EUDOXOS

Teachers' workshop proceedings

Friday 28 - Saturday 29 of March 2003

NCSR Demokritos

and Ellinogermaniki Agogi

Athens, Greece

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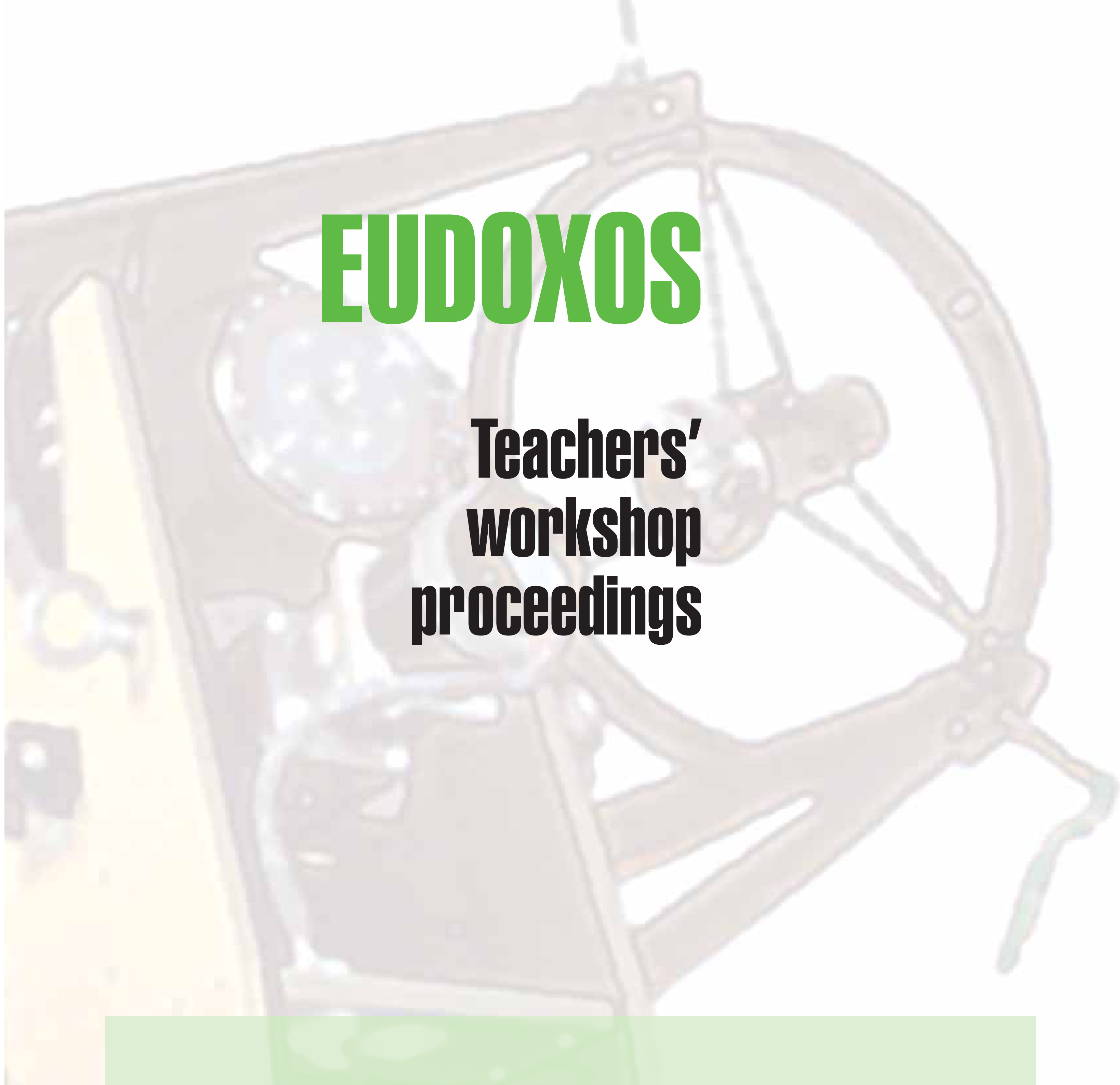

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Preface

The **Eudoxos project** aims at using the possibilities the Internet offers in order to transform the classroom into a research laboratory. The project studies the applicability of the emerging technology in the school sector and provides a platform that allows the students to use the Andreas Michalitsianos Telescope of the Eudoxos National Observatory for Education and Research in the framework of their school curriculum. The robotic telescope is installed on the Ainos mountain on Kefallonia Island, Ionian Sea, Greece.

In the framework of the project a user-friendly web based educational environment is being developed in order for the telescope to be operated via queue based scheduling by high school students and their teachers. The development of the educational environment is the outcome of the collaborative effort of scientists, peda-

The project's website:
www.ellinogermaniki.gr/ep/eudoxos

The participating countries in the Eudoxos project

gogical and software experts, technicians, teachers and students.

The project's implementation includes two cycles of school-centered work in real school environments in Greece, Italy, Spain and Austria. For the first cycle an adapted curriculum is being developed around a solid educational framework that captures the main learning objectives of the project (observation of the sun, the moon, planets, galaxies, nebulae, variable stars, eclipsing binaries), while during the second cycle the students and the teachers of the participating schools will have the chance to design and perform their own projects by using the telescope for their own direct astronomical observations.

The main aim of the Eudoxos project is to take advantage of the popularity of Astronomy among students and their attraction to the idea of using a first rate scientific instrument, in particular a high grade telescope, to learn concepts and ideas of science, of a multidisciplinary nature spanning through the areas of mathematics, statistics, chemistry, physics etc. and of cource astronomy, astrophysics and cosmology. The objectives of the project are the following:

- Development of a pedagogical framework that will allow the successful application of the advanced technology in science teaching.
- Enhancement of constructionist approach in science teaching.
- Enhancement of motivation of students.
- Enhancement of students' critical capacity.
- Development of new learning tools and educational environments.
- Development of a concrete evaluation scheme of the educational and technological aspects.

The project's evolution relies in parallel on the further development of the telescope (improvement of the access to it through the development of a higly user-friendly user interface, in order to be used for educational purposes) and the design and development of the appropriate pedagogical framework for the introduction of the scientific inquiry in science teaching at high school level. The pedagogical framework includes the necessary adjustements to the normal school curriculum, teachers training (on-line seminars and workshop) and support, development of lesson plans for the project's implementation in the classroom and development of the suitable educational material (conventional and electronic).

The above arguments indicate the significance of **Teachers' Workshop** in Eudoxos project's evolution. It was a major contacting event between the scientistic and pedagogical parthners expressing their close cooperation and the ideas of productive collaboration that govern the implementation of the project. It took place at the time period where the initial version of the web platform was available for testing in real pedagogical environments.

Teacher's Workshop: Explanation of the celestial coordinates

The aim of the **Teachers' Workshop** was to familiarize the teachers of the participating schools with Eudoxos' approach. It initiates the teachers' training phase of the project. During this workshop the Andreas Michalitsianos robotic telescope and the User Intarface were present to all participants and teachers had the chance to investigate and test these tools. Teachers had the chance to report appropriate modifications for the user-friendliness of the web platform. The evaluation methodology of the project was presented analytically and there were valuable discussions on the the pedagogical aspects concerning the implementation of the project in the school.

Additionally in the workshop there was a detaled discussion on the proposed pedagogical framework and on the necessary adjustments to the curriculum of each of the participating schools.
The teachers represented the participating schools, namely IT IS Pininfarina school from Italy, Colegio Publico Rural Campina de Tarifa, Bundesgymnasium und Bundesrealgymnasium Schwechat from Austria and Ellinogermaniki Agogi from Greece.
The evaluation scheme of the project was presented by University of Cadiz (specific the group LACE which the field of expertise is the evaluation of Educational and Social Programmes) and the pedagogical framework was presented by Management Center Innsbruck. The User Interface, the implementation plan and the project's lesson plans were presented by NCSR Demokritos and Ellinogermaniki Agogi.

Teachers' Workshop Agenda

Friday March 28, 2003

09.30 Welcome - Introduction
G. Fanourakis - NCSR Demokritos

10.00 The Eudoxos site and the e-tool
E. Anastasiou, N. Andrikopoulos - Ellinogermaniki Agogi

11.00 Coffee break

11.30 The Eudoxos evaluation plan
G. Fanourakis - NCSR Demokritos

12.30 The lesson plan "Measuring the Size of Saturn's Rings!"
N. Solomos - NCSR Demokritos

13.30 Lunch

15.00	The lesson plan "Shandows on the Moon" *G. Fanourakis - NCSR Demokritos*
16.00	Coffee break
16.30	The lesson plan "Does the Sun Rotate?" *O. Korakianitis - Ellinogermaniki Agogi*
18.00	Videoconferencing with the LACE group at University of Cadiz

Saturday March 29, 2003

10.00	Eudoxos Lesson Plan for Primary Schools *M. Quilez - Colegio Publico Rural Campina de Tarifa*
11.00	Coffee break
11.30	The lesson plan "Asteroids Rotation Periods" *K. Zaxariadou - NCSR Demokritos*
12.30	Implementation of the lesson plans
13.30	Lunch
14.00	Discussion on implementation and evaluation issues
16.30	AOB
17.00	End of Meeting

Implementation Scheme

The project's implementation includes **two cycles of school-centered work** in real school environments.

For the first cycle an adapted curriculum has been developed around a solid educational framework that captures the main learning objectives of the project (observation of the sun, the moon, variable stars, eclipsing binaries), while during the second the students and teachers of the participating schools will have the chance to design and perform their own projects by using the telescope (determination of the orbital elements of asteroids (minor planets in the solar system and other ambitious projects and experiments) from their own direct astronomical observations.

Students in Eudoxos Observatory

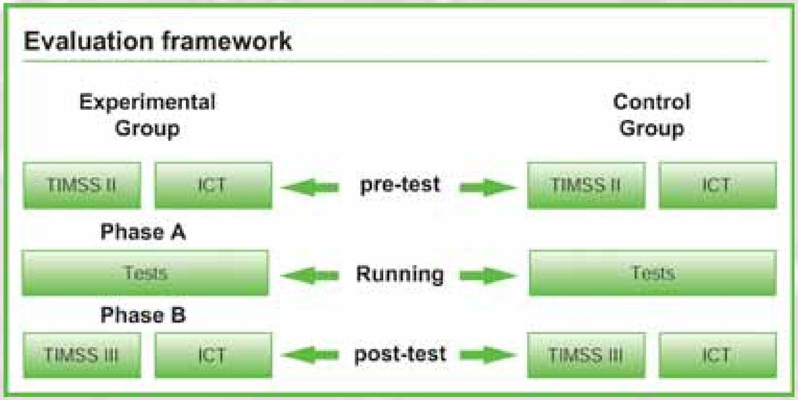
The project will be implemented initialy in schools in Greece, Italy, Spain and Austria, while during the second cycle of school centered

Using the telescope during the lessons

work more schools will be allowed to the network from other European countries.

The project's approach includes the nesesary adjustements to the normal school curriculum, teachers training (on-line seminars and workshop) and support, development of lesson plans for the project's implementation in the classroom and development of educational material (conventional and electronic).

The classroom activities has been based mainly on observations with the telescope, however, input with information from other more powerfull telescopes including the Hubble telescope and radiotelescopes or other astronomical instruments located on earth or in space, will be also used to enhance the validity of the scientific ideas and the educational value of the project.



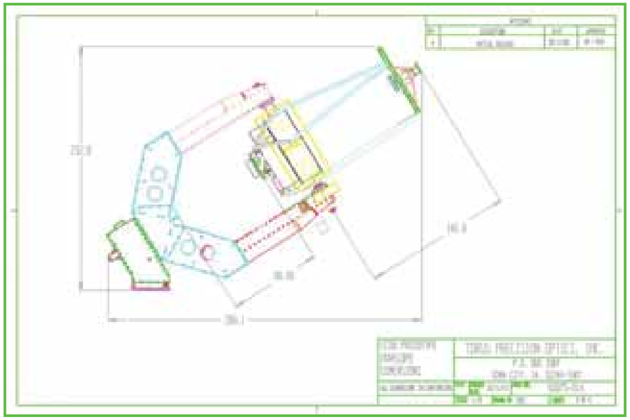
The evaluation scheme, evaluation will proceed in parallel with the final run

Andreas Michalitsianos Robotic Telescope

The **Andreas Michalitsianos** is a 60cm Cassegrain type remotely controlled robotic telescope. It consists of a fully autonomous computerized telescope, automated enclosure, meteorological sensors, and a large format imaging CCD camera with photometric filters as well as a fleet of peripheral instruments currently under construction.

The facility is located 16 km SE of Argostoli, Kefallonia Island, Greece at a plateau 600m below the peak of mount Ainos (height 1628m). It is housed in a former military communications base of the Hellenic Air Force, 30.000 m^2 in extend, donated to the "Eudoxos" establishment.

All equipment is completely controlled by two central computers



which communicate via a local ISP to the participating secondary schools and institutions. An innovative automated telescope control and analysis software system controls the entire installation which is backup-powered by 4x15-kW emergency generators.

The Andreas Michalitsianos Telescope was constructed by TORUS Technologies USA according to the specifications set by the "Eudoxos" collaboration. It is a computer-controlled classical cassegrain telescope system designed for serious research. The optics, mechanical construction, and control system are of the highest-quality. The tracking, pointing accuracy, and precision of this telescope system are extraordinary, making them ideal for CCD imaging, search programs requiring high repeatability, remote operation, automated operation, and other demanding applications. The Andreas Michalitsianos Telescope control system supports observations through internet and is governed by ΛETAM an evolved version of "TALON", in such a way that highly successful robotic observatory software is linked with one of the most sophisticated and powerful control systems designed for ASTs.

A Web-based interface allows anyone with internet access to select, observe, and retrieve their own astronomical images.

The Telescope was named "Andreas Michalitsianos" to honour the memory of Andreas Michalitsianos (1947-1997) the eminent Cephalonian Astrophysicist and Director of the Laboratory for Astronomy & Solar Physics of NASA, not only symbolically -for his early contact with robotic astronomy at Kitt Peak (in the-70s)- but for his profound scientific originality, experimental skills and steep rise in astronomy since the age of 16, which offers a unique bright paradigm to the younger generation.

Andreas Michalitsianos Technical Data

Optics	f/6 0,6 m
Field of View	~30 arcmin (uncorrected) ~50 arcmin (corrected)
Accuracy of pointing	<10 arcsec ±2 arcsec RMS
Theoretical pointing accuracy	<0,27 arcsec
Tracking accuracy	2’’ in 20 min
Access Speed	10 deg/sec
Control	Local, remote, Autonomous
OS	LINUX

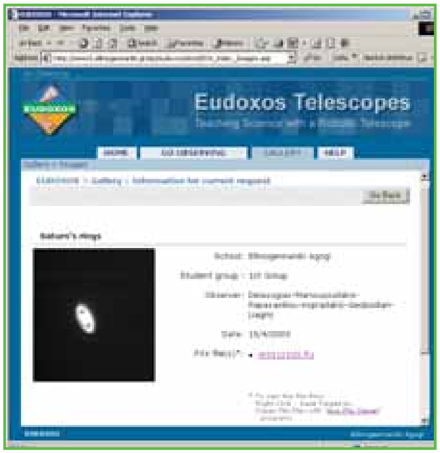
Presentation of the User Interface

The Eudoxos project brings the opportunity to use a remotely controlled telescope in a real-time, hands-on, interactive environment to students around Europe. It enables students to increase their knowledge of astronomy, astrophysics, and mathematics; improve their computer literacy; and strengthen their critical thinking skills.

The User Interface is considered to be one of the most valuable Eudoxos components. It has been developed to be an adding tool that will bridge science teaching and technology. This software educational tool will support teachers and students in the new learning environment and will be at the same time compatible with graphics and analysis software components, so students can easily investigate trends and patterns in the data they collect by using the telescope.

Four steps for an astronomical observation

Selecting an object to observe



Downloading images from Eudoxos Gallery

Students will be able to graphically view all quantities under study and the data correlations through a scatter diagram on the computer screen. This specially developed interface will also be used for data download (transfer from the telescope), analysis and presentation of data, in an organized educational way.

The main emphasis on the user interface is the improvement of the interaction between students and the universe of digital services. The project also has an equally important goal at the level of the social dimension of learning. It will be attempted to overcome the limits of the classroom by having a network of schools gathering the same type of data and asking the students to compare their findings and exchange their ideas. The User Interface will help students recognize that the scientific method can be used to study astronomical phenomena in their school class.

Research will thus become a collective process, whereby the interactions will not merely be at the level of data analysis but at the level of the formulation of hypotheses, exchange of opinions, announcement and communication of results using the collected data that will be regularly submitted to a Web database.

The user has to follow four easy steps in order to make an astronomical observation using the Eudoxos e-tool.

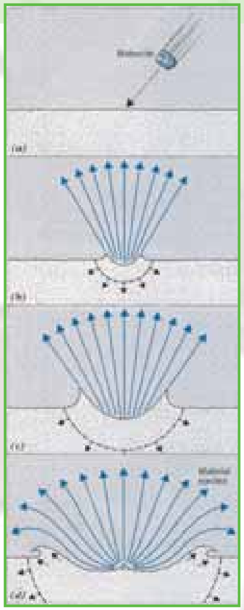
1. Choose Telescope
At first the user has to choose the appropriate telescope (Andreas Michalitsianos or Apollon telescope) for the observation.

2. Check the Weather
Next the user has to visit the weather forecast for Kefallonia Island.

3. Select an Object to Observe
The User has to select an object to observe using the sky map.

4. Fill in the Form and submit the Observing Proposal
Finally the user has to fill in the Submission Form and submit the Observing Proposal to Eudoxos Observatory.

Presentation of the Lesson Plans



A series of lesson-plans has been developed to be implemented in classroom during the first cycle of the school-centered work. The lesson plans are in accordance with the science curriculum of the participating schools and are designed to utilize the experimental capabilities of the robotic telescope. The aim is to implement these lesson scenarios for the familiarization of the students with the idea of scientific investigation in order to reach the last stage of the work in the school environment. At the final cycle of the school-centered work students and teachers will have the opportunity their own projects for observations.

Each lesson plan consists of two main parts; the first part gives general information concerning the lesson. It is based on the curriculum and provides details for the implementation in classroom. In this part information about the time duration, vocabulary, the tools and the materials necessary for the observation are given.

The educational aims of the each activity are specified and categorized in general and more specific didactical objectives. Finally the usual student's misconceptions on the teaching subject are presented to teachers in order for them to have a better notion on what students believe.

The second part of the lesson plans provides information about the pure educational phase of the lesson. This is the part where ideas to stimulate students are proposed and the observational activities are described. Discussion, observation and analysis of the data are proposed as well, while the expected conclusions that should be the outcome of the lesson are listed. In order to assist consolidation, a series of exercises and questions and further activities are proposed.

Four lesson plans have been developed so far, namely:

1. Shadows on the Moon
2. Measuring the Size of Saturn's Rings
3. Does the Sun Rotate?
4. Asteroids Rotation Periods

The lessons are presented in the following:

1. Shandows on the Moon

CLASS : Technology, Astronomy or Physics
GRADE : Senior High School

1.1 Educational outcome:
To learn, by applying their knowledge of geometrical optics and using simple mathematics, how to estimate the height of the lunar craters.

1.2 Purpose:

- To get familiar with selecting, planning and performing research activities.
- To acquire the ability to draw information by using simple computational methods.
- To exercise in observing, describing and explaining physical phenomena.
- To investigate the properties of a physical entity with the use of geometrical optics.

1.3 Educational approach:
The students use the experimental method (observation-collection of experimental data and their analysis) to record and analyze data in order to study a cosmic physical phenomenon and estimate its parameters. The phenomenon under study is the presence of craters on the moon created by falling meteorites. The lesson involves the observation of selected craters, with the Andreas Michalitsianos robotic telescope of the Eudoxos center for education and research, and the estimation of the height (depth) of the craters.

The Moon

1.4 Equipment tools:

- Telescope
- A personal computer with internet connection
- A sheet of paper, a pencil
- A ruler

Initial Instructions: A necessary requirement for the estimation of the height of a crater is the fulfillment of a particular geometrical arrangement of the moon, the sun and the earth in the sky. I this geometry the line connecting the center of the sun with the center of the moon is perpendicular with the line connecting the moon with the earth. This happens during the first and third quarter of the moon phases. This defines the nights for the observation of the moon.

1.5 Short description:

The students organize and perform an experiment with the purpose to determine (estimate) the height of selected lunar craters. The realization of the experiment is accomplished by observing the moon with the AM telescope and collecting images of the moon for further analysis. The final procedure involves the estimation of the height of a particular crater and the announcement of the results in the special datesheet.

Measuring the craters' shandows using the Eudoxos images

1.6 The structure of the lesson:

Introduction

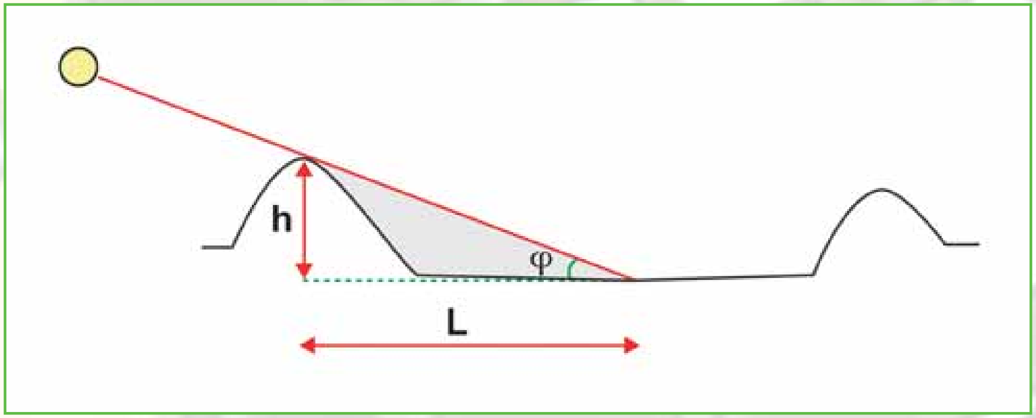
A method of determining the height of mountains or craters on the surface of celestial objects is by studying the shadows they cast on their surfaces. This method was used when NASA and USAF, in the United States, planned the Apollo missions to the moon. Very detailed and high-resolution images taken by satellites were analyzed to determine proper landing areas. The heights of surface elements of the moon were determined by measuring the length of their shadows on these images.

The same method slightly modified will be used in this experimental approach to estimate the height of the lunar craters not from satellite images but from images taken by the students using the earth-based telescope AM of the Eudoxos observatory.

Detailed description of the teaching procedure

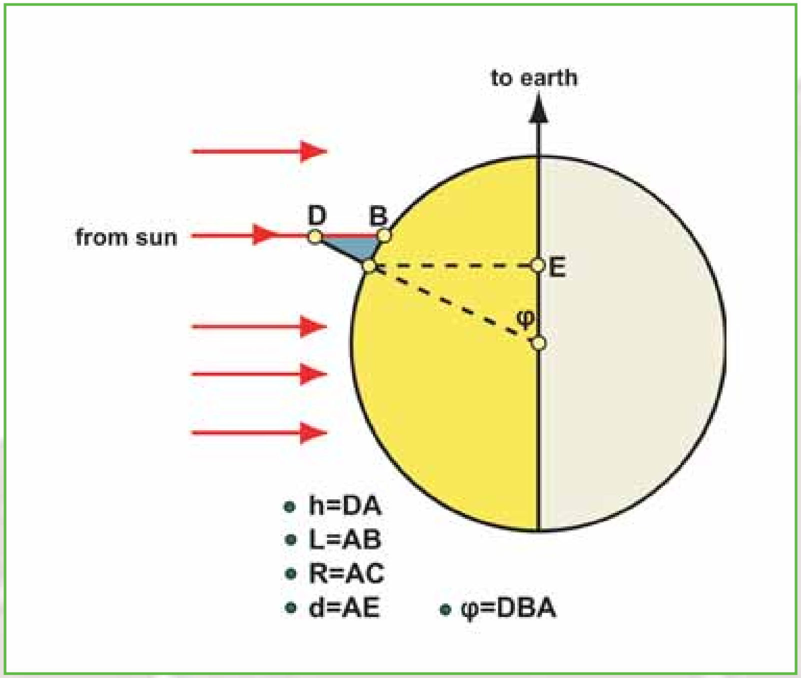
The students will access the web site of Eudoxos that will guide them to conduct the lesson-experiment. At start, they should study the theory involved. This is a necessary step to be taken in order to be able to follow and understand the instructions.

This also involves the procedure of the determination of various parameters, which are needed in the estimation of the height of the craters. Subsequently, guided by the users interface, the students will find the celestial coordinates of the moon and direct the telescope to take the proper image. The telescope control system will send the image taken to the students for further processing.



Estimating the height of a crater

The analysis of the image involves measuring the length of the shadow as well as certain distances in terms of pixels. After using the measurements to define the real length of a pixel the height of the crater can be estimated and also the accuracy of the measurement.



Estimation of the angle φ

2. Measuring the Size of Saturn's Rings!

CLASS : Technology, Astronomy or Physics
GRADE : Senior High School

2.1 Educational outcome:

- To learn how to organize and perform an astronomical observation by using an advanced scientific instrument and modern Internet technology, to analyze the acquired data and report the results of the analysis.
- To learn, by applying their knowledge of geometrical optics and using simple mathematics, how to measure the size of Saturn's rings.

The Saturn

2.2 Purpose:

- To get familiar with selecting, planning and performing research activities.
- To acquire the ability to draw information by using simple computational methods.
- To exercise in observing, describing and explaining physical phenomena.
- To investigate the properties of a physical entity with the use of geometrical optics.

2.3 Educational approach:

The students use the experimental method (observation-collection of experimental data and their analysis) to record and analyze data in order to study a cosmic physical phenomenon and estimate its parameters. The phenomenon under study is the presence rings around the planet Saturn. The lesson involves the observation of Saturn’s rings, with the Andreas Michalitsianos robotic telescope of the Eudoxos center for education and research, and the estimation of their size (diameter).

2.4 Equipment required:

- Telescope
- A personal computer with internet connection
- A sheet of paper, a pencil
- A ruler

Initial Instructions: The only prerequisite is that Saturn and the extremities of its rings are clearly visible.

2.5 Short description:

The students organize and perform an experiment with the purpose to determine (estimate) the size of Saturn's Rings. The realization of the experiment is accomplished by observing the Saturn with the AM telescope and collecting images of the Saturn for further analysis. The final procedure involves the estimation of the size of Saturn's Rings and the announcement of the results in the special datasheet.

The Saturn's rings

2.6 The structure of the lesson:

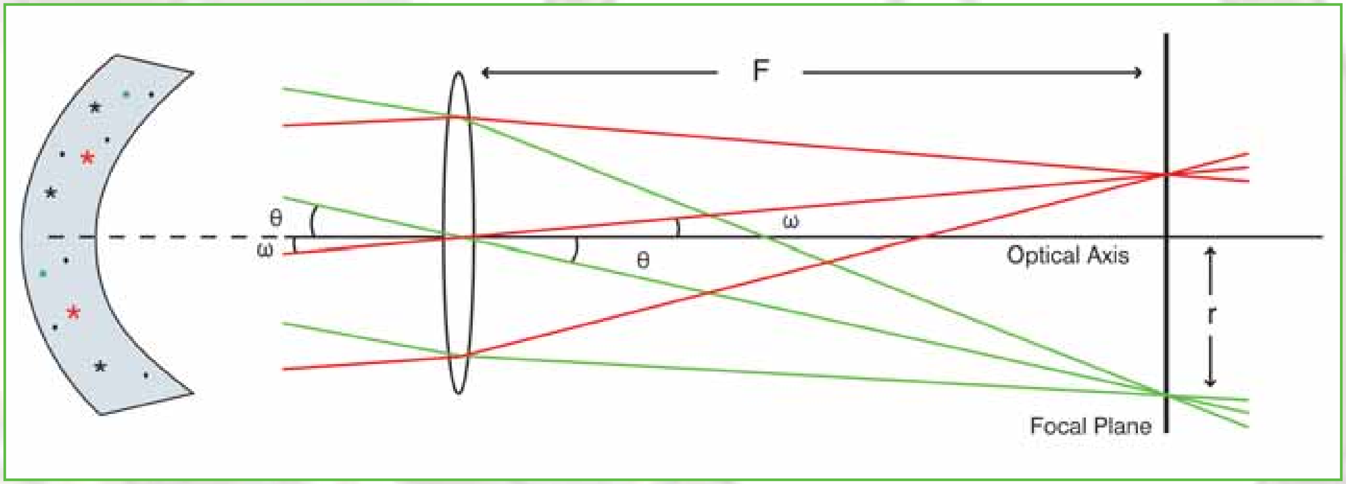
Introduction

In order to measure the size of an object, if we know its distance from Earth we just need to measure its angular size -i.e. the angle that it subtends in the sky. But since we are using images through the telescope made on a sensor (CCD chip) to do that measurement we first need to know how the telescope forms those images.

Detailed description of the teaching procedure

The students will access the web site of Eudoxos that will guide them to conduct the lesson-experiment. At start, they should study the theory involved. This is a necessary step to be taken in order to be able to follow and understand the instructions. This also involves the procedure of the determination of various parameters, which are needed in the estimation of the size of Saturn's rings. Subsequently, guided by the users interface, the students will find the celestial coordinates of Saturn (or simply select Saturn from the

Object's list) and direct the telescope to take the proper image. The telescope control system will send the image taken to the students for further processing. The analysis of the image involves measuring the length of the distance between two extreme points of a ring in terms of pixels and then transforms this distance to an angle on the sky. After using the measurements to define the real length of a pixel the size of the ring can be estimated and also the accuracy of the measurement.



Estimating the size of Saturn's rings

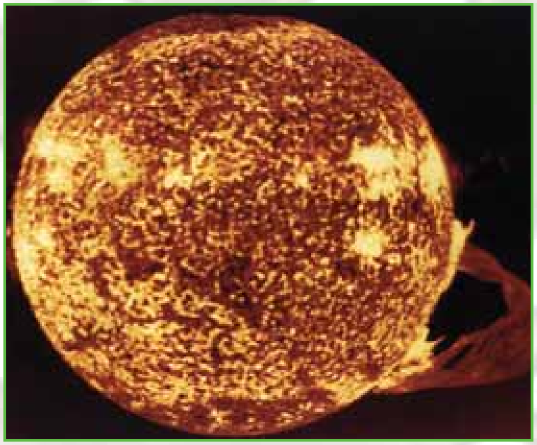
3. Does the Sun Rotate?

CLASS : Technology, Astronomy or Physics
GRADE : Senior High School

3.1 Educational outcome:
To learn, by applying their knowledge of geometrical optics and using simple mathematics, how to estimate the solar rotation.

3.2 Purpose:
- To get familiar with selecting, planning and performing research activities.
- To acquire the ability to draw information by using simple computational methods.
- To exercise in observing, describing and explaining physical phenomena.
- To investigate the properties of a physical entity with the use of geometrical optics.

The Sun

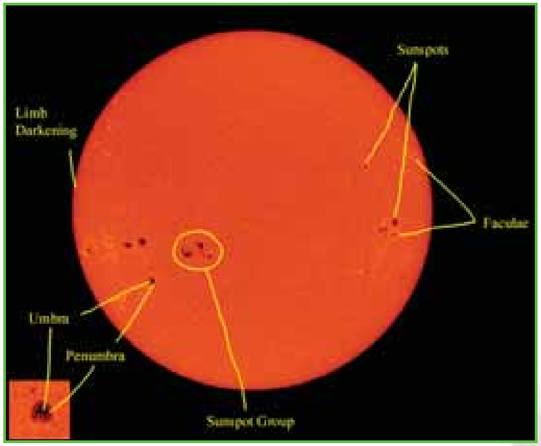


3.3 Educational approach:
The students use the experimental method (observation-collection of experimental data and their analysis) to record and analyze data in order to study a cosmic physical phenomenon and estimate its parameters. The phenomenon under study is the solar rotation. The lesson involves the observation of selected sunspots, with the Apollon robotic telescope of the Eudoxos center for education and research, and the estimation of the solar rotation.

3.4 Equipment required:
- Solar telescope
- A personal computer with internet connection
- A sheet of paper, a pencil

- A ruler

Initial Instructions: Never attempt to view the Sun through a telescope, however small, without a suitable filter that blocks the harmful solar radiation and dims the image enough to be comfortable to the eye.



Solar activity

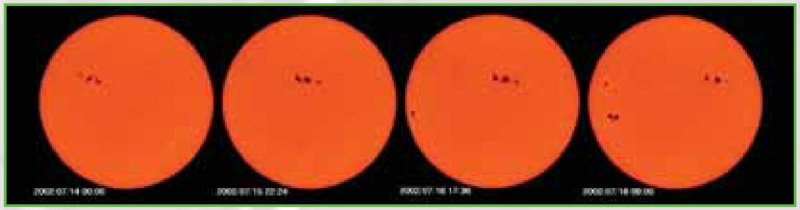
3.5 Short description:

The students organize and perform an experiment with the purpose to determine (estimate) the solar rotation. The realization of the experiment is accomplished by observing the sun with the Apollon telescope and collecting images of the Sun for further analysis. The final procedure involves the estimation of the solar rotation and the announcement of the results in the special datasheet.

3.6. The structure of the lesson:

Introduction

The Sun is the closest star to Earth and therefore it gives us the opportunity to study it in great detail, since we can resolve features on its surface even with small telescopes. Historically the first observations of such features were by Galileo Galilee, who was surprised to observe mysterious black spots, with a very small telescope that he had constructed himself. Although, it is possible that very large spots could have been observed even with the unaided eye at sunset or sunrise in the ancient times, the study of the Sun and continuous dependable records of its activity start with the telescope.

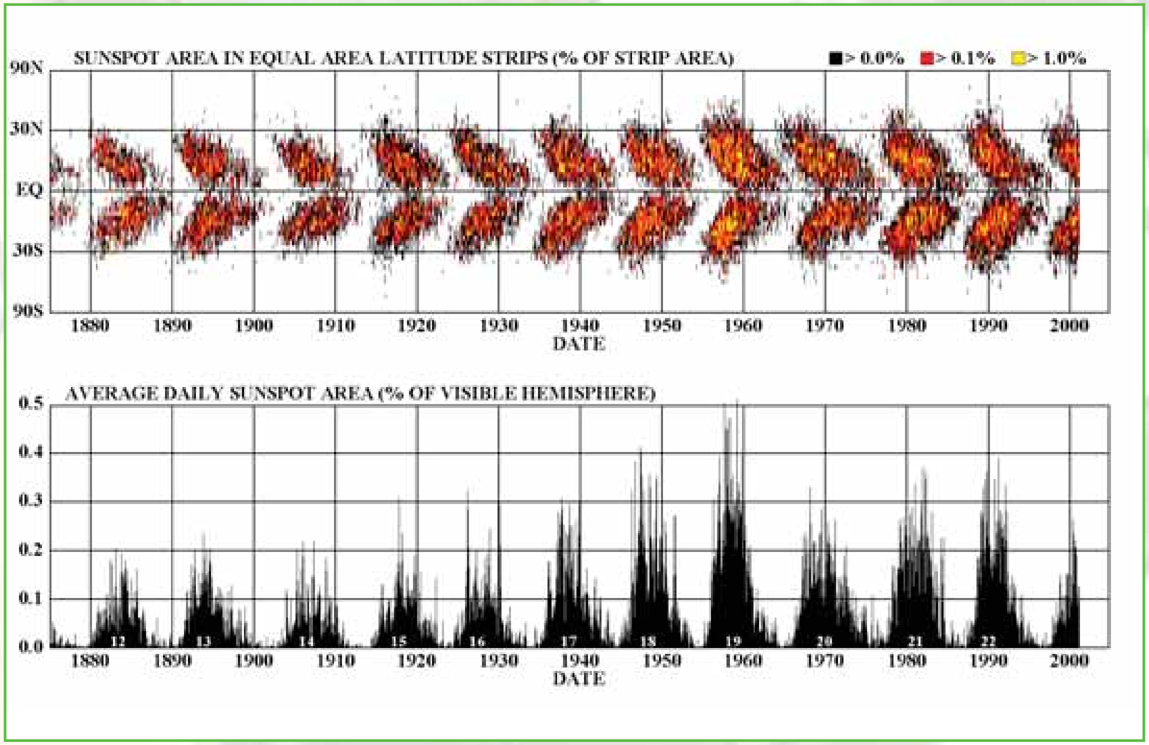


Observing sunspots during a five days time

Detailed description of the teaching procedure

The students will access the web site of Eudoxos that will guide them to conduct the lesson-experiment. At start, they should study the theory involved. This is a necessary step to be taken in order to be able to follow and understand the instructions. This also involves the procedure of the determination of various parameters, which are needed in the estimation of the solar rotation. Subsequently, guided by the users interface, the students will find the celestial coordinates of the sun and direct the telescope to take the proper image. The telescope control system will send the image taken to the students for further processing.

The Butterfly diagram



The analysis of the image involves measuring the coordinates of a solar feature in terms of pixels. The sunspots above all other features are carried along with the rotation of the Sun and therefore by measuring their motion it could be possible to measure the rotation period of the Sun.

The number of Sunspots varies roughly periodically with a period of 11 years. In addition to the variation in the number of sunspots, their location on the surface of the Sun changes over the Sunspot cycle. As the activity of the Sun increaces the appear closer to the equator of the Sun, producing the so-called butterfly diagram.

4. Asteroids Rotation Periods

CLASS : Technology, Astronomy or Physics
GRADE : Senior High School

4.1 Educational outcome:
To learn, by applying their knowledge of geometrical optics and using simple mathematics, how to estimate the Asteroid rotation.

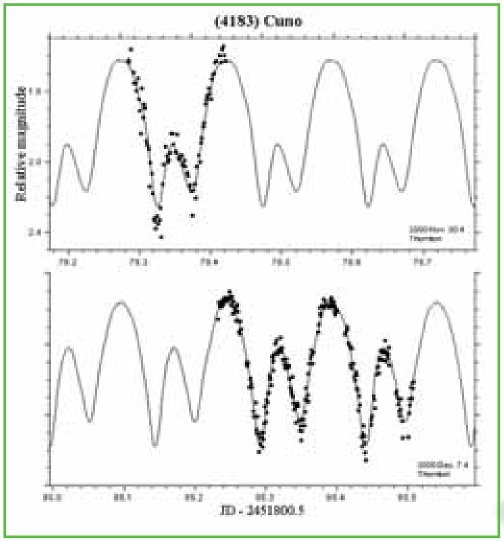
4.2 Purpose:
- To get familiar with selecting, planning and performing research activities.
- To acquire the ability to draw information by using simple computational methods.
- To exercise in observing, describing and explaining physical phenomena.
- To investigate the properties of a physical entity with the use of geometrical optics.

The Asteroid 433 Eros

4.3 Educational approach:
The students use the experimental method (observation-collection of experimental data and their analysis) to record and analyze data in order to study a cosmic physical phenomenon and estimate its parameters. The phenomenon under study is the presence of asteroid rotation. The lesson involves the observation of selected asteroids, with the telescope of the Eudoxos center for education and research, and the estimation of the rotation periods.

4.4 Equipment tools:
- Telescope
- A personal computer with internet connection
- A sheet of paper, a pencil

- A ruler



Photometric light curves from asteroid 4183 Cuno taken a week a part

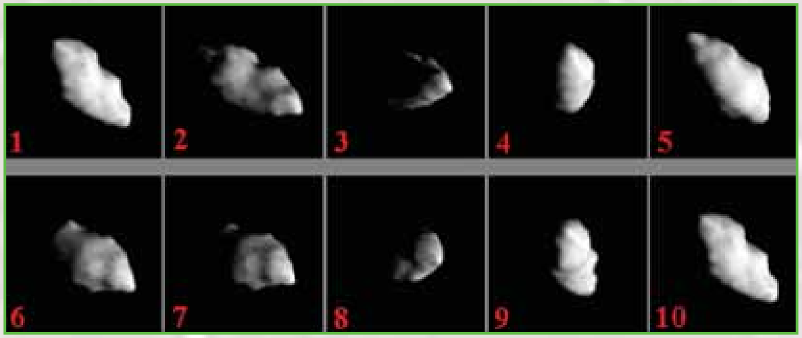
4.5 Short description:

The students organize and perform an experiment with the purpose to determine (estimate) the asteroid rotation periods. The realization of the experiment is accomplished by observing the moon with the telescope and collecting images of asteroids for further analysis.

4.6 The structure of the lesson:

Detailed description of the teaching procedure

The students will access the web site of Eudoxos that will guide them to conduct the lesson-experiment. At start, they should study the theory involved. This is a necessary step to be taken in order to be able to follow and understand the instructions. This also involves the procedure of the determination of various parameters, which are needed in the estimation of the asteroid rotation period.



A sequence of views from Earth of asteroid Geographos that demonstrates how the cross-section varies with time

Presentation of the Evaluation Scheme

The evaluation scheme of the Eudoxos project was presented in detail to the teachers during the workshop. The evaluation of the project is going to be performed on three aspects: evaluation of student's learning, evaluation of the underlying pedagogical framework and ethnographical evaluation.

Evaluation of the student's learning. In assessing student's learning, student's engagement in science as inquiry will be primarily examined. It is believed that the activity of designing projects and experiments provides a powerful way for students to become meaningfully involved in scientific inquiry. In this way the dimension of self-expression will be introduced, something that is often missing in science education. Prompting students to see all sorts of daily activities, as possible subjects of both formal and informal scientific investigation will increase their motivation. Furthermore, the proposed approach will help students in developing critical capacity and deeper understanding of the scientific concepts underlying the investigation. Finally students will gain firsthand experience in the ways that technology can both serve and inspire scientific investigation.

Evaluation of the pedagogical framework. The major theoretical issue underlying the proposed project is whether the implementation of the advanced technologies could offer a qualitative upgrade to the science teaching at the high school level. In such a case the introduction of technology would not act as a substitute of the conventional teaching but rather as an add-on that has to justify its introduction through the qualitative upgrade it offers to everyday school practice.

Ethnographic evaluation. The project will take advantage of the different school environments across Europe and will study the attitudes of students and teachers with different cultures towards the implementation of ICT in education as well as the attitudes between students themselves coming from different countries.

During the project's implementation and especially during the final run all the above-mentioned dimensions are going to be evaluated according to a systematic research plan which will include both measurements and on field observations for both students and teachers.

A two group (experimental and control group) design will be adopted for the measurements in the case of the students. The data will be statistically analysed with numerical methods and the results will be systematically evaluated. For the on field observations the partnership intents to use the pre- and post tests, which are performed to evaluate the effectiveness of the settings regarding the students' knowledge acquisition. The test is an excellent tool to test differences between nations (it is internationally validated on a RASH-scale).

<table>
<tr><th colspan="3">PHASES OF THE EVALUATION OF THE PROJECT</th></tr>
<tr><td colspan="3">1st Phase: Exchange detailed information about the participants.
March 2003.</td></tr>
<tr><td rowspan="2">2nd Phase: Evaluation during the process of Implementation of the project.

April, May and June 2003

October, November, December 2003 and January 2004.</td><td rowspan="2">Use of the Evaluation tools:

Teachers' Diaries
Students' Portfolios
Inter-School Collaboration Journals</td><td>Analysis of the process of preparation:
Lessons
Technical aspects (e-tool)</td></tr>
<tr><td>Analysis of the implementation process.</td></tr>
<tr><td>3rd Phase: Production of Summary Documents

January and February 2004.</td><td colspan="2">Each school produces:

Summary of Teachers' Diaries
Summary of Students' Portfolios
Summary of the Inter-School Collaboration Journal
Conclusions/Recommendations.

To be translated into English.</td></tr>
<tr><td>4th Phase: Production of the Final Report

February and March 2004.</td><td colspan="2">UCA will take responsibility for the production of this report.</td></tr>
</table>

EUDOXOS

Pedagogical Aspects

One of the main goals of the Eudoxos project is to study the applicability of the emerging technology in the school sector. This will be tested by providing a platform that will allow learners to navigate a telescope in the framework of their normal school curriculum. Aim is to demonstrate in practical terms how e-learning can improve and enrich the quality of the learning and teaching process in science and technology.

Within this given context the pedagogical approach consists of providing an adequate frame for improving teaching and learning in school education. Lesson plans and methods can be enhanced and adapted according to the national curricula of each participating country. However, as a second step it needs to be kept in mind that technologies provide new educational potentials which are still not sufficiently reflected in school curricula. Besides improvements to be achieved with the given technologies new pedagogical (constructionist) approaches for science teaching are supported as well which allow learner-centred approaches to be implemented such as project-based or problem-based learning (setting up own experiments and performing observations etc.). As consequence national curricula will need to be adapted as well taking into account the new possibilities given by the integration of the remote control of the Eudoxos telescopes. Taking into account the cultural differences in European school education (curricula, pedagogy and learning approaches) this task will need to be performed at a national level in each partner country.

As consequence there cannot be a common pedagogical approach applied by all project partners in all countries. Due to the diversity of schools, their curricula, users (including age of learners), lessons, missions and needs - any kind if pedagogical suggestion needs to be down-scaled to the local contexts and cultural background. Namely different school subjects and classes (age groups) involved make it impossible to formulate one singular pedagogical approach. However, an example of the application of the proposed lesson plans in the local context of the Ellinogermaniki School, Greece, is annexed to the implementation plan. It will serve as a reference for the adaptation to local school contexts.

Project benefits are given to a wider audience as well. Next to teachers and pupils of the participating school bodies, European school education in general will be a potential beneficiary of the project outcomes. This will need to be reflected in the follow-up of the project and dissemination activities. Furthermore informal learning potentials for the European public will be kept in mind as well during the design process of the Internet-based electronic environment.

There are various aspects how information technology is used in education: as a platform for the development and delivery of products for teaching and learning and as a tool for the organisation of the learning contents and resources as well. This covers relevant aspects about environments and courses which cannot be analysed separately due to their inter-dependency. The question arises as to whether open and flexible learning environments built on information technology, as provided by the Eudoxos project, will lead us to qualitatively better, more effective and more efficient education and how these new educational models have to be brought about. This will be analysed during the project. The evaluation shall provide new insights into practises and adequate approaches for the remote telescope application in school education.

However, instructional methods and the quality of courses in traditional and virtual settings can hardly be compared, since it is the whole setting of the educational activities which must be considered too.

In the framework of the Teachers' Workshop, participants had the chance to examine the Eudoxos e-tool themselves. The idea was to investigate Eudoxos e-tool capabilities and record their remarks, comments and suggestions on what they have been presented. The aim was to initiate a dialogue on the pedagogical aspect of the project. The feedback from the teachers and the users of the Eudoxos e-tool in general is considered as a very important parameter for the progress of the project and thus teachers' contributions are valuable.

EUDOXOS

Moments of the workshop

Presentation of the Lesson Plan "Shandows on the Moon"

Short discussion on Celestial Coordinates

Explanation of the estimation of the craters' height

Move about the Celestial sphere

Presentation of the Eudoxos User Interface

Teachers from Spain and Greece

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