				
Guiding my students to keep to deadlines.				
Guiding my students to communicate opinions and ideas verbally.				
Working in collaboration with other teachers from different disciplines in one common project course				
Using text processing spreadsheet and presentation software (Word, Excel, Power Point)				
Using geographic information and mapping software (e.g. QGIS, ArcGIS, etc.)				
Using map-based applications (e.g. Google Earth, GPS)				
Using smartphones or tablets.				
Playing location-based games (e.g. Pokemon Go, Geocaching, Zombies Run!)				
Developing location-based games (e.g. on platforms like Aris, Enigmapp, TaleBlazer)				



#### Part IV: Attitudes/interest

In this section we would like to identify your interests and attitudes in relation to the themes of the project.

15. How interested are you in teaching about the following?

	Not interested at all	A little bit interested	Moderately interested	Very interested
Climate change: causes and impacts on landscapes.				
The history of water surfaces in my town.				
Problems connected to landscapes in your town.				
What are the benefits of landscape planning /land-use planning				
What are the benefits of landscape management				

16. Please mark, how interested are you in the following topics?

	Not interested at all	A little bit interested	Moderately interested	Very interested
Working in a school project together with my students and experts.				
Taking my students out of the classroom and doing fieldwork.				
Establishing a closer connection between the science subjects (physics, biology, chemistry, math etc).				
Establishing a closer connection between the science subjects and Art in school.				
Working in collaboration with other teachers from different disciplines in one common project course				
Being able to instruct my students in using geographical information softwares.				
Being able to instruct my students in developing and playing location-based games.				
Supporting my students in communicating their findings to a wider audience.				



17. Please mark, to what extent do you agree with the following statements?

	Strongly disagree	Disagree	Agree	Strongly agree	I have no opinion
I would like to improve my knowledge regarding landscapes.					
I am interested in global environmental issues (like the climate change, water pollution etc.)					
People should care more about the protection of the environment.					
I would like to do more in order to protect the environment and our landscapes.					
Threats to the environment are not my business.					
I really enjoy playing on my smartphone/tablet.					
I like to work as a member of a team.					
New technologies make school science more interesting.					

18. Please mark, to what extent do you agree with the following statements?

	Strongly disagree	Disagree	Agree	Strongly agree	I have no opinion
People have intervened too much in the environment, and the main effect is that natural landscapes degrade.					
Landscapes have an important role in the field of culture, ecology and environment.					
Landscapes contribute to the formation of local culture and human well-being.					
The changes in the economy accelerate the transformation of landscapes.					
The protection of landscapes is our duty.					
Water habitats are much richer in species than forest habitats.					



19. How often have you done the following activities?

	Never	Sometimes	Often	Very often
Visited the water surfaces (the sea, lakes, rivers, streams etc.) in your city or region for recreation.				
Visited the water surfaces in your city or region for nature observation.				
Visited the water surfaces in your city or region for sport.				
Read a map to find your way.				
Used a compass for orientation.				
Used GPS or mobile applications for orientation.				
Read about nature and science in books or magazines.				
Visited a science centre or science museum.				
Visited a protected area of natural interest.				



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## WATERSTEAM – STUDENTS' QUESTIONNAIRE

This questionnaire has been formulated in the framework of the WaterSTEAM Erasmus+ project. WaterSTEAM proposes an innovative and integrated learning methodology for secondary school education, centering around an inclusive and collaborative STEAM approach in education<sup>1</sup>. Landscape<sup>2</sup> values and the role of water in shaping it is the core topic of the educational project.

We would kindly invite you to fill in the following questionnaire, where we would like to measure your level of knowledge, skills, interests and attitudes regarding issues related to landscapes, the role of water, global environmental issues and the methodology offered by the project. Please, remember that there are no right or wrong answers, and this is not a test!

Filling the questionnaire will take approximately 20 minutes.

An online version is available at <http://surveyor.rkk.hu/index.php?sid=35824&lang=en>  
To get the results of your online survey, you have to contact the Hungarian partner.

Thank you for your time!

### Part I: General questions

1. Please fill in your gender
  - Male
  - Female
2. Please fill in your age
3. Name of your school
4. Town (where your school is located)

### Part II: Knowledge

In this section we would like to measure the level of knowledge regarding issues related to landscapes, the role of water, and global environmental issues. Remember, this is not a test!

5. Where do you think you can find a landscape? In: (You can mark more than one.)
  - A forest
  - A city/urban environment
  - A village
  - Agricultural fields
  - Rivers and lakes
  - The sea
  - A coastline
  - A painting

---

<sup>1</sup> STEAM Education is an approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking.

<sup>2</sup> "Landscape" means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.

6. Which of the following do you think can be considered as part of a “landscape”? (You can mark more than one.)
- Water elements (sea, rivers, streams, lakes, etc.)
  - Forests/trees
  - Coastlines
  - Mountains, hills
  - Railways
  - Roads/streets
  - Bridges
  - Quays
  - Humans
  - Animals
  - Dam
  - Water reservoir

7. Which of the following terms would you connect to the term “landscape”?

	No connection with landscapes	Low connection with landscapes	Moderate connection with landscapes	High connection with landscapes
Culture				
Heritage				
Natural beauty				
Cities				
Villages				
Flora and fauna				
Water surfaces (sea, lakes, rivers etc.)				
Agriculture				
Industry				

8. Please mark, which of the following pictures do you think are representing landscapes? (You can mark more than one.)



1



2



3



4



5



6



7



8



9



10

9. Do you have any knowledge on the issues below?

	I have no knowledge at all	I have some knowledge	I have sufficient knowledge	I know a great deal
The history of natural water systems (rivers, lakes, the sea, etc.) in my region.				
Degradation of natural landscapes (causes and what it consists of)				
Pollution of water surfaces (causes and what it consists of)				
Ecology of landscapes in your surrounding (animals, birds, plants, fish, etc)				



How has climate change affected the landscapes around you				
How has human intervention affected the landscapes around you				
The difference between natural and artificial landscapes				
History of irrigation systems and aqueducts				

10. Do you know the meaning of the following terms? Remember, this is not a test.

	Yes	No
Blue infrastructure		
Green infrastructure		
Landscape management		
Landscape protection		
Sustainable development		
Climate change		

11. Which of the school subjects would you relate to the topics below? (You can mark more than one per row!)

	Biology	Physics	Geography	Information Technology	Maths	Chemistry	Art	History	Literature	English (foreign language)
Attributes of landscapes										
Landscape protection										
Climate change										
Water elements (sea, rivers, lakes, etc.)										

12. In which of the school subjects below have you already heard about the following topics? (You can mark more than one per row!)

	Biology	Physics	Geography	Information Technology	Maths	Chemistry	Art	History	Literature	English (foreign language)	None
Climate change											
Water surfaces and areas in general											
Rivers/waters in my region											
Environmental problems											
Landscape											



### Part III: Skills

In this section we would like to measure the levels of skills related to the methodology proposed by the project.

13. Please rate, how often you have performed the following activities!

	I have never done that	I have done it once or twice	I do it regularly	I do it very often
Working in a team with fellow students				
Doing fieldwork to gather information.				
Using Word for text processing.				
Using Excel.				
Using Power Point for presentations.				
Using geographic information and mapping software (e.g. QGIS, ArcGIS, etc.)				
Using art (drawing, painting, design, etc.) to communicate ideas and notions				
Using map-based applications (e.g. Google Earth, GPS)				
Using smartphones or tablets.				
Playing location-based games (e.g. Pokemon Go, Geocaching, Zombies Run!)				
Developing location-based games (e.g. on platforms like Aris, Enigmapp, TaleBlazer)				

### Part IV: Attitudes/interest

In this section we would like to identify your interests and attitudes in relation to the themes of the project.

14. How interested are you in learning about the following?

	Not interested at all	A little bit interested	Moderately interested	Very interested
Climate change: causes and impacts on landscapes.				
The history of water elements in my town.				
Problems connected to landscapes in your town.				
The benefits of landscape planning /land-use planning				
The benefits of landscape management				



15. Please mark, how interested are you in the following topics?

	Not interested at all	A little bit interested	Moderately interested	Very interested
Working in a school project together with other students.				
Going out of the classroom and doing fieldwork.				
Discovering connections between different science subjects (physics, biology, chemistry, etc).				
Selecting yourself the issue to focus on and study within a wider topic				
Being able to handle geographical information software.				
Being able to develop and play location-based games.				
Communicate your findings to a wider audience.				

16. Please mark, to what extent do you agree with the following statements?

	Strongly disagree	Disagree	Agree	Strongly agree	I have no opinion
I would like to improve my knowledge regarding landscapes.					
I am interested in global environmental issues (like the climate change, water pollution etc.)					
People should care about the protection of the environment more.					
I would like to do more in order to protect the environment and our landscapes.					
Threats to the environment are not my business.					
I really enjoy playing on my smartphone/tablet.					
I like to work as a member of a team.					
Science subjects (like physics, chemistry, biology) are very difficult for me.					
New technologies make school science more interesting.					



17. Please mark, to what extent do you agree with the following statements?

	Strongly disagree	Disagree	Agree	Strongly agree	I have no opinion
People have intervened too much in the environment, and the main effect is that natural landscapes degrade.					
Landscapes have an important role in the field of culture, ecology and environment.					
Landscapes contribute to the formation of local culture and human well-being.					
The changes in the economy accelerate the transformation of landscapes.					
The protection of landscapes is our duty.					
Water habitats are much richer in species than forest habitats.					

18. How often have you done the following activities?

	Never	Sometimes	Often	Very often
Visited the water elements (the sea, lakes, rivers, streams etc.) in your city or region for recreation.				
Visited the water surfaces in your city or region for nature observation.				
Visited the water surfaces in your city or region for sport.				
Read a map to find your way.				
Used a compass for orientation.				
Used GPS or mobile applications for orientation.				
Read about nature and science in books or magazines.				
Visited a science centre or science museum.				
Visited a protected area of natural interest.				



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## WATERSTEAM – STAKEHOLDERS' QUESTIONNAIRE

This questionnaire has been formulated in the framework of the WaterSTEAM Erasmus+ project. WaterSTEAM proposes an innovative and integrated learning methodology for secondary school education, centring around an inclusive and collaborative STEAM approach in education. Landscape values and the role of water in shaping it is the core topic of the educational project.

STEAM is an educational approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking.

A key objective of the proposed educational methodology is to invite stakeholder organisations active in a wide range of fields related to the project theme (i.e. formal and non-formal education, research, environmental awareness, landscape/water/environmental management and planning) to contribute in the learning process as outside experts.

With this questionnaire we invite you as members of stakeholder organisations (Universities, education authorities, science associations, organisations of the civil society active in environmental protection and management, water and landscape management authorities, spatial planning authorities) to share your views regarding the proposed educational approach and explore your interest in contributing as external experts.

Your participation in this research study is voluntary. The procedure involves filling a questionnaire that will take approximately 15 minutes. Your responses will be confidential and we do not collect identifying information (the survey will not contain information that will personally identify you). Data will be analyzed only in aggregate form.

Thank you for your time!

### Section 1: Profile

1. Please select your age-group:

- below 25
- 25-35
- 36-45
- 46-55
- 56-65
- above 65

2. Town (where you live):

3. Please mark the type of organisation you are involved in:

- NGO, civil organisation
- Local authority organisation
- Academic institution
- Science association
- Research centre
- Education authority
- Cultural association / organisation
- Other \_\_\_\_\_



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4. Please mark the main fields of interest of your organisation (you can mark more than one)

- Formal education
- Non-formal education
- Environmental protection/management/planning
- Landscape management/planning
- Water management
- Environmental research
- Environmental activism
- Science
- Art
- Other \_\_\_\_\_

5. Is your organisation a public or a private sector entity?

- Public
- Private for profit
- Private non profit

**Section 2: Basic inquiry on the project topics**

6. How would you rate your interest in the following topics?

	Not interested at all	A little interested	Moderately interested	Very interested
Climate change: causes and impacts on landscapes.				
The history of water elements in my town.				
Problems connected to landscapes in my town.				
The benefits of landscape planning /land-use planning				
The benefits of landscape management				
The role of water in shaping the landscape				
Education of youth (ages 12-18)				

7. Do your organisation’s activities include work related to secondary education (e.g. educational projects, study visits, training etc.)?

- Yes *(If Yes, the participant continues to Section 3)*
- No *(If No, the participant it taken to Section 4)*



**Section 3: Experience with secondary education**

7. In your work, how often are you involved with students of secondary education (12-18 years old)?

- Almost every day
- Very often (1-2 times per week)
- Sometimes (1-2 times per month)
- Rarely, occasionally (1-2 times per year)
- Never

8. In your work, how often are you involved with teachers of secondary education?

- Almost every day
- Very often (1-2 times per week)
- Sometimes (1-2 times per month)
- Rarely, occasionally (1-2 times per year)
- Never

9. In what ways has your organisation worked with teachers/students of secondary organisation? (You can select more than one)

- Teachers training
- Educational projects
- Study visits
- Educational visits at the schools (presentations, teaching etc.)
- Involving the students/teachers as volunteers
- Other \_\_\_\_\_

10. Have you ever participated (as an educator/facilitator) in a learning course in secondary education (i.e. with students aged 12-18), covering the below mentioned topics? (Please mark in the following table!)

	Environmental protection	Landscape protection	Water management / protection	Art
Project-based learning course				
Organisation of a student camp				
Exhibition				
Thematic week				
Clubs, study classes				
Educational contests				
Other				
No educational experience in the topic				

11. If Other, please describe:

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**Section 4: Interest and attitude**

12. Please mark, in your opinion, which of the following disciplines are related to the issue of landscape protection, management and planning?

	Not at all related	Poorly related	Related to some extent	Very strongly related	I don't know
Biology					
Geology					
Geography					
Physics					
Chemistry					
Information Technology					
Maths					
Art					
Literature					

13. Is there any other discipline you would relate to the issue of landscape protection, management and planning?

\_\_\_\_\_

14. How would you rate your knowledge about the STEM and STEAM learning paradigm?

	I have no knowledge at all	I have some knowledge	I have sufficient knowledge	I know a great deal
STEM				
STEAM				

15. Please mark, to what extent do you agree with the following statements?

	Strongly Disagree	Disagree	Agree	Strongly Agree	I don't know
Formal education should put more emphasis on the topic of landscape management issues.					
Expert stakeholders should collaborate with secondary education schools and contribute in the learning process.					
Landscape management and the study of contemporary environmental issues (e.g. climate change) should be left only to the experts and not the secondary education.					
Students in secondary education would not be interested in our work as an organisation					
The collaboration with a secondary school would benefit my organisation					

16. Would you be interested in contributing to a school project in the theme of landscape protection/management and the role of water, as an external expert?

1. Yes
2. No

Please write down your E-mail address: \_\_\_\_\_(optional)