

CONNECT

Inclusive open schooling
with engaging and
future-oriented science

GOOD PRACTICES

Description for the site:

Title: " Integrated approach to scientific research process."

This good practice presents an open schooling education initiative for the Connect program, developed in the 1st High School of Kissamos by the educator Liakos Theodoros from 28/11/2021 to 27/05/2022). Two scientists participated in the activities: Konstantinos Dounas, marine biologist researcher of ELKETHE Heraklion and Michael Heseemann, laboratory preparer at the Hamburg Volkshochschule, specialized in foraminifera, and founder of the website <https://foraminifera.eu/>.

It was supported by the Regional Directorate of Education of Crete, the Mediterranean Agricultural Institute of Chania (MAICH) with the biologist Ms. Christina Fournaraki and her team, the website team <https://foraminifera.eu/> and ELKETHE of Crete. The fellow teachers of KPE Vammos also supported our action, preparing for us a presentation on the planktonic organisms, corals and algae of the Mediterranean as well as ecological activities during our visit there.

Photos and documents from all the activities of this practice can be seen at the following links:

- https://connect-eu.exus.co.uk/?attachment=3826&document_type=document&download_document_file=1&document_file=836
- https://connect-eu.exus.co.uk/?attachment=145&document_type=folder&download_document_file=1&document_file=145
- https://connect-eu.exus.co.uk/?attachment=146&document_type=folder&download_document_file=1&document_file=146
- https://connect-eu.exus.co.uk/?attachment=152&document_type=folder&download_document_file=1&document_file=152
- https://connect-eu.exus.co.uk/?attachment=147&document_type=folder&download_document_file=1&document_file=147
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- https://connect-eu.exus.co.uk/?attachment=148&document_type=folder&download_document_file=1&document_file=148
- https://connect-eu.exus.co.uk/?attachment=150&document_type=folder&download_document_file=1&document_file=150
- https://connect-eu.exus.co.uk/?attachment=153&document_type=folder&download_document_file=1&document_file=153
- https://connect-eu.exus.co.uk/?attachment=149&document_type=folder&download_document_file=1&document_file=149
- https://connect-eu.exus.co.uk/?attachment=144&document_type=folder&download_document_file=1&document_file=144

Care: The students wondered about the origin but also the future of the pink sand on the famous and highly touristic beaches of western Crete. A real problem that concerns the local community for reasons both ecological and mainly economic. The question that caught the students' interest was "what is pink sand and how long will it continue to exist?" They were asked to discuss this question in the form of a questionnaire with their relatives and record their answers. These answers, which highlighted the essential ignorance of the local community about the "pink sand" phenomenon, were investigated in the laboratory and thoroughly discussed in the following months.

The students who participated in the activities were students of 1st and 3th grade of High School and mainly of two specific classes of A1 and C1, where I was supporting teacher. The main research core



consisted of two mixed age groups with a total of 17 students. Many more students from other departments also participated in the various activities, excursions, briefings and visits, fulfilling to a large extent my expectation to be informed, through participation and to stimulate curiosity about the program, of almost the entire school.

Know: The students used knowledge about single-celled organisms, food webs, the systematic classification of organisms into categories based on how they feed and how they use energy, fossils, marine biodiversity, ecology, human intervention, pollution and contamination, microplastics, mainly knowledge from the field of biology but also physics and chemistry (eg elementary nomenclature of chemical elements).

The skills the students acquired through continuous practice were using a stereoscope and microscope, using laboratory forceps, precision weighing, observing and creating data for analysis, discussing claims and evidence, collaborating both with each other and with research agencies i.e. teamwork.

They understood how important the scheduling is in a research process and in general. How conclusions are made and how they are presented to the general public. They experienced media and conference presence and practiced what is called "communicative courage". Although the skills listed below, are not skills in the strict sense of the term, I believe that self-discipline and self-confidence were successfully practiced especially in the students who "carried the burden" of publicizing our research.

Do: At the end, the students prepared a powerpoint presentation of our research, took micro-photographs and sent material (sand) to Germany where the foraminifera species were identified and entered on the website foraminifera.eu. They completed the activities working as a team under my guidance. Our research work was presented at the student conference organized by the Regional Directorate of Education of Crete and the CONNECT program, while we also presented the topic on a local TV Station.

Conclusions on Open Schooling: The activity was not integrated into the timetable or the curriculum exactly. However, it accompanied, and through the research he gave meaning and explained basic material of high school biology, mainly about cells, food webs, the systematic classification of organisms into basic categories based on how they feed and how they utilize energy, fossils, marine biodiversity, ecology, pollution and contamination etc. Apart from these, through the sensitive microscopic organisms we were studying, we dealt with and discussed issues such as climate change and the way it can affect them as well as more generally human intervention and activities such as tourism, while they were given the opportunity to come into contact in practice in terms and concepts such as microenvironment, pseudopods, plasma membrane, indicator organisms, etc.

But, because our work was essentially primary research, the students came into contact with the process of producing new knowledge. They saw the exciting, gratifying and sometimes painful aspects of the research process. The complexity of biological issues and the multitude of factors that need investigation. In other words, they understood experientially the importance of asking questions, organizing them and studying them. They also understood that this is a team effort and that collaboration with other scientists and agencies is absolutely essential. They understood that not everything has been discovered and that not all the answers are in a mobile phone... They saw that scientists do not know everything, that they disagree and make mistakes (eg at first we thought that the pink grains are broken corals, then there was a disagreement about the how deep the particular foraminifers live). They got a first idea of how important





different views and approaches are in science and saw that there are no absolute truths and that biology is full of "exceptions". They learned the importance of questioning and practiced deductive thinking.

For all the above reasons, I believe that the program was a challenge since it was largely about research in "deep unknown waters", it was innovative and of course many times useful, mainly because it was understood that science is not something distant but something everyday that deals with "our own questions" and that we can "use it too", while also due to the pleasant way in which it was carried out it contributed to the creation of a positive attitude of children towards science and especially biology.

Experiential open schooling education is more than important to escape from the "museum" perception and practice of "transferring" knowledge provided by the Greek school. A common "argument" of the children is "and where will I need all this?". The teaching material is far removed from the daily life of the students, or at least it seems so since the connection with the daily life is not made and the provided knowledge is not used to solve questions, searches and problems that children have. Practical - experiential and seemingly non-material activities, at least for the field of natural sciences, I think are not only useful but necessary especially at these ages when children should have the opportunity to show off their inclinations, preferences and "talent" and acquire a positive attitude towards science.

For some teachers, these practices may be a problem because they are out of the ordinary and need to be informed and above all to act outside the context in which they have learned. In other words, it needs work. But they ignore the "rejuvenating" effect that these practices have both on the way we as teachers perceive our work and on the relationships with students and parents, which are significantly upgraded. When children get excited about something, they talk about it at home and parents realize if the child goes to school happily.

The change/innovation was supported by: School management school association/network Local government Other: Parents

Student results: The core of students that finally formed after 2-3 weeks were very cooperative, consistent and hardworking. Participation was high from the beginning with few drop-outs, mainly due to other activities at the same time or the bus schedule (many children in our school came from distant villages), but also with new entries "on the way". And the fact that our meetings were held every Friday, that is, on the last day of the week, after the end of the program clock, and they participated for an hour or two more shows, that their process was pleasant. Several even came from villages relatively far away and were awake very early in order to come to school.

In the 3 educational trips we carried out (KPE Vammos, Elafonissi and MAICH) many more students participated, so that the cost of transportation could be covered but also because I wanted an expanded participation in general so that our research could be embraced by the whole school. We always combined research with free time and sports, especially at the MAICH where we carried out an important part of our research, since the professional micro-photographs took place there, while overall its facilities were offered for many parallel activities. The goal was of course to make the whole process as pleasant as possible.

I consider this goal to have been achieved. To quote the words of a student: "I hated biology, I was thinking of becoming a philologist, but now I'm thinking of becoming a biologist" or, others, "this is how school should be", "scientists have a good time", etc.

In terms of learning outcomes, starting with the simplest ones, eg converting lt to ml, gr to mgr for the needs of weighing. The clarification of the difference in volume and mass, up to specialized knowledge about marine biology, such as:





- what are foraminifera; they are not shells and which creatures we call shells,
- what is meant by a decomposer, an autotrophic and a heterotrophic organism,
- what is the life cycle,

and other questions that are difficult to determine since the questions and discussion often arose spontaneously.

This practice contributed to the increase of:

[x] engaging families with sciences [x] involving girls in science [x] raising awareness among students about careers in the natural sciences

1. The subject of pink sand is something that concerns the daily life of the residents of the area, so there was a relative curiosity from the start anyway. Initially, the opinion of the parents was asked to be recorded, and not only, regarding "what is the reason", "if there is a decrease in the phenomenon", "if you think it is in danger of disappearing". Then some parents who deal with the sea gave us important information and also brought samples very important for our search about where they live (depth distance from the shore) and in what form they are first washed up as pink grains of "sand". There have been parents who have expressed to me their personal interest and their desire to help in whatever is needed. Also, no one raised an issue or refused to pay when needed for our travel on educational trips. All this shows that the program was accepted and therefore, even just by talking with their children, some parents more or less engaged in science through it.

2. The girls in our school, and in general I believe, have a better presence in the classroom and in the lessons than the boys, at least on average. Nevertheless, there are stereotypes and prejudices against science and mathematics. Many girls have the opinion that they don't understand maths, physics or chemistry. The subject of biology, at least in our school, was not very popular. However, slightly more girls than boys participated in the program. Most of the students were hardworking and responsible, participating and asking questions. In my opinion, on the contrary to what they wanted to believe, some of them are, "born researchers". They were oblivious to the microscope, while being particularly skilled with the tools and inventive in the way they carried out the activities.

Through the program inclinations were encouraged and revealed. One student revealed that she liked to observe and photograph spiders, but had never shared it with her friends since "spider observation" is not considered a "female activity". Along with the foraminifera, we also worked on and identified the student's spiders, something that the others eventually found interesting as well. The girls enjoyed working with the laboratory and microscopes as well as tinkering with the tweezers. The visit to the Mediterranean Agricultural Institute of Chania (MAICH) where all the research staff we met were female biologists and agronomists, I believe contributed to breaking the convenient stereotypes of female students.





However, if I judge from their reaction, the publicity of our research in the media and at the conference played a role. Apart from the fact that they want to make their own people happy, girls at this age are very involved with celebrities, social networks and want to project themselves in a corresponding way. They like to have an audience. It is characteristic that both in the presentation at the conference and in our presence on Crete TV, no boy wanted to appear in any way, while most of the girls, on the contrary, wanted to and showed remarkable seriousness and discipline throughout the preparation of the presentation.

Our 16-minute appearance in a midday light show of general interest on Crete TV, with TV presenters from the modeling field, was important, I believe, in showing some girls that science and these areas are not completely incompatible after all. How the "beautiful" appreciate and admire science and there is general acceptance and appeal. That various avenues open up through research, which may include publicity.

Likewise with the conference, although online, the fact that they will be seen by students from many parts of Greece appealed to the girls, especially since they were convinced of the importance of our work. In conclusion, I believe that the area in which the program was most successful was in relation to girls and their engagement in science.

3. The reasons I mentioned above also apply to boys. Therefore, as a whole, through a research process, the students came into contact with the real tangible world of natural sciences, which is admittedly if not always exciting, certainly interesting. In summary, I will dare to "predict", although this also depends on their teachers in the years to come, that this High School will produce natural scientists...

Select the most relevant photo related to your initiative (which will be public and published under an open license) to represent the practice.







ABOUT THE CONNECT PARTNER that supported the school

ORGANISATION	Regional Directorate of Primary and Secondary Education of Crete (RDE)
COUNTRY	Greece
Όνομα συνεργάτη	Georgios Panselinas
Implementation period	Starting date: 28/ 11/2021 Ending date: 27/ 05/ 2022

ABOUT THE TEACHERS PARTICIPATED

SCHOOLS	1 st High School of Kissamos
TEACHERS names (for Good Practices' Certificates)	Liakos Theodoros
Gender	Male
SUBJECT (Natural Sciences, Physics, Chemistry, Biology...)	Biology, Physics, Chemistry, Mathematics
How many subjects were used in open schooling?	Our meetings were weekly every Friday after school for 1-2 teaching hours. 3 trips were made to KPE Vammos, MAICH, Elafonisi. Mainly, biology course and less physics, geology and chemistry was covered.
Title of open school education resource used	
Type of learning scenario of science activities (structured or open scenario)	Open Scenario
Curriculum modules	From the 1st grade's high school biology book, the 1st chapter "organization of life". From the third grade's biology book the first two chapters "organization of life - biological systems" and "organisms and their environment".

ABOUT THE STUDENTS PARTICIPATED

Class	First and third grade of High School
Age (average)	12-13 and 14-15
Number of students participated that concluded the educational scenario	17 + (17 the core of students)
Number of students who completed the educational scenario of scientific activities	17

SCIENTISTS PARTICIPATED:

Name	Dr. Konstantinos Dounas and Michael Hesemann. MAICH researchers under Mrs. Christina Fournarakis. The teachers of KPE Vammos.
Field	Marine biologist Researcher ELKETHE and Specialist in foraminifera respectively. Mrs. Fournaraki Biologist MSc. The teachers of KPE Vammos were from various fields including theoretical sciences.





QUESTIONNAIRE

01. How have you (teachers) used open educational resources? Could you describe what you did in your lessons?

Student activities with scientists:

1. The students were informed at the KPE Vammos about the marine life of the Mediterranean. They saw some prepared preparations under the microscopes and discussed freely. Together with fellow teachers, they made their own bag with recyclable materials. This meeting took place on 8/12/21.

2. After we had progressed and learned, in our weekly meetings in our laboratory, how to use the stereoscopes and microscopes to isolate the organisms we want and take pictures with our mobile phones, we visited the MAICH and specifically the unit conservation of Mediterranean plants to do professional micro-photography in the special photographic stereoscope of the research center. The students, under the supervision and guidance of the MAICH scientific staff and the director Ms. Christina Fournarakis, organized in small groups, did precision weighing, isolation and micro-photography in the state-of-the-art stereoscope. In addition, the students were informed about the activities of the MAICH and the endemic plant species of Crete, watched videos, asked questions and played sports. The visit took place on 10/3/22 and a press release was issued.

<https://www.ertnews.gr/perifereiakoi-stathmoi/chania/synergasia-toy-maich-me-to-1o-gymnasio-kissamoy-gia-ekpaideytikes-perivallontikes-draseis/>

3. On 23/3/22 a remote tour was held at the Heraklion aquarium, while the next day a visit was made with foreign visiting students of the "Erasmus" program, in Elafonisi where we informed them about our work.

4. On 12/4/22 there was a video conference of the students with Dr. Douna marine biologist and researcher of ELKETHE. In the previous period I was in frequent contact with him for information, exchange of opinions, reflection and literature. During the teleconference the students updated him on our progress and questions were asked from both sides.

5. Although the students never met the German foraminifera expert Michael Hesemann responsible for the website <https://foraminifera.eu/> his contribution to my own information and guidance was decisive. However, the students prepared a sample which we sent to his laboratory and there identification, photographing with a tomograph and posting of the most important species of foraminifera in our sample took place. Our school post is here:

<https://foraminifera.eu/loc.php?locality=Falasarna>

Student activities with their families:

At the beginning of the program, the students were asked to ask and record the opinion of their parents and other members of their extended family about what pink sand is, if they notice a decrease in the phenomenon and if they think it can disappear. After the program, the process with the parents was spontaneous. The children informed their parents and some of them (mainly those involved with the sea) showed their interest by bringing us samples, asking questions and also saying some of their observations. The parents were discreetly next to our program since they were also the financiers of our excursions.





02. How have your students used the CONNECT resources? Do you have (or could describe) samples of better scientific actions (for our site/rewards)?

Any examples of what the students prepared?

The students conducted the survey, and photographed the marine organisms or their remains mixed in the sand grains, especially foraminifera. Together we created a presentation and sent material to be posted on an international website.

We also presented our research on a local channel.

Slide? Poster? Video?

(Add an image if possible)



Figure 1 Μικροφωτογράφιση τρηματοφόρου στο MAIX

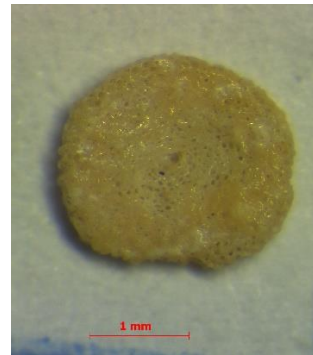


Figure 2 Μικροφωτογράφιση τρηματοφόρου στο MAIX



Figure 3 Στιγμιότυπο από την παρουσίαση μας στο ΚρήτηTV

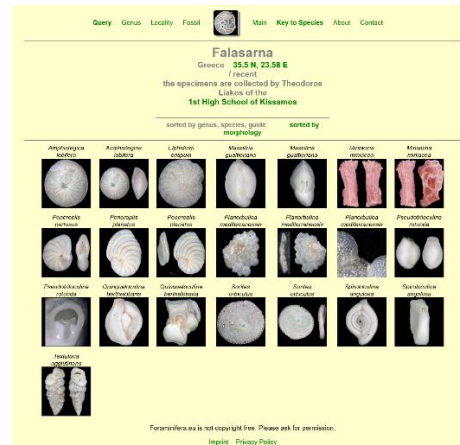


Figure 4 Η καταχώρηση του σχολείου μας στην ιστοσελίδα foraminifera.eu





03. How well did the science action learning scenario resources meet your needs?

Example related to the school curriculum:

The scenario was created by me, because of the uniqueness of the phenomenon and the local interest. Of course there was a connection with the curriculum. For example, the foraminifera with which we thoroughly dealt are single-celled, heterotrophic planktonic organisms, with an invisible role in the complex marine food webs. The understanding of these concepts and their use by the students themselves is a key issue of High School biology.

Students involvement:

The participation of the students was great even though from the beginning I only addressed specific classes. I had to create two work divisions that worked alternately every Friday. Their involvement was very high since they practically did almost everything, observation, isolation, photography, etc. Especially in our educational trips, the participation was very high and their behavior was impeccable. The very idea of the program actually came from students when in a discussion at recess where my children were talking about the attractions of the area we all realized together that we know nothing about the phenomenon of pink sand.

Student interest and confidence in science:

It is difficult to understand exactly what children understand by the term "science". What is certain is that the interest in the courses was low and for the "good" students it was rather processing. Despite this, they never cease to have questions and observe their surroundings with the typical innate human curiosity. Children's science confidence cannot be determined. Children trust their parents. The latter, due to the situation with the corona virus and the various excesses we experienced, it seems that a significant percentage began to have greater doubts and less trust in science or better in its agents. What is certain is that the children, through our program, came into contact with a scientific research process and found it very interesting and fun. In terms of trust, the children came into contact and practiced inductive thinking and logic with the aim of learning to rely on data and logical associations, to challenge but with logical arguments a process that certainly requires a lot of time.

04. How easy or difficult it was to use the science action learning scenario resources?

Issues related to materials, procedures, pressure from the interaction with the curriculum:

There were several difficulties of this kind:

1. The program had to take place after school and the only free day was Friday after last teaching hour. This in itself acted as a deterrent for many children who even came from distant villages and wanted to go home to eat, rest and go to their other activities (English, dance, training, etc.). Also for many of the children who came from afar, there was only one return bus to catch. This unfortunately excluded many children from the surrounding villages, with the result that the core consisted more of students who lived in Kissamos or close enough.

2. There was no necessary logistical equipment for this research, i.e. stereoscopes, tweezers, Petri dishes, etc. This was successfully dealt with in various ways, a lot of personal effort and the help of





the High School Principal, the Teachers Association, the Municipality of Kissamos and luck. However, there were no workbenches with adjustable laboratory chairs, with the result that many students sat on their knees to look at the microscopes or stood up. In general, our research literally started from scratch.

05. What were the benefits of implementing the science action learning scenario for your students?

Describe the results of the students in their scientific actions related to:

KNOWLEDGE	They introduced terms such as unicellular, multicellular organism, food chain, environmental indicator organisms, fossils, etc. They learned about the marine microcosm, what foraminifera are, how they live, how they make their shells because it is wrong to call them shells, what is the category of molluscs to which the different shells belong, what are their differences with foraminifera. What are corals and how are they different from algae? They learned some rocks like quartz that abound in the sand. They realized the complexity of the interdependencies of marine life.
SKILLS	Students learned how to properly operate microscopes and stereoscopes, saw the different magnifications, also worked on a professional photo microscope and learned how to operate and take pictures. Familiarized with laboratory equipment and terminology, forceps, plates, precision scales. They practiced teamwork, cooperation, inductive thinking and ingenuity. They found solutions to the various small problems that presented themselves such as the lack of tweezers by using pieces of wire and their fingers to isolate an interesting specimen. They learned to make public presentations. They mainly came into contact with the organized and systematic teamwork that scientific research requires.
ATTITUDES	Through teamwork for a common goal that concerns and interests the whole community, responsibility, teamwork, the feeling of contribution to the whole is cultivated, while self-confidence, self-discipline and sociability increase, especially through the activities of publicizing our research. The theme was such that through the perception of the microcosm and the understanding of the interactions - the interconnectedness between all organisms, the ecological consciousness and behavior is strengthened. The involvement of the students in a real research and in fact with the collaboration of scientists and scientific bodies showed them that science is not something distant "for others...", that it is interesting, can be fun and has a more general acceptance since the media took an interest, ultimately increasing the positive attitude of male and female students towards science.





06. What have been the challenges of using educational science activity scenarios for your students?

Main challenges faced by students (Please select all that apply):

- Difficult...
- Long duration...
- Boring...
- Other (Please specify): it was something new and unfamiliar. It required additional school hours in a timetable that had 4 days with seven teaching hours and 1 day with six teaching hours, in a daily life filled with other activities that tend to seem more important

07. What activities worked well with the curriculum?

What helped the children achieve the learning objectives:

Both our laboratory meetings and trips really supported the learning process and the creation of a positive attitude towards science.

08. What activities did not work well with the curriculum;

Anything that could be done differently or avoided:

The teleconference with the scientist from ELKETHE who guided us. Although our one-on-one telephone communication was frequent and very helpful regarding the students, only one remote meeting took place with a long delay and unclear content. Live meetings are irreplaceable and it would be very nice if scientists would visit us in our laboratory.

09. The school Principal's opinion about CONNECT:

"It is certain that with the activity implemented in our school, the 1st High School of Kissamos, on the origin of the pink sand which was implemented in the context of the wider CONNECT program, many of our students understood from their relatively young age the concept of scientific research and great pleasure and satisfaction that it can offer. The communication with scientists, getting to know the microscope, the dissemination of useful and interesting results in the local community, the sense of creative contribution and the cooperation cultivated in the students, are important elements of progress and experience. I should mention the interest shown by the parents, asking, helping with material, supporting every action of the program and declaring their desire to repeat it in the following years. Thanks to all contributors of the Connect program for the added value our school received. Special thanks to the teacher in charge, Theodoros Liakos, who creatively inspired the children."

Georgios Psarakis, Director of the 1st High School of Kissamos



10. Parents' opinion about CONNECT:

“My daughters, aged 14 and 12, had the opportunity to take part in the study of pink sand from Falasarna and Elafonisi beaches. Observing the pink sand with a stereoscope, they reached scientific conclusions on the justification of its color. They were thus able to understand the process of conducting an original scientific investigation and taste the joy and satisfaction of searching for scientific truth, as well as drawing knowledge and conclusions from it. My daughters talked enthusiastically about their activities in the program, they were happy during it and they started thinking about studying biology instead of literature they say.”

Anastasia Kouroupi

Submission:

1. Please save the file in the following format: **YEAR MONTH DATE COUNTRY SCHOOL** (e.g. 20220326GR1stPrimarySchoolHeraklion. docx)
2. Please send this form to CONNECT Panel: <https://tinyurl.com/Connectbestpractices2022>

