

Open Instruction within the Framework of a School Astronomy Team

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Astronomy outclasses all the other natural sciences by the ability to attract students of all ages out of the school building and let them take part in impressive phenomena of the sky.

Introduction

The Astronomic Society shapes criteria for a proper instruction in natural sciences in her Memorandum [1]. On the one hand it demands teaching of natural sciences by direct observation of natural phenomena, and on the other hand the Society wants to let the students take actively part in the process of "science" by means of discovering learning. Thereby school with its traditional education concepts has to be opened in different dimensions.

Since 1993 there has existed an astronomy team at the Kopernikus Gymnasium in Wissen (Leaders: Peter Stinner and Anke Wendt), that tries to arouse the students' interest for astronomic phenomena. In a variety of projects we have tested new structures, methods, and contents of instruction. The basic intentions were the "opening of school and teaching", and the combination of different school subjects [2].

Opening of school and instruction

The aim of an ***opening in respect of content*** is a many-sided self-awareness and worldly wisdom. This aim can be reached first of all by an interdisciplinary, project-orientated procedure with a direct reference to everyday life.

A vital feature of a ***methodically opened instruction*** is an active organisation of their own process of learning by the students themselves. This means that the students take part in the planning of projects, that they may freely choose the learning group and the modality of their social arrangement. Especially astronomic projects provide a wide variety of material choice and issues.

The ***opening in respect of institution*** aims at the opening of school as institution with regard to the extracurricular reality. Thereby students ought to be enabled to experience, to arrange, and to change reality [3]. Our projects aim at particularly this dimension by a complex co-operation with extra-curricular partners in out-of-class-learning locations.

In the following we describe practical experience from projects of the astronomy working group at the Kopernikus-Gymnasium in Wissen embedded in the context of opening of school and instruction.

The astronomic working group in Wissen

The Astronomy team at the Kopernikus-Gymnasium in Wissen has existed since 1993. In addition to the later described more extensive projects we have started many

particular projects concerning at a time actual events in the sky: photographic excursions for the observation of comets, public observations at partial solar eclipses, lunar eclipses and the Venus-transit. The historical development of our world view was subject of a philosophic project.

Three central solar eclipses

You may find our experiences from interdisciplinary processes of learning at observation projects and experimental projects in the course of three central solar eclipses at [4]. These provide planning and experimental proposals for out-of-class-learning locations at thematical school trips, at stays in school youth hostels and at project days.

The solar eclipse trilogy started in 1999 with an excursion to South Germany. 20 students at the age of 11 to 18 could observe the total solar eclipse on the central path. They registered and documented the climatic-geographic effects in purposive experiments [5].

This excursion was a first step towards the institutional opening of school: We organized it in co-operation with the youth welfare office of our district. Interested young people of other schools were invited to take part. Our astronomy team constructed an exhibition showing the results of the excursion, which was presented to the public at different places of our home district. The project was chosen as contribution to "Physics on Stage 1".



Fig.1:Two of our students registrating the chronological sequence of the annular solar eclipse on 03.10.2005 in Spain

We organized a natural scientific field excursion to a annular eclipse in Valencia in October 2005. The students experimented project-orientated and interdisciplinarily in terms of the opening in respect of content. Matters of the curricula of astronomy, physics, geography, mathematics and informatics were used for the preparation, performance and evaluation of the experiments. The participating students, who were highly motivated, edited the results of their fotografic and climatic-physical experiments in an exhibition in the building of the local authorities in Altenkirchen, which had an intensive feedback in the public. Twelve forms of different kinds of schools took the opportunity to let themselves explain the genesis, the course, and the effects of sun eclipses with the help of demonstrative model experiments by our participants of the excursion.

During the total solar eclipse in Turkey in 2006 as well the members of our team carried out climatic-geographic and fotografic experiments. They presented the results to



Fig. 2: Climatic geographic experiments in the surroundings of the total solar eclipse on 29.03.2006 in Turkey

many school classes and in public in Wissen, where our school is located [6].



Fig. 3: Halogen lamp – metal ball – webcam instead of sun – moon - earth:

Two young visitors of the exhibition taking part in an experiment showing the geometric relations in total, annular, and partial solar eclipses.

The comprehensive public relations in the setting of the solar eclipses gave the students the opportunity to target the inhabitants of our district and let them take part in their work at out-of-class-learning locations in South Germany, Spain, and Turkey.



Fig. 4: A student of our astronomy team demonstrates our self made device for registering the zenith brightness: A sheet of white paper representing a white cloud is passing the "blue sky" (blue cardboard on the ceiling). The Y-T-recorder registrates a curve like that in the below-mentioned diagram of the zenith brightness about 13.00h and a few minutes past 14.30h.

Co-operation with Bonn University

Since 2001 the Argelander-Institute for Astronomy at Bonn University has regularly provided our students with the possibility to use its Observatory „Hoher List“ for observatory practical training. In the course of such trainings our students have the opportunity to observe at comparatively large telescopes and particularly with modern CCD-cameras.

The handling of such high-tech-instruments and the associated use of the computer for the collection and interpretation of data has proved to be an important factor of motivation for the future consequent preoccupation with experimental natural science.

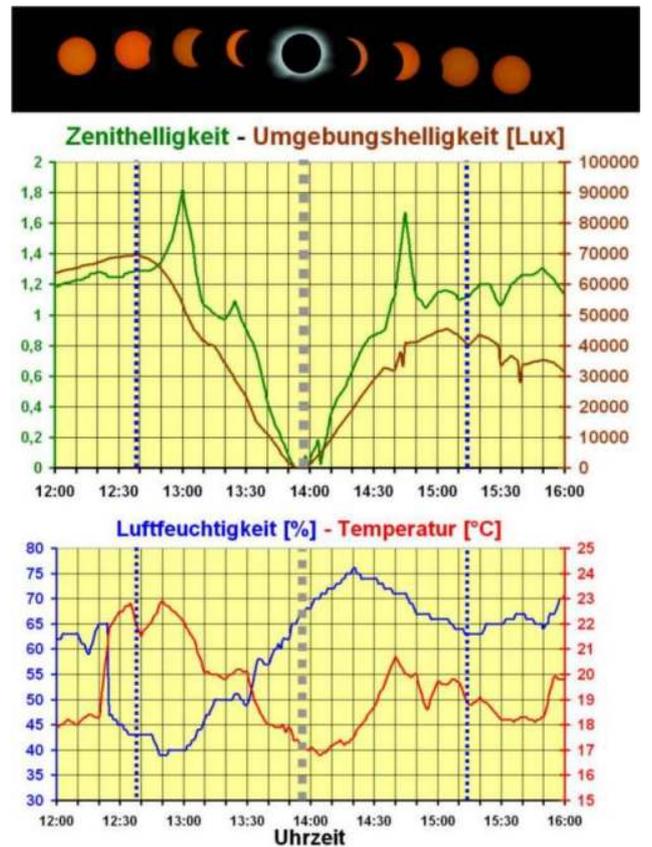


Fig. 5: Results of climatic geographic experiments at the solar eclipse 29.03.2006 in Turkey:

The upper continuous shooting of the chronological sequence of the solar eclipse shows the chronological development of the occultation of the sun. Beneath there are illustrated the developments of the zenith-brightness, the brightness of the total sky, humidity, and temperature in an identical time scale.

The thin spotted lines mark the first and the fourth contact. The broader interrupted bold print line marks the period of the total occultation of the sun.

The remarkable maxima at the zenith-brightness at 13.00h and shortly after 14.30h are caused by passing cirrus clouds and con trails of aeroplanes. This effect has only a minimal impact on the surrounding brightness shortly after 13.30h.

Astrophotography, observation of comets, video-astronomy, UBV-CCD-photometry and the co-operation in guided tours are parts of the practical training at the Observatory „Hoher List“. At the „Hoher-List-Colloquium“ in July 2006 four members of our working-group had the opportunity to present matters of their practical training to an audience of international specialists. Our practical training is an integral part of the „Student’s Academy Argelander“ under the direction of Dr. M. Geffert, which is in the phase of build-up.

At regular intervals the teachers of our group give lectures at teachers’ training courses at



Fig. 6: The Bolivia Astrograph is prepared for CCD observations with a ST6 camera



Fig. 7: A guided tour for visitors at „Hoher List“ by one of our students. Just now a video stream of the planet Saturn is pictured by means of a 60cm-RC-Telescope

the Institute in Bonn. In return scientists from Bonn enrich our public events in the school observatory in Betzdorf by their lectures. Since the school year 2006/07 members of our working group can serve their academic professional practical training at the Institute in Bonn. The thereby gained know-how is an enormous enrichment for the work in our astronomy team.

The reactivation of the observatory in Betzdorf

The lasting enthusiasm caused by the first practical training at „Hoher List“ in 2001 brought about that our group reactivated the astro dome of the Geschwister Scholl Realschule (junior high school) in the neighbour city Betzdorf, which was left vacant for decades, by installing a 8"-telescope and by regular observations.

Already in the winter of 2001/2002 we could start with the CCD-Observations for our "Physics on Stage 2"-Project "Colour

Magnitude Diagrams of Open Star Clusters". Using a self-created software we generated colour magnitude diagrams of eight open galactic star clusters from our own CCD-photographs, from which we deduced age and distance of the star clusters [7].

cluster (NGC-number)	distance modulus ($V_0 - M_v$)	distance (light years)	age (millions of years)
1528	8.9(0.3)	1990(280)	280(130)
1912 (M38)	9.75(0.35)	2940(480)	243(120)
1960 (M36)	10.4(0.35)	3980(640)	27(9)
2099 (M37)	9.9(0.6)	3230(880)	395(270)
2264	8.9(0.65)	2050(600)	59(23)
2281	8.1(0.3)	1370(200)	400(200)
2632 (M44)	6.4(0.4)	635(115)	580(320)
2682 (M67)	8.85(0.4)	1960(360)	1000(240)

Fig. 8: Results of the CCD-photometric experiments at „Hoher List“ and in the school-observatory in Betzdorf:

We were successful in determining the age and distance of eight galactic star clusters from our own CCD-photographs by the analysis with self-constructed software.

For the redoing of this astrophysical project with other learning groups there are CCD photographs, soft-ware for analysis and a manual available.

A series of events in the observatory

Our students organise events for groups from kindergartens and schools. They open the observatory for all interested people when there are special occurrences. We established three series of regular public events in the observatory to satisfy the large interest in astronomy in all classes of population. These are described in the following as further samples for the opening of school in respect of institution. The students exchange their role as learner for the role of teacher: They impart their knowledge and experience and last not least their enthusiasm.



Fig. 9: The Geschwister-Scholl-Realschule with the 3m-Baader-Dome in the Betzdorf quarter Struthof: A gallery encircles the whole dome, and allows common observation even to larger groups.

The Betzdorf Astronomy Eves

The astronomy eves at Betzdorf are mainly directed towards adults. We started 2004 with a lecture about the „Structure of the Universe“ by P. Stinner. In 2005 we officially celebrated the dedication of the reactivated observatory with the second event. Dr. M. Geffert from Bonn University was the special guest and speaker with the topic „Extraterrestrial Life?“ In the following events the main lecturers were Prof. Dr. U. Backhaus from Essen (2006, „The Movement of the Planets in the Sky and of the Earth round the Sun“) and Prof. Dr. W. Seggewiß from Bonn (2007, „Target Earth – Celestial Missiles Threaten Life on Our Planet“).

Our students are involved in the preparations for the Betzdorf Astronomy Eves in key positions. They present their projects before the main lectures to a large audience, they attend to the guests, they frame the events with live music, and they instruct interested visitors in the observing with the telescope.

Nationwide Astronomy-Days

The „Vereinigung der Sternfreunde“ (VdS) every year announces one Saturday of September as „Astronomy-Day“. Since 2004 the school observatory in Betzdorf has taken part in this event. Predominantly families with their children and juveniles make use of the offered Astronomy-Day. In the afternoon we afford the opportunity to observe the sun, and from the beginning of dawn the paragon objects of the autumn sky are in the focus of observation. In addition we offer guided tours in the observatory, lectures, researcher-

experiments and poster exhibitions, even if the sky is cloudy.



Fig. 10: The fourth nation-wide astronomy day on 16. September 2006 at the school observatory in Betzdorf: Young visitors observing the sky with a Maksutov Cassegrain telescope.

„Astrokids“ - astronomy for children

Several times during the winter term we invite astrokids at the age of 8 to 12 to our school observatory in co-operation with the youth welfare office. At first the kids construct rotatable celestial charts. They practise the handling (depending on the weather) either under the night sky or with the help of an artificial starry sky, which is conjured on the wall of the classroom by means of a data projector. Such an evening for the Astrokids for sure can't be done without the investigation of the astro-dome, and the glance through the telescope, even if it is only for to see the artificial luminous sources of the city.



Fig. 11: Astrokids constructing rotatable celestial charts. In co-operation with the youth welfare office of the local authorities in Altenkirchen the astronomy team Wissen offers several events for children during winter time.

Conclusion

The lively interest of the regional public for the specified projects shows, that our astronomy team is on the right track in the intention to make a contribution to the opening of school in

respect of institution. Many of the former members of the team in the meantime are dedicated in natural scientific academic studies or professions. They willingly support the current students to cope with consistently appearing organisatory problems with the established cycles of events in our observatory. At least with these former students school knew how to stimulate effectively the interest in natural sciences. – You can find further informations about the projects of our astronomy team at: www.sternwarte-betzdorf.de

References

- [1] <http://astro.physik.tu-berlin.de/~chris/ALU/Handouts/Memorandum.pdf>
- [2] www.lehrer-online.de/astro-ag.php
- [3] Düker, M., Hebel, H.-R., Zipfel, E.: Mit Freuden lernen: Offene Unterrichtsarbeit 1, in: PZ - Information 12/90, Bad Kreuznach 1990
- [4] Stinner, P., Wendt, A.: Im Schatten des Mondes – Ein fächerverbindendes Unterrichtsprojekt im Umfeld zweier zentraler Sonnenfinsternisse, in: Nordmeier, V., Oberländer, A., Grötzebauch, H.: Didaktik der Physik – Regensburg 2007, Berlin, Lehmanns Media, 2007
- [5] Wendt, A., Stinner, P.: Experiment Sonnenfinsternis, Praxis Geographie **30** (1/2000)
- [6] Wendt, A., Stinner, P.: Schwarze Sonne über der Ägäis, Astronomie + Raumfahrt **43** (6/2006)
- [7] Stinner, P., Bieler, F.: Farben-Helligkeits Diagramme offener Sternhaufen, Astronomie + Raumfahrt, **40** (1/2003)