**Integrating Activities for Advanced Communities**


# D2.5- Recommendations to authors of educational resources

Project No.730938– INTERACT

**H2020-INFRAIA-2016-2017/H2020-INFRAIA-2016-1**

Duration: 48 months

Start date of project: 2016/10/01

Due date of deliverable: 2019/09/30 (M36) Actual date of deliverable: 2020/03/31 (M42)

Lead partner for deliverable: IGF PAS

Author: Anna Wielgopolan

| **Dissemination Level** | | |
|---|---|---|
| **PU** | Public | X |
| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the Consortium (including the Commission Services) | |
| **CO** | Confidential, only for members of the Consortium (including the Commission Services) | |

# Table of contents

**Publishable Executive Summary** ..... **3**
**1. Introduction** ..... **4**
**2. Materials prepared in the framework of INTERACT project** ..... **4**
***- Wicked Weather Watch worksheets*** ..... **4**
**3. CAWI surveys – summary** ..... **5**
**4. Supported skills** ..... **7**
**5. Educational materials** ..... **9**
5.1. Different age groups ..... 9
5.2. Diversification of educational tools ..... 11
5.2.1. Online tools ..... 11
5.2.2. Involving students ..... 12
5.2.3. Visual content ..... 13
5.3. Special recommendations on polar topics ..... 13
**6. Conclusions** ..... **14**

## Publishable Executive Summary

This report appertains to recommendations for authors of educational materials for teachers and students on various educational levels, in particular materials dedicated to polar areas, issues and research.

It is based on selected educational materials prepared in the framework of the INTERACT project, namely two educational tool-kits for secondary schools and three worksheets for primary schools (Wicked Weather Watch). It also takes into account teachers' feedback on the abovementioned materials.

Authors of educational materials must consider a number of factors in order to offer an effective and relevant activity. This report addresses, among others, skills that should be supported, taking into account modern educational trends, adaptability of materials based on cognitive abilities and learning patterns of different age groups, different tools and approaches. In every case, concrete examples from INTERACT educational resources, are offered.

## 1. Introduction

This report appertains to recommendations for authors of educational materials for teachers and students on various educational levels, in particular materials dedicated to polar areas, issues and research.

This report is based on end-users feedback gained via:

1) CAWI reports; Deliverable D2.2: 1st CAWI survey report gathering teachers expectations towards educational materials dedicated to polar issues, Deliverable D2.3: 2nd CAWI survey report providing detailed end users' feedback on first educational tool-kit, elaborated and disseminated in framework of INTERACT project (PERMAFROST); Deliverable D2.4 3rd CAWI survey report focused on possible introduction of polar topics into curricula in various countries;
2) Discussions with teachers during workshop and webinars organized to promote educational tool-kits
3) Experience and good practice gathered during parallel and previous activities involving educational materials, including cooperation with various scientists and reviews by external bodies, e.g. European Commission.

In addition, this report is based on educational materials prepared for outreach purposes within WP2 of the INTERACT project.

The aim of this document is to provide solid methodological background, share good practices, and tips that could be applied not only in context of polar-related materials, but also to create a universal framework allowing to produce educational tools in any topic.

## 2. Materials prepared in the framework of INTERACT project

*- Wicked Weather Watch worksheets*

This is material that is dedicated to primary schools. They are short, 2-page materials, with short explanations of phenomena, illustrated experiment scenarios with global context (Why does this matter?).

- *Educational tool-kits*

INTERACT educational tool-kits are dedicated to secondary school teachers and students 13-19 years old. Some elements can also be used with younger children. Each educational tool-kit contains:

- SYLLABUS – table of content with basic information and resources, links to crucial definitions, mind map
- MATERIAL FOR TEACHERS – comprehensive and reliable resource – "topic in a nutshell", illustrations, Basic facts, Advanced material, Research methods, 5 fun facts
- LESSON PLAN – detailed, yet easily adaptable description of suggested activities (minute-by-minute) with homework, preparation, goals, evaluation
- WORKSHEET – hands-on activities for students, based on actual research results + version for teachers – with answers and explanation; online activities (Educaplay, Kahoot)
- EXPERIMENT SCENARIO – easy "Doing Yourself In" (DYI), engaging activities without special equipment
- PRESENTATION – PowerPoint, ready to be used by teacher as introduction
- WEBINAR – recording of 15 min lecture by an expert-scientist
- ANIMATIONS – narrated, illustrative explanations of phenomena.

By March 2020 3 materials of Wicked Weather Watch (Ocean Currents, Rising sea levels, Peat and bog secrets) and 2 educational tool-kits (Permafrost and Glaciers) were published on INTERACT's website (https://eu-interact.org/arctic-awareness/).

## 3. CAWI surveys – summary

In the framework of INTERACT project, 3 Computer Assisted Web Surveys (CAWI) were conducted, each designed for a different purpose related to educational materials dedicated to polar topics.

The first one was aimed at obtaining teachers requirements regarding educational materials, the second one provided feedback on prepared educational toolkit and the last one allowed to identify entry points in various European curricula.

The most important findings particularly useful from the point of view of production of educational content, with adequate conclusions, are summarized below (with findings that are particularly useful as recommendations for authors of educational resources):

*CAWI No 1 – main findings*

- limited time to introduce polar issues in the classroom (*tip for authors of resources: adjustable lesson plans allowing to use parts of proposed activities; short online activities, clear and well structured materials allowing to find useful information fast, ready hands-on activities*)
- Among the suggested topics, the most interesting one for teachers was "Climate change – causes and consequences" (*tip for authors of resources: addressing current topics, putting a global context around discussed phenomena*)
- Many teachers and educators are willing to use English, even if it's not their mother tongue (*tip for authors of resources: vocabulary of crucial terms and visual content should be included*);
- The most desirable types of new educational materials were "Multimedia presentations – PowerPoint", "Movies", and "Graphics and schemes".

*CAWI No 2 – main findings*

- The highest valued materials were-materials for teachers (topic in a nutshell with basic/advance information, research methods and 5 fun facts), and worksheet (hands-on activities for students); (*tip for authors of resources: comprehensive background materials with reliable external resources should be provided*)
- Polar issues are perceived as complicated, not well known, and the use of scientific data/results/language poses some difficulties to teachers/educators/students (*tip for authors of resources: working with actual data and research results should be introduced, as well as scientific language, but explanations should be provided in order to make teachers feel comfortable with the materials and encourage students to pursue the topic; in case of worksheets/tasks/activities, solutions with detailed explanation should be provided as additional material for teachers; to facilitate use of material, short stories, infocards should be included, e.g. fun facts etc., in order to attract students' attention and encourage them to explore the subject*)
- Not only climate change, but also more social sciences-oriented topics were suggested (*tip for authors of resources: in STEM topics it is important not to overlook social context, e.g. social impacts, indigenous people, their culture, historical aspects, biographical notes etc.*)

*CAWI No 3 – main findings*

- Introducing polar topics into school practice will strengthen trans-disciplinary collaboration to encourage the uptake of integrative teaching

- Polar topics can be in some cases included at a very early stage of education (pre-school), but mostly it fits primary/secondary school curricula
- Climate change, its natural and anthropogenic causes are a reoccurring topic in many aspects
- There are various entry points into curricula for polar studies, not limited only to STEM (history classes, social studies etc.)

For detailed information see deliverables: D2.2, D2.3 and D2.4 available at INTERACT's web site https://eu-interact.org/deliverables/

## 4. Supported skills

Educational materials prepared within the INTERACT project, educational tool-kits for secondary schools in particular, were designed not only to spread knowledge about polar landscape, research and phenomena, but were also aimed at shaping crucial competences, strengthening their ability to learn and cope in modern world, while being equipped with STEM knowledge and basic researcher's craft. It is a recommended practice to address directly skills that are trained with the use of materials produced.

One of the most widely accepted classifications (also used in educational resources prepared within the INTERACT project) is "21st century skills" set that comprise skills, abilities, and learning dispositions that have been identified as being required for success in the 21st century society and workplaces during the Information Age by educators, business leaders, academics, and governmental agencies. Many of these skills are also associated with deeper learning, which is based on mastering skills such as analytic reasoning, complex problem solving, and teamwork. They differ from traditional academic skills in that they are not primarily content knowledge-based.

21st Century skills are (with examples of fostering those skills, based on INTERACT educational tool kits):

1. **Critical thinking** –which involves logically assessing information to make informed decisions (*example of a task in the educational tool-kit GLACIERS: calculate the how much the global ocean level would rise if all the ice melted based on given set of data and then analyse if this simplified calculation is indeed correct; the aim is to identify the misleading simplification*).

2. **Creativity** -that empowers students to see concepts in a different light, leading to innovative thinking and problem solving (*example of a task in the educational tool-kit PERMAFROST: designing buildings in areas where permafrost is present, taking into account active layer (the layer on top of the permafrost that thaws and refreezes on an annual bases*)

3. **Collaboration** that involves multiple persons working together to achieve a common goal (*example of a task in an educational tool-kit – lesson plan: group work, analysis of materials and public presentation of results*)

4. **Communication**, which is the practice of conveying ideas by using a variety of methods (*example of a task in an educational tool-kit – lesson plan: group work, analysis of materials and public presentation of results*)

5. **Information literacy**, which gives your students the tools needed to distinguish fact from fiction (*example of a task in an educational tool-kit: quizzes, matching sentences*)

6**. Media literacy**, which helps students to analyse media and understand potential issues that can arise when using digital tools (*example of a task in an educational tool-kit: using external materials, including videos*)

7. **Technology literacy**, involving students supported in understanding different applications and the best ways to use them (*example of a task in an educational tool-kits: searching data obtained by INTERACT network stations, including permafrost active layer thickness and ground temperatures, mass balance of glaciers etc*.).

8. **Flexibility** understood as someone's ability to adapt to change and understand differences in views that impact decisions.

9. **Leadership**, involving ability to influence and guide others towards a common goal.

10**. Initiative**, related to creating plans, and executing strategies on their own (*example of a task in an educational tool-kit: experiments; creating mind maps*)

11. **Productivity**, measuring how well someone is able to prioritize, plan, and manage their work (example of a task in the educational tool-kit: experiments, public presentation of analysed materials)

12. **Social skills**, referring to the abilities to interact effectively with others, especially when working with a diverse group of people *(example of a task in an educational tool-kit: group work, public presentation of results, experiments).*

## 5. Educational materials

Authors of educational materials must consider a number of factors in order to offer an effective and relevant activity. First, they must think about the chosen material in relation to the target skill of the lesson and the ages of the learners. Also, materials should be adaptable to other variables such as the class environment and size, the language level of learners.

### *5.1.Different age groups*

Adaptation to different age groups must take into account level of development, attitude towards learning, capabilities and psychological conditions (selected characteristics are and summarized divided by age groups below), with examples from INTERACT materials how particular issues are addressed (based on: *Handbook of Child Psychology and Developmental Science, Cognitive Processes, Wiley J., 2015*)

1. **Preschoolers (3-6 Years)**

CHARACTERISTICS:

- Egocentric
- Animistic thinking (objects possess life or human characteristics)
- Motivated by curiosity
- Active imagination

SOLUTIONS:

- Allow manipulation of objects
- Use simple drawings and stories
- Stimulate senses: visual, auditory, tactile, motor

*EXAMPLES FROM INTERACT EDUCATIONAL MATERIALS:*

*Wicked Weather Watch, Changing climate and weather: Revealing the secrets of ponds and peat bogs: Using play dough in different colours, different artefacts; demonstrative approach*

*https://eu-interact.org/app/uploads/2017/10/Demonstrating-Arctic-Climate-Change_Pond-and-peat-bog-secrets.pdf*

2. **School-Aged Childhood (7-11 Years)**

CHARACTERISTICS

- Understands cause and effect

- Deductive/inductive reasoning
- Wants concrete information

SOLUTIONS:

- Encourage independence and active participation
- Allow time to ask questions
- Use analogies to make invisible processes real
- Provide group activities
- Use drawings, models, dolls, painting, audio-and video-tapes

*EXAMPLES FROM INTERACT EDUCATIONAL MATERIALS:*

*Wicked Weather Watch, Arctic Climate Change: Ocean currents and the role of the Arctic: demonstration on ocean water movements*

*https://eu-interact.org/app/uploads/2017/10/Demonstrating-Arctic-Climate-Change_Ocean-Currents.pdf*

**3. Adolescence (12-19 Years)**

CHARACTERISTICS

- Abstract, hypothetical thinking
- Can build on past learning
- Reasons by logic and understands scientific principles
- Peer group important
- Intense personal preoccupation

SOLUTIONS:

- Address fears/concerns about outcomes of global changes
- Use peers for support and influence
- Focus on details
- Make information meaningful to life
- Use audiovisuals, role play, reading materials
- Apply new knowledge through role play and hands-on practice
- Draw on meaningful experiences
- Encourage active participation

*EXAMPLES FROM INTERACT EDUCATIONAL MATERIALS:*

*Educational tool-kit "PERMAFROST"- lesson plan: 10 students prepare short (3') oral presentations regarding 5 topics (FUN FACTS about permafrost) – 2 students per topic; worksheet- Exploring permafrost temperatures in different parts of the Arctic (working with actual, up to date data); Materials for teachers, FUN FACTS: From frozen ground to space exploration - Studying environments that are similar to Mars helps to prepare biologists to identify traces of life in outer space (direct application of polar studies); analysis of the consequences of thawing permafrost (with climate change background). Using webinars and animations as audiovisuals, using background source materials for reading.*

*https://eu-interact.org/arctic-awareness/*

### *5.2.Diversification of educational tools*

Materials, such as easily adaptable tool-kits equip teachers with ready-to-go resources. The key feature such materials should have is adaptability to teachers' and students' different needs, depending on curricula, topic, time, target group, teacher's experience etc. The more diversified tools and solutions are used, the more probable it is that they will reflect teachers' and students' needs to maximum extent and will be used on daily basis. The combination of online and offline activities, based on different models allows keep high level of interest and incite passion for science among students with different learning schemes. Some of the tools and methods used in INTERACT materials, educational tool-kits in particular, are discussed below.

#### 5.2.1.Online tools

Virtual tools have been enriching teachers' toolboxes for several years and become particularly useful on multiple occasions, fostering working with students with special individual needs, remote teaching etc. *For INTERACT educational materials, following tools/resources were used:*

- POLARPEDIA.EU - multilingual interdisciplinary illustrated glossary of polar-related terms, explaining polar phenomena and presenting polar research. Polarpedia is an output of HORIZON2020 funded EDU-ARCTIC project, one of the initiatives that INTERACT project developed strong links with. Each educational tool-kit prepared within INTERACT project has a syllabus,

equipped with a set of links to crucial terms explained in POLARPEDIA. Polarpedia offers 17 language versions, facilitating understanding of studied phenomena.

- Kahoot.it is a platform that allows to create, share and play educational quizzes. For each lesson plan proposed as a part of INTERACT educational tool-kits, one online quiz using Kahoot was prepared. Kahoots are best played in a group setting. To join a game, each user needs a unique PIN, and a game host needs a big screen. Players answer on their own devices, while questions are displayed on a shared screen. In addition to live games, kahoot challenges can also be sent, that players complete at their own pace – for example, for homework or remote training.
- Educaplay.com is a platform to allow to create and share multimedia teaching activities, such as interactive maps and pictures, cloze activities, dialogue analysis and many learning games such as quizzes, matching games, riddles, crosswords etc.
    - All of these platforms are free of charge for users, easy learn and self –explanatory. It is important that those activities not only complement educational materials, but also offer some entertainment, a relief for students, making sure that the toolkits are not overloaded with knowledge.

### 5.2.2. Involving students

**Flipped classroom** is a type of blended learning where students are introduced to content at home and practice working through it at school. This is the reverse of the more common practice of introducing new content at school, then assigning homework and projects to be completed by the students independently at home (*example of task in educational tool-kits: students build a mind map based on source materials*).

**Group work** is a method that helps reinforce collaboration and teamwork, effective method to motivate students, encourage active learning, and develop key critical-thinking, communication, and decision-making skills (*example of a task in an INTERACT educational tool-kit: students work in groups to perform an experiment, e.g. on permafrost thawing*).

**Presentation and public speech** should be fostered, in order to prepare students to give oral presentations in front of an audience, develop debating skills etc. (*example of a task in INTERACT educational tool-kit: students work in groups and prepare a presentation of a given part of a topic, based on written and online materials*).

**Experiments** as hands-on activities, crucial for cognitive activation promote the development of scientific thinking in students, who are viewed as active learners and not just passive recipients of knowledge. With

deduction, new concepts are introduced naturally (*experiment scenarios are a part of each INTERACT educational tool-kit*).

### 5.2.3.Visual content

The human brain can process visuals faster than text, therefore, in order to make the content resonate to the audience, it needs to engage photos, infographics and videos. Narrated animations are a crucial element of INTERACT educational materials, offering visualisation of processes, explanation of land forms and presenting field work. Another element is the recording of webinar, accompanying each educational tool-kit. The webinar is a short lecture by an expert in the relevant field introducing the topic, illustrated with unique materials. Additionally, these video materials play one more role, giving an insight to scientific community, and bringing researchers closer to the classroom, also as role models.

## *5.3. Special recommendations on polar topics*

In the course of work on materials prepared for the INTERACT project, some exceptional findings were gathered, in terms of preparation of materials dedicated to polar issues:

- Working with real-life data, instead of imaginary examples designed for educational purposes only bring research into the classroom and allows to build trust in scientific methods.
- Data mining, proposed as an activity (searching for measurements results for mass balance of glaciers, ground temperature of permafrost) fosters deduction and shows that scientific papers contain useful, non-hermetic information. This also equips students in tools to fight fake news and spread scientific approach.
- Activities based on actual research results, especially from stations forming the INTERACT network, can become an incentive for students to pursue scientific careers. This also applies to photos from field work, contributing to positive image of researchers.
- Both for authors of materials, as well as end users, being able to look at polar research from a certain distance, is a great opportunity to find global context even for very details and seemingly hermetic polar research.
- Having said that, it is recommended not to limit the use of materials and their content only to Mathematics, Engineering or Technology classes. On the contrary, polar studies are interdisciplinary in their nature, and it is crucial to include social or historical context.

## 6. Conclusions

To sum up, every author of educational resources should begin with a set of answers to basic questions:

- **WHO** the users will be

Age of target group, possible language barriers etc.

- **WHERE** the materials will be used

Will it be in a lecture, classroom, or homework

- **WHAT** facilities will be available

Can the material be used online or does it have to be printed?

**HOW** the materials will be used

Will the teaching method be didactic, interactive, group work, project assignments?

Then it is recommended to

- Consider the educational background of users
- Test materials on a sample of users and modify the material accordingly
- Use plain language to explain scientific language
- Keep the message brief, to the point and avoid irrelevant material
- Emphasise key messages using bold, appropriate size and style fonts and colour
- Use pictures when the message can be conveyed in this way

.