EURAC JUNIOR

EARTH OBSERVATION SCHOOLLAB AT THE EUROPEAN ACADEMY IN BOLZANO/ITALY

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ABSTRACT

With the project EURAC junior the European Academy Bolzano/Italy establishes an interface between schools and science. In this framework EURAC junior offers together with the research institute for Applied Remote Sensing a three hours schoollab that introduces high school kids to the topic of earth observation. Students take part in a well balanced program that combines theory and practical experience. In several short picturesque presentations students receive background information on satellite systems and the basics of remote sensing as well as the current research activities of the institute. The practical part includes the use of technical instruments, the application of a remote sensing software and an exercise on the interpretation of satellite images. The students experience a scientific working atmosphere and get the opportunity to approach scientists directly. The set up of the schoollab highlights links to school subjects like Math, English, Geography, Physics and Ecology. Students understand the importance of integration for the different disciplines and the knowledge as the key to applied remote sensing and science.

The activity of EURAC junior has the vision of building a vivid platform in South Tirol for initiatives that propose current research topics for teachers and students in all level of education. This opens new opportunities for the teachers to enhance their teaching tool kit and their own education. Students benefit not only through the diversification of teaching methods, but the contact to science might motivate them for their own career. The gain for the research institute is expected to be seen in a higher reputation in society and in the support to determine the myth of science being in an ivory tower. EURAC junior is using this win-win situation as an opportunity to offer different formats to schools. Besides schoollabs, we offer a visit of scientists at schools, intermediate-term roll-playing and an initiative called “young researchers wanted”. This initiative is not restricted to the topic of applied remote sensing but wants to establish suitable activities for the ten different research institutes of the European Academy in Bolzano.

INTRODUCTION

Opening up the European Academy (EURAC) located in Bolzano. Italy has its own tradition of communicating and inviting outsiders. The research centre was founded in 1992 and employs about 200 collaborators working in 6 different research departments that split up into 11 different research institutes covering science and humanities. EURAC junior is a new initiative within the research centre who wants to foster the kids interest in research. The goal is to establish a permanent interface between schools and the research elaborated in the EURAC.

EURAC was host for the first science festival in Italy 2002 with themed “expirer science” and offered lectures, workshops, guided tours, excursions and science cafes to about 13000 visitors. Henceforward the science cafes are offered each year during the summer as a venue for experts and interested people for a common discussion and mutual learning. In 2005 the EURAC has established an annual intra-regional young academics award called “young researches wanted”. All these activities aimed at getting the visitors and students active and taking part in the fascination of research. In 2007, during the Earsel conference hosted by the EURAC and the Institute for Applied Remote Sensing, the schools were invited for the first time to participate in schoollabs about remote sensing and earth observation at the EURAC. At this time for many schools the appointed time was not suitable. But the offer has been so attractive that the teachers asked for a different appointment and therefore the activity was carried on. This led finally to fund of the project EURAC junior.

In 2008 the project EURAC junior started with different activities. In the authentic atmosphere of our research centre, we provide students different experimental laboratory sessions from the very basis of the scientific work of the different EURAC Institutes. The students are able to jump into the role of the researcher and make their own experiments, analyses and simulations. Together with the Institute for Applied Remote Sensing we are offering a schoollab called “earth observation” for middle and high school students, teachers and preschool kids.

MOTIVATION

We life in an age of constant scientific discovery and — a world shaped by revolutionary new technologies. The influence of science and technology on the living conditions of the society becomes more and more important. We all need to learn livelong in order to appreciate the world around us and in order to make informed personal choices [1]. Science has to communicate its newest results and has to open up a common discussion about the expected consequences. It is not only the responsibility of each individual but also of scientists and educators to provide everyone with the background knowledge to enable us to take part in these discussions and to help us coping with the changes of today and tomorrow.

So far science communication within the society has its limits, because often latest results are either only published in professional journals or rarely noticed by the news. Still the potential readers must be able to understand the issues. The basis for this has to be established in school education. On the long run students in schools are the most important target group for a dialogue with science [2].

[1] Hazen, 2002
[2] Engeln, 2004

Studies like the "Program for International Student Assessment (PISA)" found out that the knowledge of school kids in science is on average low[3]. Many students do not reach a level of science literacy and as a further consequence the society misses young academics in these fields. Solomon & Thomas [4] lament: "it is one of the ironies of science education that while science itself depends so strongly upon the curiosity and originality of its practitioners, the public associates it with dry facts". Studies about the problems of teaching and learning show that school kids often miss to interlink their knowledge[5]. As a consequence a lot of initiatives have been elaborated lately for extracurricular offers that allow school students to work and learn autonomously [6] in places outside of school. EURAC junior is offering such an opportunity and wants to add on.

EURAC junior wants to emphasise the importance of science in our everyday life. Ignorance and misinformation may lead to aversion to research. Our approach is to adjust the state of knowledge with a targeted intermediation with information. Therefore we aim at fostering the students acceptance of science. In a second step we hope to reach the parents through the new raised interest of their kids.

METHODS

Pedagogical background

The name schoollab was chosen, because with the expression laboratory we want to emphasise the experimental part for the students. Although they are not visiting a classical laboratory and not wearing lab coats, they are applying scientific methods and doing research like in a lab. With the schoollabs we are aiming at two goals: one is to provide the students with an overview of the basic physical facts of remote sensing, arise their interested in earth observation and show the scientific application of the topic; the other goal is to provide the students with an insight view to a scientific institution and to the people who work there.

The schoollab consists of a composition of different activities with a methodological variety of lectures, experiments, tutorials, a film and collaborative learning. For each participant we provide a workplace with a computer, a printed tutorial that contains the agenda and all steps of the exercises as well as a printed handout with background information, a glossary and interesting weblinks. We follow a multi language approach, because we are offering our schoollabs in both official languages of South Tyrol: German and Italian, while the software used is in English.

We aim at introducing school kids to the institution of a research centre as well as to the topic of applied remote sensing. The schoollab starts with a classical welcome. We present the building which is one of the eye-catching structures in Bolzano, because of its combination of an old part build in the thirties and a new part consisting of glass and steel. It is located at a junction of the two rivers and an important street in the town. Most students know it from outside and get the first chance to enter the building. Furthermore we introduce the topics of the different institutes of the research centre and provide the students with details about gender distribution, age structure and origin of the collaborators. Our goal is to eliminate the prejudice of a researcher being an old weird man working in a stinky laboratory. We introduce the project of EURAC junior and explain why we invited them to come. After that each member of the team introduces himself with a short biography.

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[3] Engeln, 2004
[4] Solomon & Thomas,1999
[5] Panijpan et al., 2008
[6] Engeln, 2004

As an ice breaker we want the pupils to get active right from the start and we ask them to follow us to our terrace and split up into three smaller groups. Each group gets a GPS device and is asked to determine their position with the help of one of us. We use the smaller subset to get closer in contact and establish relations to some of the individuals. Our aim is to motivate the participants and to establish a corporate feeling that enables participants and scientists to interact more freely.

Classical lectures of 20 and 10 minutes are used to give the students important background information and a summary of the work done at the Institute for Applied remote sensing. The first one is used to provide them within a short time with the basics of remote sensing and prepare them for the following exercises. The second one is an overview of the research done at the EURAC with many pictures and applications. The third one introduces into an exercise of different illumination conditions of the earth. During and after the presentations students are stimulated by questions of the lectures and asked to rise own questions as often as they can. For the middle school we offer only two presentations with about 10 minutes in order not to lose the pupils attention.

In exercises students are asked to work individually at their computers with the help of the tutorial and the team. Working individually each of the participants can follow their individual learning speed and takes the responsibility for his/her own learning process. We notice a big variety within the classes of fast and slow respectively motivated and less motivated students. The team takes care to go on with the faster ones and to help the slower ones a well. We provide almost one collaborator for four to five students during the exercises.

Collaborative learning where we form groups who are in competition to each other is used for the final exercise where the students interpret different illumination conditions of the earth at different time of the day and the year. The difference to a normal group work is the incentive of a present for all members. In our case we give a satellite image for the fastest group that accomplishes without a mistake. The success of the group depends on the input of each individual.

A film that was made for an event called the long researchers night is used to reawaken the participants attention after the break. It shows the aesthetic quality of satellite images and shows events before and after a natural hazards like the tsunami and the hurricane Katharina. Students mention the film mostly as the high light during their visit.

For pre-school kids we have developed a playful approach with only one message: satellites take pictures of the earth with a bird eye view. Therefore we have a simplified map of the city where the kids are asked to construct the buildings with Lego and wood bricks. Every once in a while a moveable satellite model is flying across and takes pictures with a digital camera of the kids and their buildings that are provided to the kids as print out.

Target groups

The major target groups for EURAC junior schoollabs earth-observation are kids in the age of pre-school, middle and high school. For the different age levels EURAC junior provides adjusted offers of earth observation. So far we are missing an offer for primary schools, but this is one of our next goals.

The main target groups are the high school kids. In this age students have a scientific background knowledge and the can understand the physical and technical insights of remote sensing[7]. Although there are high schools with different curricula within the local system, all of them have heard about electromagnetic spectrum and the basics of light and colors. There is a noticeable

[7] Manakos et al., 2007

difference in motivation and comprehension of the students between a scientific high school class and a commercial high school. Nevertheless due to Google Earth and satellite images used in the news most students[8] are used to see the world from a birds perspective.

Pupils in the age of middle schools lack the knowledge regarding the specifics of the electromagnetic spectrum[9] and the physical background. At this level the scientific education focuses more on attracting them to the topic and providing the very basics of satellites and their images in very short lectures. Furthermore hands-on experiments and treasure hunt with GPS serve as agents to keep their attention.

Pre-school kids are confronted only by demonstration material and physical matters. Our messages is simple and comprehensible. Nevertheless we bring kids in a very early stage in contact with science and its basics that might have an impact towards their attitude about research and science.

Moreover we train teachers, in order to provide scientific introduction to remote sensing, working materials and software as well as further information and references.

Scientific content

For the scientific content we focus on only 2-3 different aspects of remote sensing within a schoollab and give a short insight to the topic. For the high school we offer the topics GPS and coordinates, the basics of remote sensing as well as its applications. Additionally the pupils have to interpret satellite images.

The use of Global Positioning Systems GPS for private households has increased since navigation systems for cars have become so popular. Almost all students have been in contact with GPS systems without knowing it. Within the schoollab for high schools all participants do measurements on the terrace of the EURAC building with different scientific GPS devices. The participants receive information on the technique and the application in science with its advantages and limits. For the verification the measured data is feed into the software Google Earth to see its accuracy and compare between the devices. In this exercise students get in first contact with satellite images during a Schoollab. Although many students have been using Google Earth before they have rarely used coordinates. They learn about the terrain function in Google Earth in order to strengthen their capacity in 3-dimensional orientation.

For students from the middle school GPS is used for a treasure hunt, where the participants are not allowed to use the track function, but only the coordinate display on the screen. The ones who are better in orientation with the help of geographical coordinates, have the higher chances to win. Google Earth is used to train their ability to read satellite pictures by providing them with coordinates of well known landscape elements or buildings and asking them to identify. This exercise is called: Do you know your home country?

The second topic is physical and technical background information on remote sensing. This covers the relevant intervals of the electromagnetic spectrum (visible, infrared and radar), the characteristics of a single satellite photo and how to combine different intervals to coloured satellite images. Furthermore the different techniques of active and passive systems are explained. Students get an insight to the geometric, radiometric, spectral and temporal resolution of satellite images. The ap-

[8] Siegmund et al., 2007
[9] Manakos et al., 2007

plication of remote sensing is demonstrated through examples of the research done at the inhouse at the Institute for Applied Remote Sensing.

In a second step students have to apply the new information in different exercises. The software used is Leoworks, which can be freely downloaded at the ESA Eduspace homepage (http://www.eduspace.esa.int). Fife exercises have already been developed in the last years. Teacher's can choose from the following exercises:

1. Change detection: Students get a LANDSAT picture in the red interval of the year 2000 and a green and blue picture from 1990. By mixing these 3 channels in the R-G-B composition students realize that everything that is in red originates from the year 2000; everything in turquoise from the year 1990.
2. Thermal channel: The students get a reflectance calibrated thermal LANDSAT image in which they have to look for the maximum and minimum values and classify it. As a next step they have to visualize it by using a colour ramp. Final step is the interpretation of the classified image.
3. Alpine transit routes: Aim of this exercise is to digitize the Alpine passes based on a MERIS image. Students have to look for major valleys in the satellite image and digitize main roads through the Alps. After having digitized the main streets the actual road map of the Alps is overlayed and compared with the students results.
4. Land cover: This exercise focuses on the classification of satellite images. Students get a false color infrared SPOT V image and start classifying it using an unsupervised – supervised classification algorithm. Students get on one hand a feeling how difficult classifying an image is. On the other hand they realize how useful this method is for the distinction between different land uses.
5. Disaster management: Thanks to the participation of our institute to the GNEX 07 exercise IKONOS images could be taken for our schoolab activities. Students get a printed image of a region in a crisis from the year 2006 and 2007. Comparing them visually the pupils have to mark the changes and make suggestions for help intervention. The pupils get a determined time and at the end they have to present their results to their classmates.

The third topic is the interpretation of different illumination situations of the earth at different time of the day and year. METEOSAT images are used and students have to identify the correct temporal and seasonal compilation. The background to this exercise is the provision of general information on METEOSAT, and on the applications and benefits of weather satellites.

RESULTS

We have organized thirteen schoollabs for high school pupils, one for a middle school class and two training courses for teachers. All in all were about 200 students and ca. 30 teachers involved. This seems to be a rather small number, but we are satisfied with our results considering the short project period. Among the participants were different types of schools like, scientific high schools, marketing schools and schools that have an emphasis of industrial development. Our success differed within this school types. The classical scientific high schools appreciated our offer the most, business schools the least. In some cases only a motivated part of a school class were allowed to come. The valuation was much more positive than the sample of the total class.

In order to evaluate our success in accomplishing our goals we are using a anonymous questioner in the end of each schoollab. The questioner has only two pages containing 80% multiple choice questions and 2 open questions about what the participants liked most and least. The multiple choice questions the participants are asked to grade into a four step system: very good/very true, good/true, poorly/not true and very poorly/not at all true. We have used this grading system to receive a defined opinion instead a middle stand point.

Almost all of the students participate and we have received a considerable record of data. Being aware that teenagers after 3 hours of schoollab might not take this questioner very seriously, we still extract useful information about the set-up of the workshop and our today's performance.

The results of the questioner show the answer in percentage. The majority of the audience was satisfied as you can see in Figures 1 and Figure 2. Students who validated the schoollab negative complained that sometimes the explanation was to fast and that we had covered too many topics.

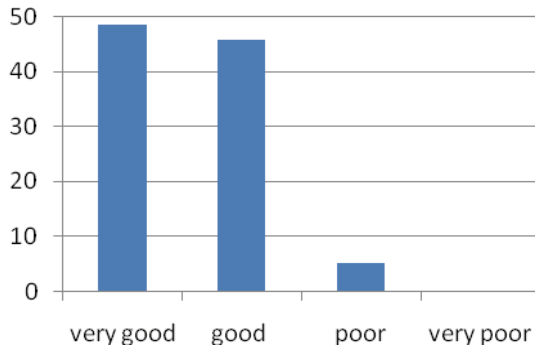

Figure 1: How do you validate the schoollab?

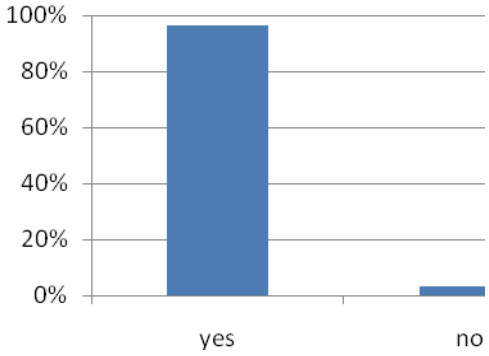

Figure 2: Would you recommend this schoollab?

Most participants claimed that they have gained some more knowledge about remote sensing during the schoollab (Figure 3 and 4). Their valuation is subjectively biased, but it shows their positive attitude towards the topic and the acceptance of the topic.

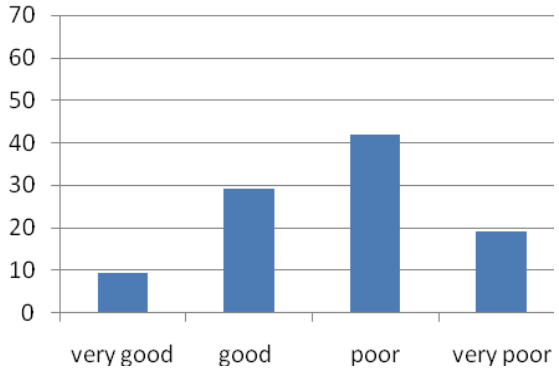

Figure 3: How was the participant state of knowledge before the schoollab?

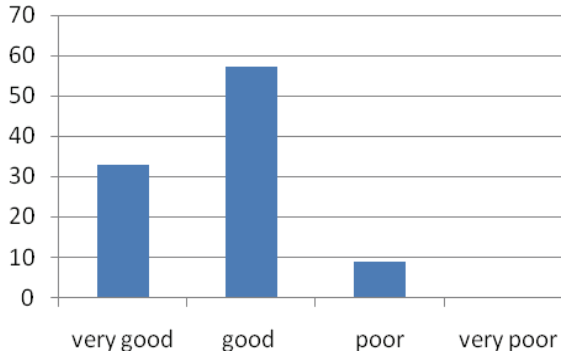

Figure 4: How did the state of knowledge change with the schoollab?

Nevertheless in not preselected classes there is always a portion that is not neither interested before nor after the workshop. They grade the schoollab as not recommendable and we do not manage to motivate them. Being aware that some teenager are having private difficulties it is one of our tasks in the future not to leave them apart.

OUTLOOK

The schoollab earth-observation is only one of the activities of the project EURAC junior. With the experience with the implemented schoollabs the next step is the diversification of the schoollab with different emphasis on topics like climate change or GPS. Our goal is to offer to offer different information for teachers and students. For the teachers we offer a portfolio to the different school levels and curricula. This will be done as an internet catalogue that shows all offers, topics and

extra offers for the different target groups and provides further material and information. For the students we are planning to use popular internet services for social networking like for example blogs or the facebook. A continuous collaboration with the pedagogical institutes and the supervisory education authorities of the three different language groups (German, Italian, Ladinian) guaranties the integration of the schoollabs and other activities of EURAC junior into the South Tyrolean school curricula. Furthermore we aim at collaborating with other institutions on a national and international basis.

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