D3.3 Recommendations for EDU-ARCTIC Program

(Public)

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“Edu-Arctic – Innovative educational program attracting young people to natural sciences and polar research”

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Leader Partner:	American Systems Sp. z o.o.
Main Author(s):	Krzysztof Man
Reviewed by:	Agata Goździk, Jan Borm, Piotr Stankiewicz, Maria Korda
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1. EXECUTIVE SUMMARY

The current report pertains to the Deliverable D3.3 Recommendations for EDU-ARTIC Program. The report contains results of actions taken in Task 3.3 Recommendations for EDU-ARCTIC Program, described in the Annex 1 PART A of the EC/REA GA, within WP3 Preparatory of EDU-ARCTIC Program. It also includes the results of three other tasks within this WP, which are as follows: Task 3.1 Desk research, Task 3.2 Requirement analysis, and Task 3.5 Methodological workshop.

The purpose of this report is to provide the Consortium with useful suggestions for the construction of EDU-ARCTIC tools and the content of the EDU-ARCTIC educational program, as well as for proper implementation of Task 3.4 EDU-ARCTIC Program development. Recommendations for the program are based on four main components: Materials presented in the Desk research (D3.1 *Report on desk research*), the results of the CAWI survey conducted in 42 schools in 4 countries: Poland, France, Norway and Faroe Islands (D3.2 *Report on requirement analysis*), the description of the program included in the Grant Agreement (DoA in the Annex 1 to the REA/EC GA), and remarks from relevant discussions, which took place during the Svalbard methodological workshop in September 2016, which was organized for consortium beneficiaries to discuss implementation guidelines and to find the best, methodologically correct and effective ways of communicating scientific results to youngsters. Moreover, the report contains information on the beneficiaries' experiences and

the lessons learned from other educational activities, e.g.: EDUSCIENCE or Scientix, which are considered useful for the realisation of the EDU-ARCTIC program.

The final part of the report contains a summary of recommendations dedicated to each of the five main components of the program, which have as follows: online lessons, Polarpedia, monitoring system, Arctic competitions and Educators Forum.

2. INTRODUCTION

The report *Recommendations for EDU-ARTIC Program* presents information collected from:

- Deliverable 3.1 - *Report on desk research*;
- Deliverable 3.2 - *Report on requirement analysis*;
- The description provided in Annex 1 of the EC/REA GA (DoA) for EDU-ARCTIC;
- Discussions during Methodological workshop held at Svalbard, from Sept. 16 to Sept. 19, 2016;
- Experience of the Consortium Beneficiaries from various educational initiatives.

3. RECOMMENDATIONS FROM THE REPORT ON DESK RESEARCH

The report is based on results gathered from recent reports of numerous European institutions focusing on STEM education – notably science – as well as some key skills, which are as follows: to learn and apply content, to integrate content, to interpret and communicate information, to engage in inquiry, to engage in logical reasoning, to collaborate as a team, ant to apply technology appropriately. These reports provide a comprehensive view of scientific publications on the subject, and in particular, documents relating to national policies and international research results. Also the CAWI Survey[1] has been issued among the consortium Beneficiaries. The main aim of the prepared questions was to better understand the barriers and current gaps. Also the surveyed Beneficiaries responded on general questions about STEM conditions in their countries. This Desk research is the first step for the preparation of recommendations for the EDU-ARCTIC program. It stresses the needs and approaches in STEM education at national and EU level. It also provides useful advice for the Beneficiaries, which is needed for the proper development of the EDU-ARCTIC program.

[1] CAWI survey – Computer Assisted Web Interview – a research technique: an interview in which participants fill in an on-line questionnaire or survey received via the Internet. More information on this technique could be found in D5.1 Evaluation Plan including KPIs, in section 2. Methods of evaluation

The need to improve the quality and adequacy of science education and STEM subjects among young people in Europe, has been recognized both at an EU and national level. Some of the countries still should seek improvements in that field. The situation transpiring at present and the current challenges Europe is facing , high unemployment among young people; this underlines the urgent need to address the importance of STEM at all levels: global, European and national level.

The most important recommendations taking into account the objectives of EDU-ARCTIC have as follows:

1. EDU-ARCTIC should actively contribute to the promotion of a positive image of science education and STEM based on facts;
2. EDU-ARCTIC should raise the general level of public awareness concerning the importance of science and science education as well as the uptake of STEM subjects;
3. EDU-ARCTIC should contribute to the improvement of science teaching and learning by using various interactive, innovative online tools;
4. EDU-ARCTIC should seek for a long-term collaboration with other STEM and educational projects of benefit to all (to widen dissemination and strengthen its impact on various groups: on students and teachers, on general public and on scientists and research institutions dealing with the Arctic);
5. EDU-ARCTIC should be developed mainly for educators, since they play key role regarding approaches to teaching in STEM;
6. EDU-ARCTIC should provide advice in schools as regards careers in STEM;
7. EDU-ARCTIC should promote STEM careers among both young girls and boys;
8. EDU-ARCTIC should contribute to the raising of awareness among young people demonstrating that obtaining better education leads to new scientific discoveries;
9. EDU-ARCTIC should promote the need for more frequent STEM programs both at an EU and national level;
10. EDU-ARCTIC should promote the need for innovative tools and effective methods of teaching science on a regular basis in schools.

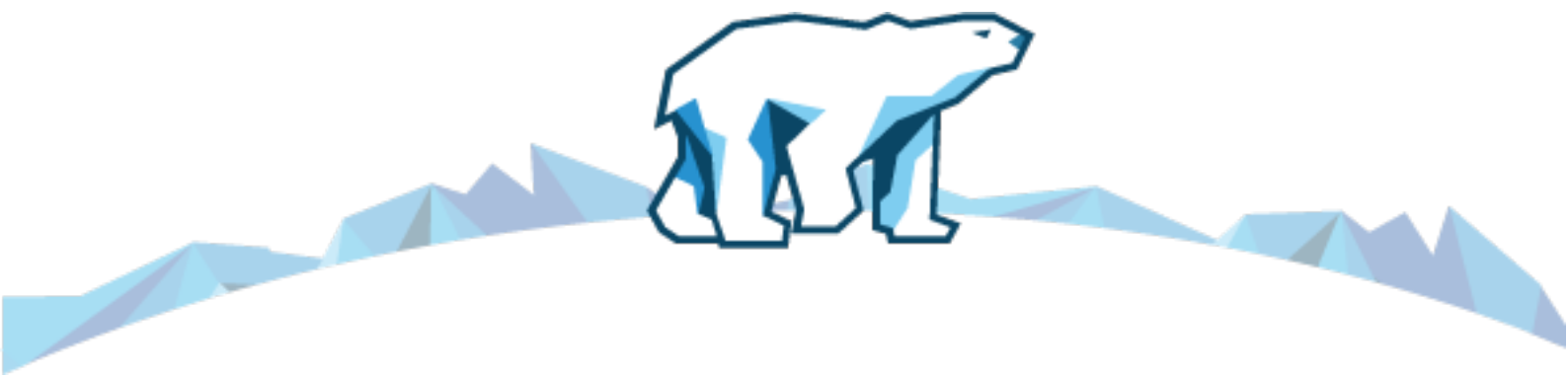
4. RECOMMENDATIONS FROM THE REPORT ON REQUIREMENT ANALYSIS

Deliverable D3.2 - *Report on requirement analysis* - presents the results of the CAWI Survey (Computer Assisted Web Interview) that was distributed among STEM teachers in 4 countries (Poland, France, Norway and Faroe Islands). Information was collected from 42 schools. This report focuses on the requirements of STEM teachers concerning the EDU-ARCTIC program and helps to achieve the objectives set out in WP3 Preparatory of EDU-ARCTIC Program. This report is the second step of preparing recommendations for the EDU-

ARCTIC program. It stresses the needs and possibilities to use the program by STEM teachers working in different educational environments.

Based on the results of the survey, the following recommendations for the program's development and implementation have been made:

1. A majority of replies come from higher secondary schools. It is anticipated that more lower secondary schools, esp. from Northern and Western Europe, will be attracted by the program. EDU-ARCTIC is dedicated to young girls and boys aged 13 to 20; the program should be custom-made for the targeted groups (lower and higher secondary schools). The process of recruitment of schools should be continuously monitored, in order to provide information, especially in case that additional activities promoting the program in lower secondary schools are needed. The list of schools will be available online for EDU-ARCTIC portal's administrators and a summary will be analyzed by the Coordinator in cooperation with UVSQ (as a beneficiary responsible for WP6) on a regular basis. It is suggested that analysis should be proceeded at least once a month during recruitment activities (i.e. from January to June and September-October 2017;
2. Given the fact that the teachers declared that quite a few online lessons are likely to be offered during voluntary extra classes, pupils' motivation needs to be stimulated by additional activities. It is suggested that short web based competitions for classes could be conducted (e.g. Kahoot quizzes, an application, which helps educators to create and play fun learning games and quizzes for any subject);
3. While preparing the project's activities and online lessons, one need to take into account the following: the English-language difficulties that a majority of schools consider as an important challenge. EDU-ARCTIC should facilitate access by using visual material to the extent possible;
4. Taking into account the lack of experience of the majority of schools as far as their participation in online lessons is concerned, special attention should be paid to this problem during the Educator Fora, and elsewhere. Having some testing webinars targeting exclusively teachers could be a good opportunity. EDU-ARCTIC should consider developing some testing and promotional webinars, during which teachers could freely test the new tool and all required settings, in order to be sure that they are technically prepared to take part in online lessons;
5. The varying degree of willingness among pupils to participate actively in discussions also needs to be taken into account. Methodological adviser of the EDU-ARCTIC program should provide beneficiaries with some recommendations and tips on how to increase active participation in discussions. It is also advisable to exploit useful



suggestions from the EDUSCIENCE[2] project, where online lessons were broadly conducted;

6. Given the relatively sound geographical knowledge of pupils suggested by the survey, attention should be paid on less well-known, but nonetheless important subjects; such as Biology, changes and human impact on the Arctic, global impact of Arctic changes. Interestingly enough, these latter subjects were mentioned mostly by responders form the Arctic countries only. Scientists delivering online lessons in the EDU-ARCTIC program should consider this while planning the thematic coverage of their online lessons;
7. As to methodology, quite a few replies stress the interest of active participation of pupils by way of individual observation or as a group. EDU-ARCTIC should encourage teachers to monitor pupils' interest and act when assistance is needed and required.

5. RECOMMENDATIONS FROM THE DESCRIPTION IN ANNEX 1

Below recommendations are provided as described in the Annex 1 of the EC/REA GA (DoA) for EDU-ARCTIC – where the concept, approach and main guidelines for the program are elaborated. Where additional recommendations have been developed, it is indicated in the text by italics.

1. Each country has its own core curriculum in STEM. To adapt the resources and the program to the needs of *a significant number of European countries*, all EDU-ARCTIC educational materials will be analyzed by national methodologists who will match each item with the adequate stage of education in the country. Each resource will be described with a set of metadata, i.e.: the school subject in the country, the age of the pupils to whom it is directed, English description of each material allowing to identify the relevant resource for each country that uses the tool. EDU-ARCTIC will be a unified model created in the languages most commonly used in Europe. The Program will be written in simple language and easy to translate into other languages. It will enable cheap and quick multiplication. All European countries will have open access to EDU-ARCTIC resources and educational materials. External stakeholders (not participating in the project) will be able to use EDU-ARCTIC material free of charge.

[2] EDUSCIENCE was the biggest innovative polish project in the field of STEM education, conducted by IGF PAS as a leader in 2011-2015. More information on the project may be found in the section 7 of this report and on its website: www.eduscience.pl

2. Three main groups of obstacles in effective introducing the program in European schools have been identified and recommendations for mitigating each one of them have been developed:

A) Technological barriers

- lack of appropriate multimedia equipment in some schools;
- possible lack of good internet connections in some cases;

Regarding the technological group of barriers, the Consortium is convinced that a minimal requirement of multimedia equipment (i.e. computer, multimedia projector, web-cameras, speakers and microphone) may be easily accessible in most European schools. Statistics reveal that computers and projectors are basic equipment in many European schools. Taking into consideration the cost of additional equipment, it may be assumed that this should not be a financial problem for schools. Regarding internet requirements they are presumed to be low: transfers of 1 Mbs will be sufficient. It appears that the majority of schools in Europe meet these criteria.

Based on the Desk research and CAWI survey 80% of Beneficiaries (IGF PAS (Poland), UVSQ (France), FINI (Faroe Islands), and AP (Iceland)) reported that schools are adequately equipped with ICT tools and more than 60% of schools in their countries have Internet access, computers, projector, speakers, webcam, etc.

B) Organizational barriers

- the obligation to implement the curriculum, which may result in reluctance of teachers to conduct classes outside the core curriculum;
- lack of a multi- and interdisciplinary approach in schools from some countries. In countries where science classes are divided into separate subjects (physics, chemistry, biology etc.), a problem of introducing polar research within a particular subject may occur;
- a small number of hours devoted to the realization of science subjects;
- focusing on the preparation to external exams;
- lack of information and knowledge about the program.

In terms of organizational barriers, they cannot be removed within the project, as it concerns teaching curricula at national levels. In order to fit the program best to teachers' needs and organizational possibilities, recommendations from teachers will be gathered and taken into account while constructing the program.

Additionally, results of the ongoing evaluation planned within the project ('During EDU-ARCTIC surveys') will help the Consortium to adjust the program continuously during its realisation.

C) The human-factor barriers

1) related to teachers:

- fear of using new teaching tools, including ICT tools;
- reluctance to change the existing, traditional formula of teaching and lack of openness to changing teaching approach;
- issue of intimidating image of the scientist; teachers' fear that they will have not sufficient knowledge or skills, that they will not understand the scientists' language and the fear of ridicule in front of the class;

2) related to pupils:

- fear of exposing themselves by, for example, stating a wrong hypothesis. Young people, especially in the age-range of 13-20, are very careful and quite introverted; they may not be willing to ask questions;
- the passivity of pupils in the learning process. Pupils are often passive participants in the learning process due to unattractive learning methods;
- the intimidating image of the scientist, which may cause pupils to be afraid of asking questions, or their fear that they will not understand a scientist;
- sense of being insignificant in scientific research.

3) related to teachers and pupils:

- lack of English-language skills; the seemingly hermetic scientific language may also cause misunderstandings *and even misinterpretations*.

EDU-ARCTIC educational program will pay special attention to human-driven barriers. To overcome some of the barriers and minimize the probability of their appearance, the following steps will be undertaken:

1. Constant technical support helping teachers to use the e-learning portal. *Organization of testing webinars only for teachers;*
2. Creation and constant enrichment of glossary and dictionaries concerning polar issues available for teachers and pupils – *in the form of Polarpedia;*
3. Educator workshops to encourage teachers to develop their skills and knowledge in the Arctic issues, enhancing their self-esteem;
4. Special methodological training for scientists providing on-line lessons to provide difficult, scientific information in more accessible and popular ways in order to stress how fascinating *and intriguing s*cience is;
5. Drawing the attention of scientists to the fact that they should provide lessons and activities in the way which encourages pupils to ask questions and to state hypotheses, overcoming their shyness. Scientists will be also trained during the methodical workshop to emphasize the importance of the possible future role of pupils in science;

6. Constant help of methodologists – teachers and practitioners who are familiar with polar research and Arctic issues are helping scientists with the selection of didactic methods and exercises to be used in class.

6. RECOMMENDATIONS FROM THE METHODOLOGICAL WORKSHOP AT SVALBARD

Discussions during the Svalbard methodological workshop (September 16-19, 2016) focused on various components of the EDU-ARCTIC program. The most important conclusions are provided below:

I. Regarding online lessons:

1. The EDU-ARCTIC program should encourage scientific careers and contribute to career advice in schools – it is recommended that each educator at the beginning of the online lesson will elaborate why and how he/she decided to follow STEM career. Personal perspective, information on his/her career path as well as some intriguing science story will be something unique, that the program may offer;
2. The EDU-ARCTIC program should encourage scientific career among young girls – it is recommended that beneficiaries make sure that among educators from their station female scientist will be represented properly. Each woman educator at the beginning of the online lesson will elaborate why and how she decided to follow STEM career;
3. It is recommended that before every online lesson educators should start with a small talk first. Such a small talk will allow participating pupils to get familiar with educator's English accent first and will enhance the further understanding of the lesson;
4. In the description of each lesson, information on required language skills should be provided.
5. Vocabulary useful for the lesson should be known in advance. Each educator should provide key scientific terminology in the description/invitation for the lesson;
6. It is recommended that online lessons should also start with something intriguing, mysterious, unexpected, as this will allow to involve pupils in learning just from the very beginning;

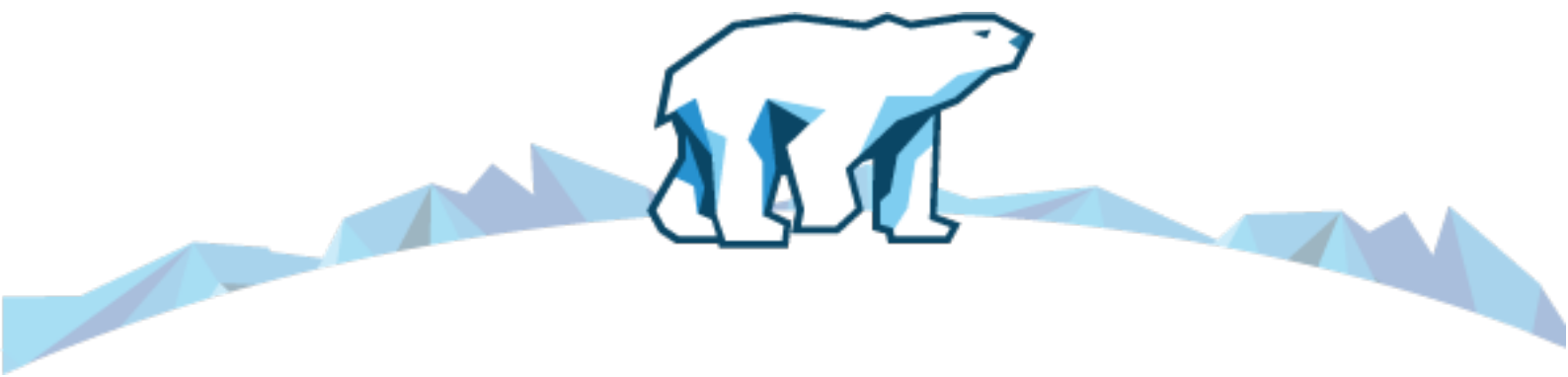
7. It is recommended to define possible risks before planning online lessons. Educators need to be aware that technical problems may occur (internet connection, firewall blocks, problems with video and audio);
8. It is recommended that before online lesson educators should define school level, and pupils' age.
9. During online lessons pupils' motivation needs to be identified and stimulated by additional activities. Exercises make pupils active; e.g. Kahoot quizzes or worksheets with exercises and tasks to be done by students (printed before lesson). Educator may display a worksheet with questions and tasks and a few minutes later display correct answers;
10. Whenever possible, guests – experts on particular topics – may be invited to deliver a lesson in order to make the topic coverage wider.
11. Educators should not provide too much information. They should engage in activities, inspire and surprise student, rather than concentrate on facts and information.

II. Regarding Arctic Competitions:

1. The rules of the competition should be elaborated till the end of October 2016 and may be announced during the process of schools' recruitment.
2. Students should present something innovative – an invention, a scientific idea. It could be prepared for different topics.
3. The final step of the competition should give opportunity to check whether the presented work was independent.
4. For winners of the Arctic Competitions – it is recommended that they should have basic knowledge about the Station, environment and research conducted at the station before the trip. Educational material on that should be prepared and distributed.
5. The plan of the trip should assume that student are active in observations and data collecting as well as spending sufficient time with scientists in laboratories or in the field, taking part in their tasks and freely asking questions;

III. Regarding Educators Forum

1. It should be consulted with local teacher training organisations, if Forum should be organized during weekends and weekdays. It will be decided by the local host for each Forum.



2. Scientix[3] workshops for teachers were mentioned, which take place from Friday evening till Sunday afternoon.

IV. Regarding Polarpedia:

1. It was suggested that one explanation should be covered in one paragraph (ca. 10-15 lines). Additional expressions may be added and linked up to the main expression.
2. It is recommended that Polarpedia has a define template, based on which the content will be displayed. The following sections have been suggested:

<table>
<tr><td colspan="5">Title</td><td rowspan="2">Gallery (maps/photos/videos)</td></tr>
<tr><td colspan="5">Languages</td></tr>
<tr><td>Tab 1</td><td>Tab 2</td><td>Tab 3</td><td>Tab 4</td><td>Tab 5</td><td rowspan="3">Links to peer-reviewed papers and additional information</td></tr>
<tr><td colspan="5" rowspan="2">Content</td></tr>
</table>

V. General remark:

The recruitment process is very important. Beneficiaries should take advantage of every opportunity to disseminate the program at a governmental level. If the program has support and recommendations from ministries of education, it will be more likely commonly used at schools.

[3] Scientix is a public funded project (within 7FP and subsequently Horizon 2020), which promotes and supports a Europe-wide collaboration among STEM teachers, education researchers, policymakers and other STEM education professionals. More information on the project may be found in the section 7 of this report or on the website: www.scientix.eu/about

7. MAIN LESSONS LEARNED FROM OTHER EDUCATIONAL INITIATIVES

The Consortium is well experienced in providing various educational activities. Beneficiaries were requested to share their experience from projects, which may be valuable for the preparation of the EDU-ARCTIC program. Information on 9 educational initiatives, from Europe should be taken as valid ideas for EDU-ARCTIC program and might be adopted and adjusted based on the project's needs.

Scientix 2 (from the perspective of the National Contact Point):

Project title	**Scientix 2 (from the perspective of the National Contact Point).**
Duration	2013 – 2016 for Scientix 2; January 2015 – March 2016 (for activities of the NCP).
Target population (e.g. primary school pupils, higher education, age of target population)	STEM teachers from all levels of education from Poland (for NCP) and the whole ofEurope (for Scientix as such).
Short project description	Scientix promotes and supports a Europe-wide collaboration among STEM teachers, education researchers, policymakers and other STEM education professionals. In its first stage (2009-2012), the project developed an online portal to collect and present European STEM education projects and their results; it also organised several teacher workshops. The main networking event was the Scientix conference, held in May 2011 in Brussels. The goal of the second phase (2013 – 2016) was to expand at national level. Through the network of the National Contact Points (NCPs), Scientix aimed to reach out to national teacher communities, and to contribute to the development of national strategies for a wider uptake of inquiry-based and other innovative approaches to science and maths education. Scientix 3 has just started its activities.
What makes the project interesting?	Scientix is open to teachers and project managers form the whole Europe. It is a unique platform (online and live) for sharing experience and good practices. It promotes widely STEM projects and products from Europe (under one condition: they must be public funded and available for teachers). Scientix events promote collaboration and stimulate creativity of teachers. Scientix is extremely **credible**, because it does not promote its own products or solutions, but supports equally various European initiatives.
Lessons learned and main recommendations	Workshops for teachers: - SCIENTIX organized 4 workshops for STEM teachers and one national conference (for ca. 150 participants); - plenary sessions should not be longer than 2-2,5 hours;

	- optimum time for one session of the workshop is ca. 90 minutes; - during workshops teachers should be as active as possible (we proposed computer classes, chemical experiments, using applications for Augmented Reality etc.); - polish teachers like to get certificates about attendance; - we had a good percentage of evaluation forms filled in (comparing to other countries); - teachers liked Scientix events very much, they could choose among various activities and projects during one event (which is unusual in polish conditions, where there are mainly one-project-based conferences or workshops). Webinars: - We conducted 10+ webinars for polish schools from the Arctowski Antarctic Station. - We used Cisco Webex tool – the same tool which is planned for the EDU-ARCTIC project. - During the webinar 2 persons are needed: one is a presenter, while the second one is a host and helps with technical issues. - When a big number of participants is present, it is difficult to have them muted and to discourage them from sharing their screens etc. - Webinars gained a lot of popularity. Pupils (esp. from primary schools) were very active. - Polar regions were extremely interesting for polish pupils. - We used various methods of activating pupils: questions and answers on chat, possibility to ask questions (with video from the class), Kahoot online quiz done by pupils or whole classes. - Groups liked to share their opinions and send regards via chat. - Pupils were really happy when they could actively communicate.
Project website	www.scientix.eu

Increasing school pupils' competence in the field of mathematics, natural and technical sciences with the application of innovative methods and technologies – EDUSCIENCE:

Project title	**Increasing school pupils' competence in the field of mathematics, natural and technical sciences with the application of innovative methods and technologies – EDUSCIENCE**
Duration	March 2011 – May 2015
Target population (e.g. primary school pupils, higher education, age of target population)	The final product was tested in 250 Polish schools (126 primary schools, 68 junior high schools, 35 high schools and 21 technicians). 1200 teachers used the program, as well as 5700 pupil recipients from participating schools. During the testing period, over 55000 hours of classes were organized. At present, over 3500 polish schools and 15500 STEM teachers are using the final products.
Short project description	The key objectives of the EDUSCIENCE project were as follows: - to increase interest in mathematics, natural, computer and technical sciences as well as foreign languages - thanks to fundamental changes in the existing ways of

	teaching, - to enhance students' skills of recognizing and specifying research problems and their ability to apply research methods within both mathematics and natural sciences - thanks to their deeper involvement in research methodology, - development of skills in the use of information and computer technologies during the process of learning thanks to the application of e-learning and blended learning methods, - to increase girls' interest in mathematics and natural sciences thanks to the application of gender-sensitive forms of promotion of the project, conduct of lessons and construction of teaching curricula. The main components are as follows: 1. the e-learning platform, 2. the popular science website (www.eduscience.pl), 3. methodological support for teachers and students, 4. program of didactic excursions to geophysical observatories and institutes of Polish Academy of Sciences, 5. program of environmental monitoring.
What makes the project interesting?	Users and recipients' reviews gathered during internal and external evaluation were mostly very positive. The level of implementation of the following indicators were examined: - the average increase of knowledge and skills counted for all branches of mathematics and natural sciences - assumed target value 20%; reached value 20%; - developing the ability to use skills acquired during the course in practice (application of research methods, analysis of the results, drawing logical conclusions, synthesis of data) - assumed target value: improvement in 70% of the pupils achieved value: improvement in 72% of the pupils; - improving the skills of analytical and synthetic thinking among pupils - assumed target value: improvement in 70% of the pupils achieved value: improvement in 76% of the pupils; - improving the ability to use specialized English language in the area covered by the project - assumed target value: improvement in 30% of the pupils, the value achieved: improvement in 62% of the pupils; - a change in the general attitude of pupils towards mathematics and natural sciences - expected target value was not indicated; 88% of teachers involved in the EDUSCIENCE project indicated that interest in mathematics and natural sciences among their pupils had increased, and in a number of cases even significantly increased.
Lessons learned and main recommendations	In EDUSCIENCE project online lessons were broadcasted for schools in Poland. The educators, scientists mainly from Polish Academy of Sciences, prepared lessons based on the methodological advisory. It gave an experience, how to teach online, involving pupils and helping them to understand science and train their skills. The lecture shouldn't be the main way of teaching. It's necessary to involve as many pupils' senses as possible. Preparing educational materials for students it's very important to use current data and science research results. All materials prepared by scientist from Polish Academy of Sciences were confirmed by scientific and methodological adviser. It's also important to publish the variety of materials (e.g. photos, videos, popular science articles, animations, slideshows, worksheets, puzzles, crosswords).

	Pupils and students from 250 schools in Poland could run the environmental monitoring. The main objective of running observations and measurements was to bring social utility professions (under the so-called service work) closer to school pupils and students. Students needed to be additionally motivated to run systematic observation. In EDUSCIENCE project schools competed to do they work most frequently. The best schools won prices. Pupils could also participate in many different competitions. They created their own videos, paintings etc. Students from high schools could compete their science skills. Two polar expeditions were organized for winners. It's very important to prepare students to polar expedition. They should have basic knowledge about the environment and research. They should prepare their own research plan. Should be active in observations and data collecting and should spend a lot of time assisting scientists, especially in field measurements and data collection. Workshops for teachers were also an important part of the project. The educators shared with teachers their knowledge and experience. Teachers were involved into workshops, they could find out new ways of teaching as well as could share their opinions.
Project website	http://www.eduscience.pl/ http://platforma.eduscience.pl/

SIMOJ (Stage d'Initiation aux Méthodes d'Observation pour Juniors):

Project title	**SIMOJ (Stage d'Initiation aux Méthodes d'Observation pour Juniors)**
Duration	3 days, 2 nights
Target population (e.g. primary school pupils, higher education, age of target population)	8-12 and sometimes 14-16, groups of 40 participants
Short project description	Children spend 3 days (2 nights) in the Haute-Provence Observatory (OHP) accompanied by several scientists, supervisors and stakeholders. They are staying on the OHP site, in the guest house 'Jean Perrin'. There are visits of the different observing systems such as atmospheric sounding instruments and telescopes for astronomy. The systems, some in operation, will be presented to small groups of children. They may therefore at leisure observe these instruments and ask questions to scientists and engineers about how they work and why they are used. They may also operate some of them. These visits are complemented by a series of presentations and workshops on the experimental devices and methods of measurements in astronomy and atmospheric physics. For example, presentations address topics and scientific results obtained at OHP with the 80 cm telescope and its operational observation missions. One of the key objectives is to make science exciting and ultimately inspire youth to pursue a career in science and technology.

What makes the project interesting?	Discovering atmospheric sciences and astronomy in real scientific conditions in order to maximize the impact of outreach activities.
Lessons learned and main recommendations	Make the activities and workshop even more focused on the instruments available in OHP; avoid general presentations.
Project website	N/A

ERIS - Exploitation of Research results In School Practice:

Project title	**ERIS - Exploitation of Research results In School Practice**
Duration	Erasmus+ project (AGREEMENT n° 2-[2015-1-PL01-KA201-016622], 28 months (31/12/2015-29/04/2016)
Target population (e.g. primary school pupils, higher education, age of target population)	Junior high school High school
Short project description	The aim of the project is to **increase interest of students in junior high and high schools in mathematics and science**, and in **making a scientific career more appealing** through the development, pilot implementation and dissemination of educational packages and methodological materials which allow the exploitation of research results in education systems in **3 European countries**. The project will be dedicated to teachers of mathematics and science, as well as their pupils from at least 30 schools: 5 junior high schools and 5 high schools in each partner country: **Poland**, **Romania** and **France**. ERIS project is divided into 2 parts: testing phase and dissemination phase. • In the **testing phase** teaching materials (**10 packages**) in national languages and in English to work with students in junior high and high schools will be prepared and tested in chosen schools in each partner country. In the **dissemination phase** all interested schools in partner countries, as well as in whole Europe, may use prepared packages during their lessons and take part in the **webcasts of online lessons** conducted by scientist in national languages and in English. Additionally ERIS Project will provide **guidebook for teachers** on the effective exploitation of research results in school practice with examples of good practice in this area and **conferences for teachers**, which will increase the level of usage of project's products among schools that have not participated in the testing phase. The project will contribute to the growth of students' ability to search for reliable sources of knowledge, and participation in online lessons and usage of educational resources in English will contribute to the increase of students' language skills and expand specialized vocabulary in STEM. It may be very useful for future students of STEM studies. In the long term, the project will also help to increase the understanding of the language of science and scientific messages.

Lessons learned and main recommendations	Educational packages prepared by scientist, based on their scientific experiences and exploration researches. Professional experts prepare educational materials, which will guarantee high quality and the latest relevant data. Packages are prepared under methodological supervision. Experienced teachers and methodological experts support scientists in preparing educational packages adjusted for the targeted age groups and their skills. Educational packages based on recent data (eg. meteorological, seismical etc.) published on open sources websites and scientific platforms. Online lessons and educational packages are focused on developing student's skills rather than giving theoretical information. Students develop their skills to analyze different types of current data to conduct their own scientific research in the future.
Project website	http://eris-project.eu

Savnsfagnaður (Museum Festival):

Project title	**Savnsfagnaður (Museum Festival)**
Duration	5 days in October for the past 15 years
Target population (e.g. primary school pupils, higher education, age of target population)	Primary school pupils, 6 - 14 years
Short project description	The annual museum festival offers free access to the exhibitions with many small educational activities for various age groups. The idea is to learn about science in a playful atmosphere.
What makes the project interesting?	Educational activities and games for children at the historical and natural historical exhibitions. The event attracts large crowds of children with adults and all the material developed for the festival is used throughout the year.
Lessons learned and main recommendations	Clear text and good graphics are essential in order to create appealing activities.
Project website	N/A

Skúlaskápið (Geological collection set for schools):

Project title	**Skúlaskápið (Geological collection set for schools).**
Duration	August 2013- August 2016.
Target population (e.g. primary school pupils, higher education, age of target population)	Target group: pupils aged 11-20 years.
Short project description	We have designed a small furniture on wheels holding 6 shelves with mineral collections. This is designed for geological lectures and includes suggestions for outdoor activities where children build up their own mineral collection.
What makes the project interesting?	We have searched for user-friendly practical furniture with an educational geological collection. We couldn't find one, so decided to design it ourselves. Other groups could also possibly use this idea and design. Children were fond of working with the material.
Lessons learned and main recommendations	It is rewarding, vital and not easy to present scientific information in an appropriate way for the age group 11 – 20 years.
Project website	N/A

PNC - Phenology of the North Calotte:

Project title	**PNC - Phenology of the North Calotte.**
Duration	2001 – ongoing.
Target population (e.g. primary school pupils, higher education, age of target population)	Elementary school, school pupils from 7 - 9 (10) grade, (about 13 to 16 years) and their teachers.
Short project description	This project includes schools in North Norway, Northwest Russia and North Finland. 1. Phenology registration in trails in the vicinity of each school. 2. Annual gatherings for teachers, with competence raising in various thematic - this year the theme is marine climate and marine pollution with emphasis on plastic. 3. Annual gatherings for some pupils, with teachers, for competence raising, project work in mixed nations groups, with collaboration over national and cultural borders.
What makes the	Pupils own phenological observations that is recorded and available at an open web site

project interesting?	Cross-multi-disciplinary: Combination of different themes: biology, chemistry, physics, new technique, accumulation of own data, mathematics, statistics, possibilities for own conclusions. This is then carried out in accordance to masterplans of the school systems in the countries. The engagement of the pupils.
Lessons learned and main recommendations	During the last four years the lowering of economy in the Norwegian schools have made it impossible to participate without substantial payment to the teachers. So funding is crucial. The quality of the observations is dependent on the teachers that learn the pupils the phenological phenophases. The stability of the teacher is very important, changes of teacher/position often destroy the continuity – long time observation – which is crucial in climate and phenology.
Project website	www.sustain.no

The schools DNA researchers lab:

Project title	**The schools DNA researchers lab.**
Duration	2014 – ongoing.
Target population (e.g. primary school pupils, higher education, age of target population)	Learning pupils of 4 - 10 grade in Norway schools about genetic.
Short project description	The pupils learn to work in a scientific laboratory and use instruments to analyse DNA samples for genetic studies.
What makes the project interesting?	This is practical work, so the pupils learn to work on visible objects with practical methods. The work and theory are adjusted to the different grades.
Lessons learned and main recommendations	This offer is heavily subsidized and demand is only 300€ for one day including travel for classes up to 30 pupils and their teachers. However, even this costs is too expensive for the schools. They demand payment for the teacher because this make extra work- working whole day. The lesson learned, is that the Norwegian school system is so emptied for economy and exhausted that any activity for the schools must be providing extra funding directly to the schools. Second, all offers need to be presented more than one year before the school can respond.
Project website	N/A

Other examples of projects and activities:

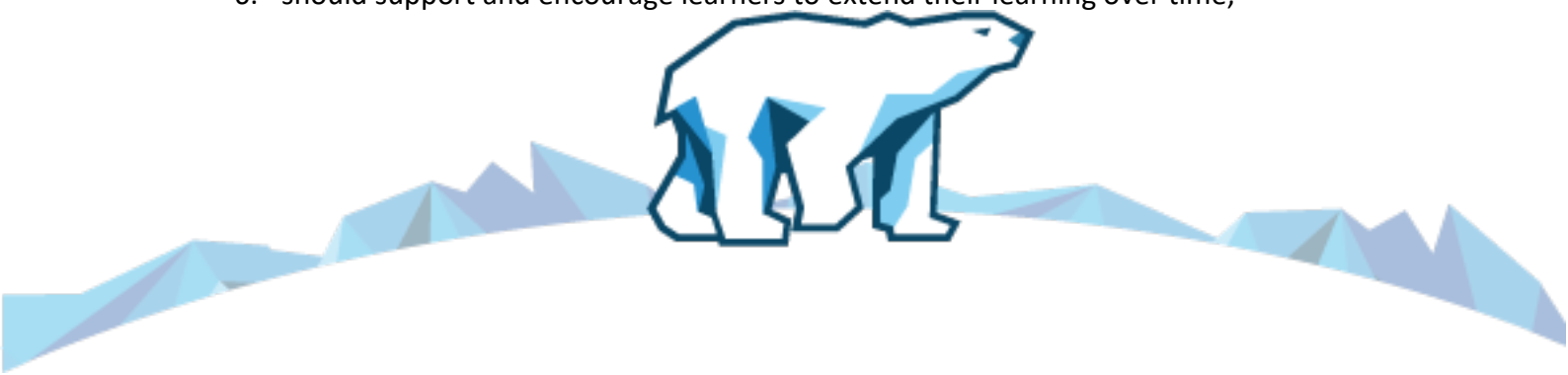
Nr	Project title and short description
1.	**Arctic Science Video Contest** - Students from Alaska and beyond can win cash prizes and share their love for the Arctic with international Arctic leaders through the One Arctic Student Art and Video

	contest. The contest is open to students aged 5 through 18. The contest theme is "many lands, one Arctic." Original art and short video submissions should express how the lands and people of the Arctic are connected and describe one or more specific aspects of the Arctic, such as animals, people, food, health, oceans or culture. The winning artwork was on display throughout the 2016 Arctic Science Summit Week, which attracted nearly 1,000 leaders in Arctic science and policy to the University of Alaska Fairbanks from March 12-18, 2016. The winning videos were screened during several conferences and public outreach events during the week. For more visit: http://assw2016.org/
2.	**International Long-Term Ecological (LTER) Network Schoolyard Book Series** - provides the scientific expertise, research platforms, and long-term datasets necessary to document and analyze environmental change. The Network brings together a multi-disciplinary group of more than 2000 scientists and graduate students. The twenty-six LTER sites encompass diverse ecosystems in the continental United States, Alaska, Antarctica and islands in the Caribbean and the Pacific—including deserts, estuaries, lakes, oceans, coral reefs, prairies, forests, alpine and Arctic tundra, urban areas, and production agriculture. The mission of the Schoolyard Series is to engage children and their families in learning about the earth's ecosystems, both locally and internationally, through narratives that reflect the dynamic research. Also by emphasizing: - Connection to the local community - Interdisciplinary ecological concepts - The importance of long-term perspectives - A connection to scientists and the scientific questions that are being studied at each LTER site. For more visit: http://www.lterschoolyardseries.com/
3.	The University of the Arctic (UArctic) - is a cooperative network of universities, colleges, research institutes and other organizations concerned with education and research in and about the North. UArctic builds and strengthens collective resources and collaborative infrastructure that enables member institutions to better serve their constituents and their regions. Through cooperation in education, research and outreach they enhance human capacity in the North, promote viable communities and sustainable economies, and forge global partnerships. For more visit: http://members.uarctic.org/

Main recommendations for each module of the EDU-ARCTIC program:

General for the portal:

1. should be designed with specific learning goals in mind;
2. should provide clear text and good graphics; this is essential, in order to create appealing activities;
3. should be interactive;
4. should provide multiple ways for learners to engage with concepts, practices and phenomena;
5. should facilitate science learning across multiple choices;
6. should support and encourage learners to extend their learning over time;



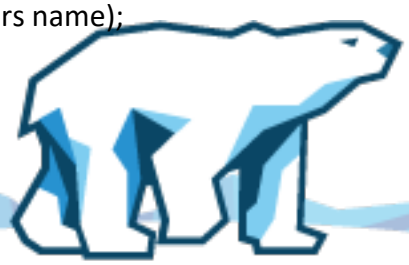
7. educational materials should be developed through iterative process and ready for adjustment and change;
8. Consortium beneficiaries should seek opportunities for constant project promotion;
9. Consortium beneficiaries should integrate bodies of research on learning science and usage of EDU-ARCTIC portal.

A. Online lessons

1. should be technically well prepared and a ready–to-use webinar tool;
2. 2 persons needed during the webinar session: one is a presenter, while the second one acts as host and helps with technical issues;
3. use of various methods of activating pupils: questions and answers on chat, possibility to ask questions (with video from the class), Kahoot online quiz done by pupils or whole classes;
4. should allow to share opinions and send regards via chat;
5. should include an action plan for various of scenarios during the webinar: when a big number of participants is present, it is difficult to have them muted and to discourage them from sharing their screens etc.
6. prepare testing webinars as a guidance on how online lessons can be used;
7. prepare webinars as a promotion of EDU-ARCTIC;
8. prepare webinars about: STEM conditions and their importance for the future – mainly for educators as they play a key role;
9. prepare webinars about: how to encourage pupils for active participation, gather opinions, motivate discussion, abandon the lecture formula and introduce new teaching methods: charts, movies, illustrations and more – for teachers;
10. should allow to repeat the same webinar with the same or different host – we assume some webinars will be very attractive and interesting (the Arctic);
11. should allow to record webinars for further utilization – we will record the most important part of the webinar;
12. should be focused on developing pupils' skills not only giving theoretical information;
13. technical and essential support is needed for questions and issues.

B. Polarpedia

1. should be easy to use
2. should be well prepared with an extensive list of expressions;
3. should be the first option to visit while looking for polar expressions;
4. should be well promoted;
5. should be full of photos, videos and variety of different materials (remember of giving the source and authors name);



6. should be correctly translated into agreed languages – one paragraph must be translated (10-15 lines);
7. technical and essential support is needed for questions and issues.

C. Monitoring system

1. should be easy to use;
2. should have a clear definition on its purpose and what data is to be collected;
3. should be promoted as a new method of learning;
4. should allow some contest among participating classes with rewards/prize;
5. technical and essential support is needed for questions and issues

D. Arctic competitions

1. the rules of participation should be well-planned and clearly set out;
2. attention must be put on the independence of the work by participants;
3. method of examination should be prepared (online conference – online transmission);
4. the program should be well promoted among teachers and pupils;
5. certificates should be also prepared – for teacher and student.

E. Teacher Workshops And Training Sessions

1. plenary sessions should not be longer than 1-1,5 hours;
2. optimum time for one session of the workshop is ca. 90 minutes;
3. preparation of certificates for participants (educators);
4. abandon the lecture formula and introduce new workshop methods: charts, movies, illustrations and more;
5. prepare sessions on active participations during workshops, on tips on how to encourage pupils to talk freely and openly;
6. promotion of all workshops and events should be well planned.

8. FINAL REMARKS

The Consortium will make every effort to create the educational program useful for schools and adjusted to the teachers' needs. Therefore, the project beneficiaries support the program's components to be continuously changed, in order to be well-tailored to expectations of European schools. Any adjustments of the program will be based on the evaluation of the outcomes.