

Exploitation of Research results In School practice

Methodological guide



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Warsaw, 2018

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Who is the project aimed at?

The project “Exploitation of Research Results in School Practice – ERIS” meets the needs of European educational systems, one of the most significant of which is to improve the level of skills, including mathematical skills and environmental reasoning, among students. It is done by familiarizing students with scientific issues, explaining natural phenomena with the use of scientific methods, and by making use of and interpreting research results prepared by scientific institutions. Materials included in the package serve not only to indicate a range of data sources containing data from various scientific research and available free of charge to all users, but also to show how to use them, analyse them and draw conclusions on their basis. They also help to include scientific data analysis in everyday school practice by developing those student skills which are required by core curricula.

The ERIS project is aimed at students between 13 and 21 years of age, with the materials divided into two types of packages: the basic package aimed at 13-15 year-olds and the extended package for 16-21 year-olds. In Poland, the first type can be used in grades 1-3 of lower secondary school and in grades 7 and 8 of the reformed primary school. The extended package contains materials of greater complexity and should be used with grades 1-3 of general secondary school and grades 1-4 of technical secondary school. Once the reform of secondary education has been implemented, the package will qualify for use with grades 1-4 of general secondary school and grades 1-5 of technical secondary school.

Interdisciplinary nature

The ERIS project materials focus on issues related to exact sciences, which is why they can be used in science, geography, biology, physics, chemistry and maths classes. It is, however, recommended to use the materials in an interdisciplinary way. For example, materials devoted to earthquakes deal with the physical aspects of the phenomenon, such as the propagation of seismic waves, but also with their spatial distribution, plate tectonics, and consequences for human life, all of which belong to the field of geography.

In terms of linking the world of science with education, the experience of the initiators of the project makes it clear that the materials along with the examples of how they might be introduced into school education will boost students’ interest in exact sciences and help to develop their skills of logical thinking, scientific reasoning, analysing and synthesizing data.

The world of science

Bearing in mind that the best way to get students interested in exact sciences is to make them aware of the practical applicability of science and its relevance for everyday life, the ERIS project makes use of real scientific data. It is possible because involved in the project are scientific institutions which carry out their own field observations and measurements, which are then published in international observational networks. As a result, the educational packages, containing presentations, videos and curiosities from the world of science, make use of the latest scientific data available in the fields they focus on and make references to real measurements and observations. Such an approach makes it possible to raise students' awareness of the practical relevance of science.

Scientists taking part in the project represent the following scientific institutions:

The Institute of Geophysics, Polish Academy of Sciences in Warsaw – packages on: seismicity, including induced seismicity and the use of the IS-EPOS platform; meteorology of polar regions (based on meteorological bulletins published by the Polish Polar Station Hornsund on Spitsbergen); ultraviolet radiation measurements; glacial changes in the Arctic; the Earth's magnetic field.

University of Bucharest – packages on: the relationship between air temperature and pressure; elementary particles and fundamental forces; chasing earthquakes, interaction between wind and waves and digital maps and geographical coordinates.

The University of Versailles has prepared the packages on: understanding the dynamics of the atmosphere (MIMOSA); understanding the concept of climate (CLIMATE); interpretation of observations from space experiment onboard a satellite (VENUS); understanding of physics and chemistry in the atmosphere using the LIDAR instrument (LIDAR); interpretation of weather maps to detect depressions in the Arctic (POLAR LOWS).

All institutions involved in the ERIS project have considerable experience in conducting projects devoted to education and popularization of science. Their participation in the development of educational materials made it possible to achieve high factual quality. What is more, all materials were tested during online lessons conducted in Poland, Romania and France. Feedback received subsequently from practising teachers have been taken into account to ensure high educational value of the final version of the materials, as a result of which they can be used in schools as supplementary materials.

Methodology

Developments in modern communication technologies, including information transfer, mean that students nowadays have almost unlimited access to information about the surrounding world. Changing conditions, in which present-day schools function, make it necessary for teachers to modify their approach to the process of education. They are no longer the only – or even the main – source of information, and whatever they say is often immediately verified by their students. This is why the role of the teacher is changing. Nowadays, they should act as guides in the world of science and knowledge. They should indicate sources of information, teach how to be critical about the available data and how to verify them. These days, curricula for particular subjects focus especially on skills development. And so did everyone involved in the ERIS project.

In terms of content, there is no close correlation between materials published as part of the ERIS project and core curricula for particular subjects. This is due to, among others, discrepancies between core curricula in various European countries, which the project is aimed at. Besides, direct correlation was not among the aims of the authors, whose major priority was to help students develop the skills involved in making calculations based on real data, analyzing them and drawing conclusions on their basis. The experience of the authors indicates that most teachers have some leeway (how much exactly depends on the country) in selecting content matter used to develop particular skills. They are willing to use additional content, as long as it enables them to work on the skills included in the core curriculum. Because the content matter of ERIS materials stimulates interest among students, using the materials in class makes class work more effective.

Even though all educational packages created as part of the ERIS project can be used in class in any way, depending on the needs and preferences of the group, methodological guides included in each package contain sample lesson plans, which may provide the teacher with some inspiration. Each lesson plan contains methodological suggestions. These include expository methods (lecture, talk, presentation), demonstration methods (videos, slide shows), activation methods (discussion, brainstorming) and practical methods (practice exercises, worksheets).

Introducing a new concept requires the application of expository methods. It must be kept in mind, however, that they should be used judiciously, as they may have a negative impact on the level of concentration and interest on the part of the students. The likelihood of this happening rises with the level of complexity of the concept in question. In order to prevent students from becoming distracted and discouraged, it is recommended to introduce breaks in the presentation. The teacher may use these breaks to quiz students on the concept or to allow them to ask questions and share their impressions.

Once the new concept has been introduced, a practical stage should follow. If time allows, this can happen in a subsequent lesson, in which case the teacher is recommended to use activation methods before moving on to practical ones. All educational packages contain worksheets with task instructions, which enable students to work independently. Many tasks can be completed in groups and thus give students a chance to develop their teamwork skills, time management and reliability.

How to get feedback from students?

The aim of the “Traffic Lights” and “Thumb up” methods, recommended to use during lessons based on ERIS educational packages, is to enable teachers to monitor how well their students understand the information which is being presented to them. Questions like “Does everyone understand?” or “Is everything clear?”, traditionally used for the purpose, are often inefficient, as students who really struggle to understand the issue in question are often too embarrassed to admit it in front of their peers. The “Traffic Lights” and “Thumb up” methods, on the other hand, make it possible for the students to let the teacher know how well they can follow the lesson without the risk of losing face.

Traffic lights

Before the lesson, every student receives a piece of cardboard (A5 size), which they cut into three pieces of equal size. On the top end of every piece they draw a circle and colour one of them green, one orange and one red, to make them resemble traffic lights (see the model below). During the lesson, the teacher can use the method to check how well the students understand the content of the lesson and task instructions.

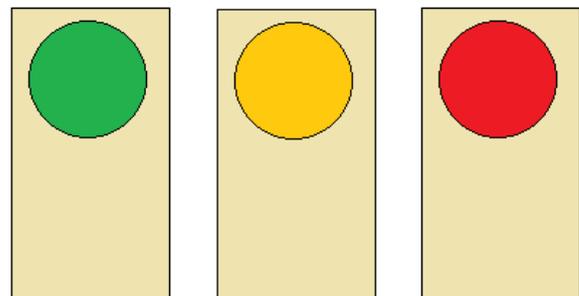
Depending on how well they feel they understand, students raise one of the cards:

green – everything is clear;

orange – I generally understand what we’re talking about, but I have a few questions;

red – I’m lost; I have no idea what we’re talking about.

Depending on the number of red and orange cards raised, the teacher knows if it is only a few students who struggle with the content of the lesson (in which case they must be given some individual attention) or if it is the majority of the group (in which case the presentation stage must be reconsidered).



Thumbs up

The “Thumbs Up” method is an alternative for the “Traffic Lights” method. It can be used with upper primary and secondary students. With the help of this method, teachers can monitor to what extent their students the information which is being presented to them. Questions like “Does everyone understand?” or “Is everything clear?”, traditionally used for the purpose, are often inefficient, as students who really struggle to understand the issue in question are often too embarrassed to admit it in front of their peers. This method, on the other hand, makes it possible for the students to let the teacher know how well they can follow the lesson without the risk of losing face.

The teacher and the students agree on three gestures which mean the following:

thumb directed upwards – everything is clear;

thumb directed sideways – I generally understand what we’re talking about, but I have a few questions;

thumb directed downwards – I’m lost; I have no idea what we’re talking about.

How to use Kahoot quizzes?

Some lesson plans contain links to Kahoot quizzes prepared specifically for this particular lesson. Each quiz is made up of several questions, which sum up the lesson and help the teacher check to what extent the lesson aims have been achieved.

To do a Kahoot quiz one needs a computer with Internet access, a multimedia projector and loudspeakers. The students also need devices with Internet access (smartphones, tablets or laptops). If not all students have the necessary equipment, the quiz should be done in teams.

Example:

1. Go to the quiz website

<https://play.kahoot.it/#/?quizId=5cc4631f-9921-42a2-9bbb-64eb70df5466>



2. Select game mode: “Classic” or “Team mode”.
 - a. Classic – Students answer the questions individually. To do this, each student must have a device with Internet access (smartphone, laptop, computer).
 - b. Team mode – Students do the quiz in teams. Before the system allows them to answer a question, they are given time to discuss their ideas. This option is particularly recommended when it is impossible for every student to use a device individually.
3. Once the game mode has been selected, a number (known as the Game PIN) will appear on the screen. Students go to kahoot.it and enter the PIN number in the space provided in order to log in. Next, they enter names, which will appear on the screen.

ATTENTION: If any of the names entered by the players is offensive or contains words generally considered to be rude, the quiz leader can delete the player from the game. Their name will disappear from the screen.
4. Once all students have logged in, the teacher clicks “Start” and follows instructions.

How to use ERIS materials?

In order to make it easier for teachers to use ERIS materials, all educational packages have a similar structure. They contain the following types of material:

- Multimedia presentations

Multimedia presentations constitute the main source of information about the concept in question. All of them have been created by specialists in the relevant fields and contain numerous images, charts, maps and descriptions. They can be used at the start of a lesson as an introduction to the topic. When using these materials, it is important not to let expository methods (such as a lecture) dominate the lesson. This is why the structure of the materials enables continuous teacher- students interaction. The presentation stage of the lesson can take the form of a conversation with students, in which the teacher asks questions and listens to students’ ideas and opinions.

- Videos

Each package contains a video, based on the multimedia presentation, in which the author of the package discusses the concept in question. The main aim of each video is to enable the teacher to get to know more about the subject matter, familiarize him- or herself with the presentation, and to clarify potential doubts and ambiguities related to, for example, the interpretation of images included in the presentation. The videos or their fragments can also

be played in class. The length of the fragments, however, must be adjusted to the attention span of the group and longer fragments should be watched in sections interwoven with activating elements, such as discussions, group work or completing worksheets.

- Worksheets

Worksheets include tasks to be completed individually by students. Some of the tasks are directly linked to the presentation or the video and can be completed during the presentation stage. The remaining tasks require students to use data from observations and field measurements, available from open source databases. Sometimes, especially in the case of basic packages, students can use preselected databases and data which have already undergone preliminary processing. This is due to the need to adjust the level of challenge to the age and ability of the group. Direct use of databases requires the user to already have some knowledge on the topic. Besides, most data are published in English, which may render the information less accessible. This is why, adjustments in the level of challenge are recommended when working with younger students. In case of particularly gifted younger learners, it is possible to use the worksheets from extended packages.

- Worksheet instructions

The worksheets dealing with particularly demanding topics include worksheet instructions, which enable students to individually familiarize themselves with appropriate methods of analysis and complete the tasks step by step. In this case, the role of the teacher is to support the student, provide on-the-spot assistance and monitor if the tasks are being completed correctly.

- Animations and videos

Some presentations contain animations and videos. To avoid problems resulting from the inability to play them during the presentation, they have been included as separate files. Such a solution has been adopted, among others, in the packages entitled “UV Radiation” and “The Physics of Earthquakes”.

- Tests with answer keys

Another component of each package is a summative multiple-choice test. Each test comes with an answer key. It can be used as a conventional test, whose results will provide the teacher with feedback on the degree to which the students have grasped the topic.

The teachers are advised, however, to use the tests in a modern, student-friendly way, involving elements of fun and competition. One way of doing it is by letting students use mobile devices (smartphones, tablets).

This requires Internet access. Nowadays, more and more European schools offer free Wi-Fi access to their students, which is why such solutions are not only possible, but also

increasingly popular. All summative tests are available in the form of quizzes on kahoot.com. Instructions on how to use the quizzes are given further on in this publication, while links to specific quizzes are included in lesson plans.

Selected tests are also available for use on interactive whiteboards in the form of visually attractive games, with all the necessary links included in lesson plans.

- Methodological guides with lesson plans

The final component of each package is a dedicated methodological guide. It contains an overview of the package it goes with as well as information on the age group it is aimed at and courses it might be used in. Moreover, different language versions contain information on thematic links between the content matter of the package and the core curriculum for exact sciences in the given country or region. Other than that, the guides contain assumed learning aims with reference to the subject matter the students will study, particular problems they should understand, and skills they will acquire. The guides contain a list of all components of the corresponding package as well as supplementary materials, including links to interesting websites dealing with similar issues.

Each methodological guide contains lesson plans with step-by-step instructions on how to conduct a lesson with the use of materials included in the package. There is also information regarding the required multimedia equipment and materials which must be prepared before the lesson. Materials included in each package are numbered and come with links. This will make it easier for teachers to follow the lesson plan if they wish to do so. It should be stressed, however, that the suggested methods and lesson plans are provided for information purposes only. All teachers are free to use selected sections of the plan and/or to modify it to better suit the needs of their groups and particular requirements of their schools.

More and more European schools shift their focus from the traditional approach based on presenting facts and preparing students for external exams. What they focus on instead is developing skills, learner autonomy and creativity. The ERIS project supports this trend and encourages teachers to hone their teaching skills and make their students more consciously involved in the educational process. This methodological guide contains samples of good practices related to the exploitation of research results in school practice.