



Xplora - the European Science Education Gateway

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Abstract:

Xplora, the new European Science Education Gateway was launched on 10 June 2005 during the ECSITE conference in Vantaa, Finland. Its services are focused on serving teachers of science, as a resource to stimulate compelling, innovative teaching, to raise interest in science acting and scientific careers among young people. Xplora is built by European Schoolnet together with a consortium of partners including ECSITE and more than 12 science museums across Europe. The project, PENCIL, is funded by the European Commission Directorate General for Research as part of the Science and Society action of the Sixth Framework Programme. The Xplora gateway itself offers activities, tools, resources, background articles and other teaching material. It has a team of teachers from Europe, the target group of Xplora, to develop material, disseminate it in their regions and guide the development of the gateway.

1 Introduction

At the Science in Society Forum in Brussels, Belgium, European Schoolnet unveiled the first version of Xplora [2], the European science education gateway for teachers. The information site is currently online at www.xplora.org, and will be developed and redesigned into a full scale gateway with a wealth of resources, opportunities, tools and information, as part of the PENCIL [3] project. The fully operational portal has been launched in the first week of June.

More than 4 million euros have been awarded by the European Commission's Directorate General for Research to PENCIL, which involves a consortium of science museums and networks. Over the next

three years, ECSITE [5], the network for science museums, European Schoolnet, and many European science museums will take on this ambitious project to raise young people's interest in science and improve science teaching through pilot projects and the Xplora gateway.

PENCIL is also part of a wider group of projects, called NUCLEUS [4], involving major science institutions such as CERN, European Space Agency and others, as well as universities, teacher associations, media companies and other partners. NUCLEUS has a collective budget of over 9 million euros, to test, develop and promote new pedagogical methods, techniques and practices for primary and secondary schools across Europe.

This is a tremendous opportunity for European Schoolnet [1], the provider of Xplora, to make a major contribution in networking the science education community, and to bring grassroot teachers into the Science and Society action of the European Commission.

PENCIL and Nucleus are results of the DG Research call for proposals for the "European Science Education Initiative" [6], aiming to provide Europe with 700 000 additional researchers by 2010, by encouraging more young people to take up science at university.

PENCIL includes a set of thirteen pilot projects bringing together science centres, schools and other organisations to test pedagogical strategies, methods and materials in science teaching. These pilots will be monitored and evaluated by Kings College, UK, and the projects, materials and results will all be available through Xplora.

To complement and supplement the work of PENCIL, European Schoolnet is also setting up a network of representatives from member Ministries of Education, called the Science Education Network (SEN). The SEN will concert on science education policy and approaches. In addition, European Schoolnet will survey Ministries of Education on major science initiatives as part of Insight. The results will be published in a forthcoming Insight policy briefing on science education through European Schoolnet Insight knowledge base for new technology & education [20].

2 Basic services

The basic services of Xplora are based on a web server with the address <http://www.xplora.org>. After accessing the home page, a menu of services invites the visitor to browse around Xplora. As long as the visitor has not registered with Xplora, he will not be able to profit from all services available. He will nevertheless be able to passively make use of Xplora. While the site content might be sufficient to get hints and obtain resources for science lessons, active participation is part of the strategy of stimulating innovation in science teaching in Europe. This innovation is meant to be a central part of the European Science Education Initiative [6], which funds the Xplora portal.

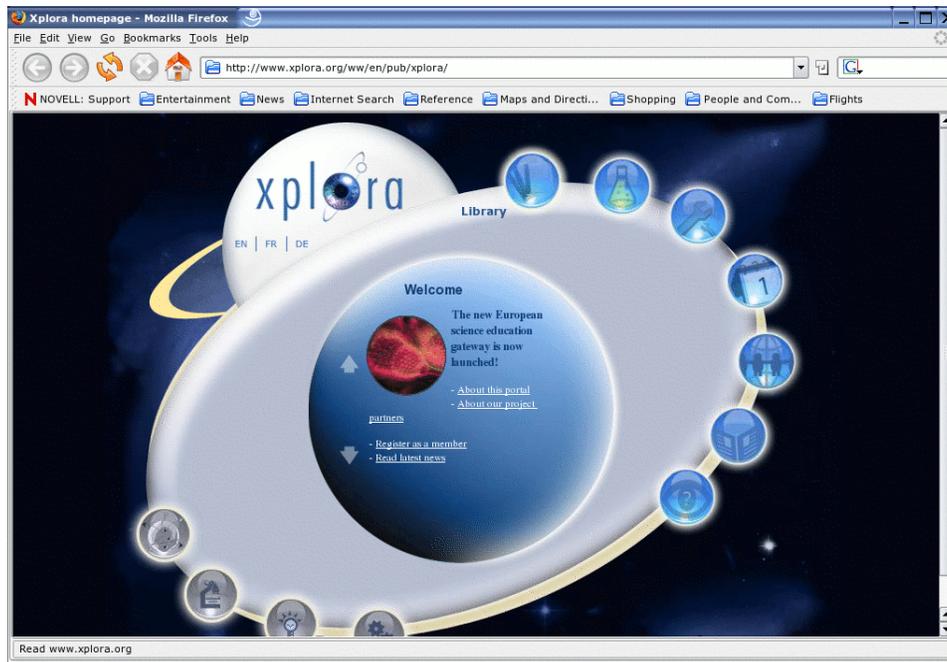


Figure 1: The home page of Xplora: placing the mouse over an icon shows where the button leads to

The home page shown in figure 1 appears as a Flash animation, which demonstrates that the authors prefer a young and dynamic presentation of science content. When the mouse is placed over an icon, a short message is shown, indicating the content of the server which appears when the mouse is clicked. The whole site structure is shown in figure 2.

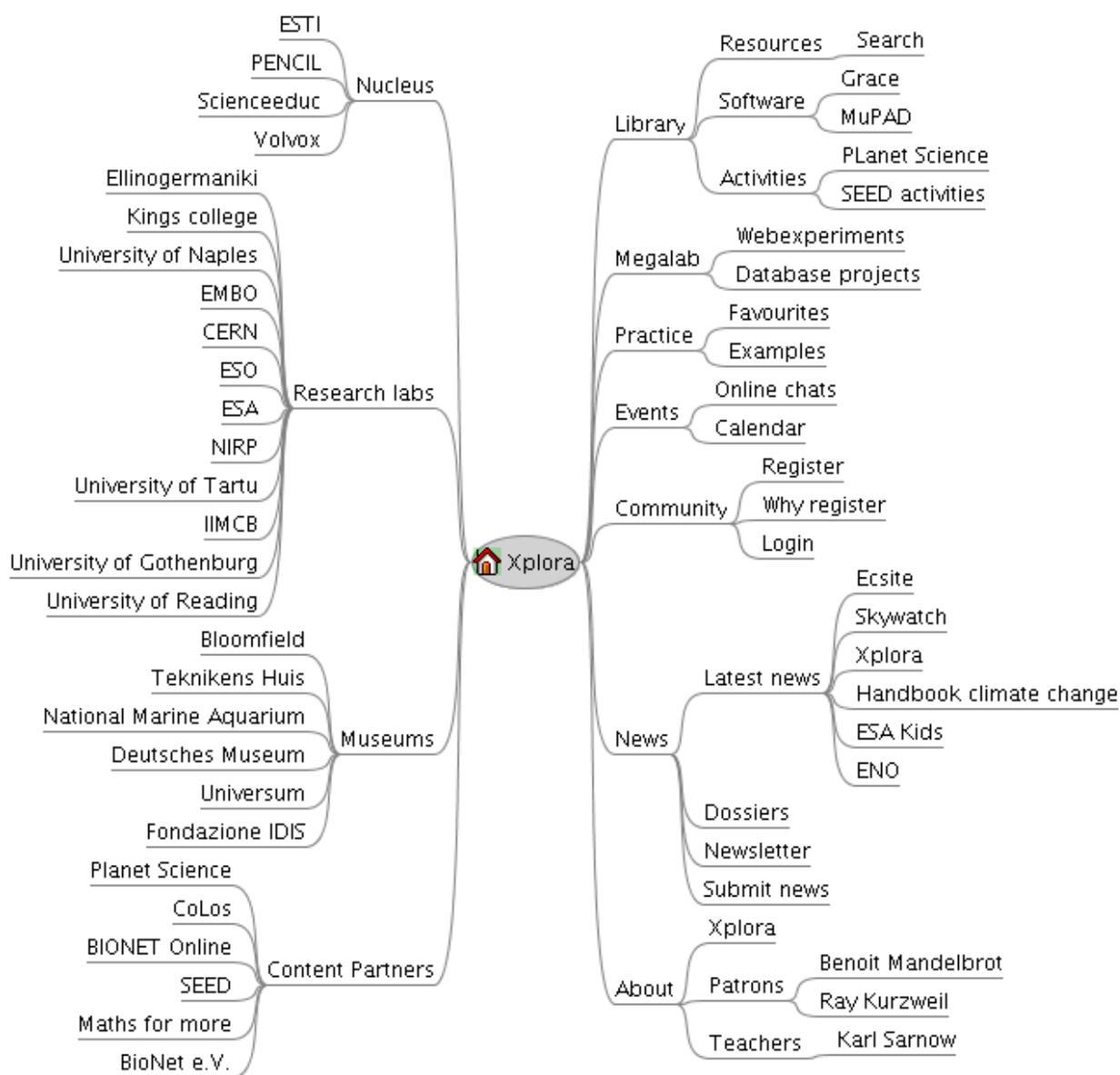


Figure 2: The site map of Xplora (Status 15.7.2005)

In figure 2, the status of 15.7.2005 is shown. The site is growing very rapidly, so frequent visits are recommended. All sections shown in figure 2 are reachable without registration. A key aspect of the site is in its openness for active contributors. All partners in the science education process are invited to contribute their ideas and material for free use by colleagues or other members of the science education community.

2.1 Xplora and languages

Xplora is offered in three languages: English, French and German. Despite this general decision due to

financial constraints, resources in any EU languages may be stored in the resource repository. Content partners are welcome to translate parts or all of Xplora contents into their language and maintain these pages at their expenses, providing full credits are given to the original authors. Xplora uses a content management system called CONTENTS which supports the use of many languages. In fact some projects under the patronage of EUN have run in all official languages of the European Union and even in Chinese, Hebrew and Arabic. So the restriction on three languages is not due to technical reasons and can therefore easily be overcome by private engagement.

2.2 Xplora and ICT

Obviously the use of Xplora resources requires ICT. The minimum ICT equipment needed is a computer with a working Internet connection. However innovative use of ICT in science teaching requires far more resources. For many applications use of special software is required or at least recommended, to achieve the goal of encouraging pupils to take up a science career. Xplora pays much attention to barrier-free access to software, and therefore tries to support software solutions which are freely distributable and usable for schools, teachers and students and which run on all hardware/OS platforms. The authors call this philosophy the Xplora main usability criteria for software (see table [cap:The-Xplora-main]). This principle results in the support of Open Source software solutions, preferably those which are available in a platform independent way. However Open Source is not a mandatory solution. We also support products, which offer a free "light version", which fulfils the main usability criteria of Xplora.

Xplora recommended software for science education must meet these criteria:

- Usable on most hardware platforms available for private and school use;
- Usable on most operating systems installed on hardware platforms available for private and school use;
- Freely distributable to schools, teachers and students;
- Usable without license fees.

Table 1: The Xplora main usability criteria for software

3 Advanced services

3.1 Registration

Via the registration process, a user gets access to the advanced services. This allows him to actively contribute to the development of science teaching in Europe. After registration, the user receives his login data via email and enters the Xplora Desktop. This registration is absolutely free and without any obligation. The only purpose is to be able to prevent potential misuse of the system, and to monitor web statistics more accurately, so as to offer a more user-focused service.

3.2 The Xplora desktop

Now the user finds himself on a web page called "desktop". On this page, individualised services are accessible:

- * Profile: a section where the user can modify his data;
- * Chat: the public chat room;
- * Forum: a place where actual science topics can be discussed.
- * List community: lists all existing communities with a search for specific topics. The user can join a community;
- * My community: gives access to all communities that the user has already joined;
- * Create community: each registered user can create his own community. With the creation of the community he becomes the moderator of the community. Moderators ensure that communities are good quality and relevant to science education;
- * Resources: a library of files and links, uploaded and commented by registered users. The files are downloadable by all users, registered or not. The system moderators are responsible for preventing misuse of the resources.



Figure 3: The Xplora desktop appears after logging in

3.2.1 Chats

The general chat room for Xplora is available as soon as an Xplora member is registered and logged in. The full names are visible, which dissuades misuse along with IP blocking tools for moderators. This room is for general discussions. Special chat rooms are setup for thematic chats [7]. For these chats, schools must register separately. The registration process itself is public [8] (see figure 4), but the participation requires registration. The chat moderator will guide an unregistered school towards registration. Xplora accepts 10 schools per chat, resulting in about 300 pupils per chat. All thematic chats are guided by known experts in their field.

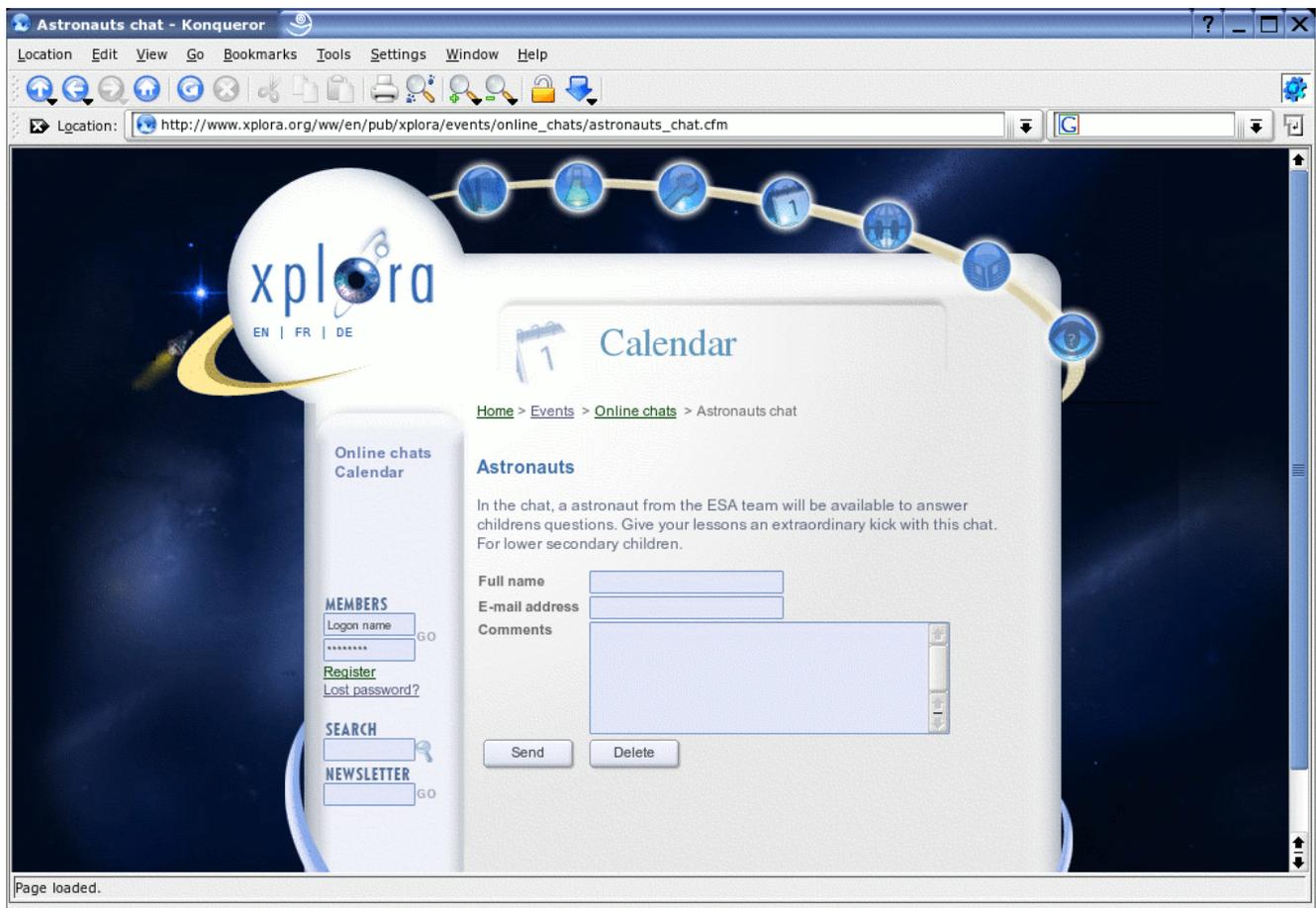


Figure 4: The thematic chat registration is in the public part of Xplora, while for the participation a registration is required

A list of proposed chat topics follows. This is not permanent and will be updated from time to time. Interested experts, who want to share their knowledge or raise interest for their topic are invited to contact the Xplora chat team on the chat pages [7]. They should feel free to volunteer the Xplora team for guiding a chat topic below as well as proposing new topics.

- * Aliens - They are there, aren't they?
- * Astronauts answer questions.
- * Bees, birds, planes - How can solid things fly?
- * Chocolate - Healthy delight or dangerous sweet?
- * Climate change
- * Coffee - Everything from the plant to the chemistry

of caffeine

- * Computer Algebra Systems - Tool for the cracks or crutch for the dummies?
- * Cosmology - The first minutes of matter
- * Deep sea life - What is living at depth hard to reach for humans?
- * Digital photography
- * Diseases report - Expert informs about seasonal dangers
- * Food problems - Children's weight increases
- * Fractals - The mathematical reasons for beauty in nature
- * Gasoline gets more expensive - Do we have alternatives?
- * GRID computing - More than supercomputers or just more supercomputers?
- * Life and death - Can scientists tell you about this?
- * Open Source or Open Sorcerer? - The value of Open Source in science education
- * Robots - machines or intelligent beings?
- * Science fiction or fiction of science? Stories of fiction that became science and not
- * Soap - Chemistry and hygiene
- * Strings - Do we live in 10 dimensions?
- * What am I? - Guess a tool
- * Who am I? - Chat leader imitates a famous scientist

3.2.2 Forum

A forum is a place where teachers can exchange ideas and questions. For registered users there are two versions of a forum:

- * The general forum: this appears as a button on the Xplora desktop. Registered users can read and write messages.

* The community forum: for each community there is a separate private forum. Only members of the community can enter the forum to read and write messages.

3.2.3 Communities

A community (figure 5) is the place where teachers of common interest meet. Registered users can create their own communities and may invite others to join them. In a community, members can upload/download files in the files section and communicate in the Forum section.



Figure 5: The Xplora community allows teachers to exchange material of specific interest for this group

In figure 5 the community is shown as it appears when a user enters it. The last forum message is shown, a mouse click leads him to the list of members, the stored files in the community folders section or to the community forum.

3.2.4 Resources

The resource section, which is publicly available for reading and downloading, offers upload for registered users only. In this chapter we describe how a registered user can fully profit from the resources.

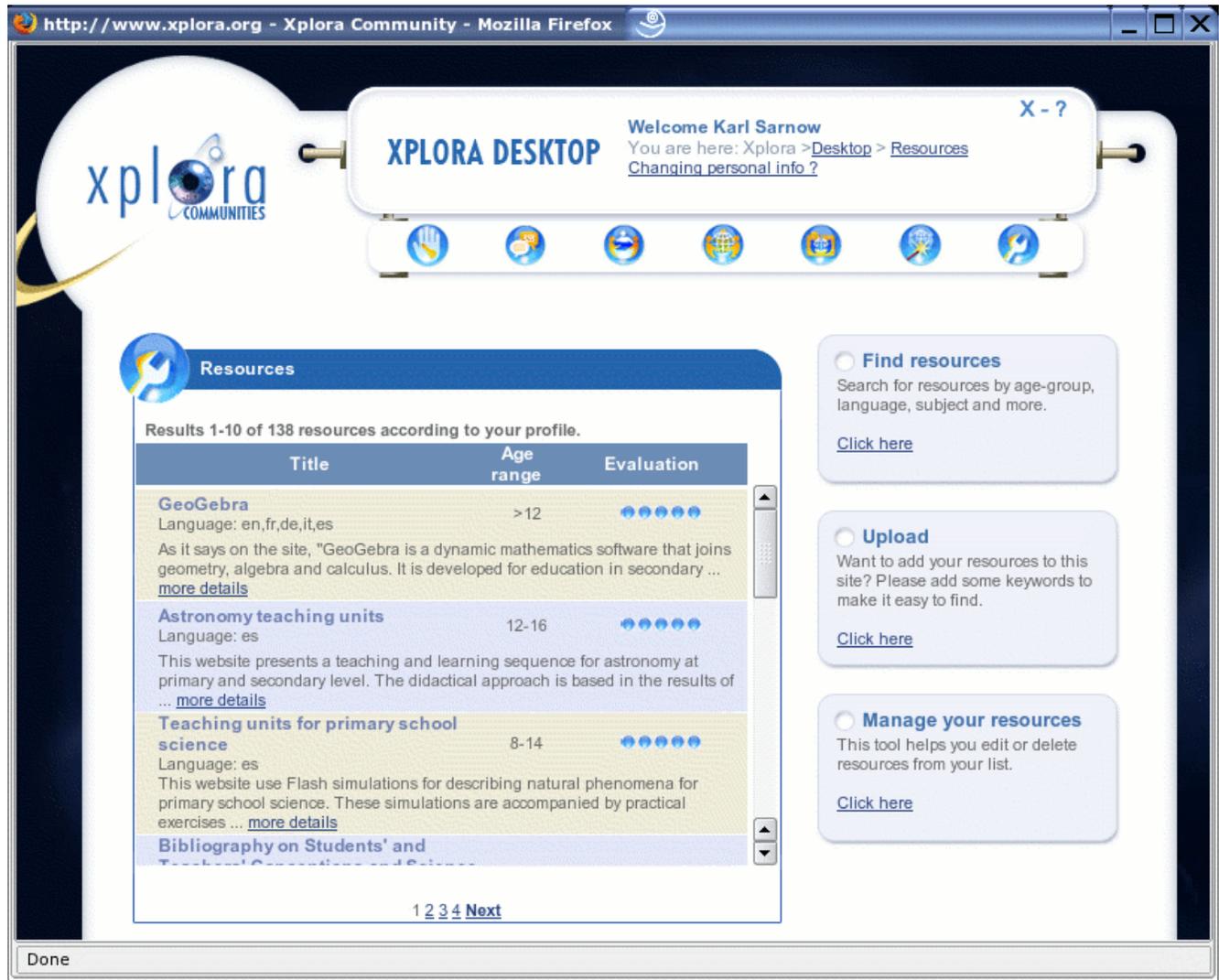


Figure 6: The resources are an elementary part of Xplora

When entering the resources section in the Xplora desktop, the user sees all available resources (figure 6) and the tools to select existing resources and upload new ones. There is also a tool to edit existing resources that he previously uploaded.

Searching for resources (publicly available)

The user clicks on "Find resources" in the resources section (figure 6) if he entered as registered user. Unregistered users arrive directly on this page (figure 7) without logging in.

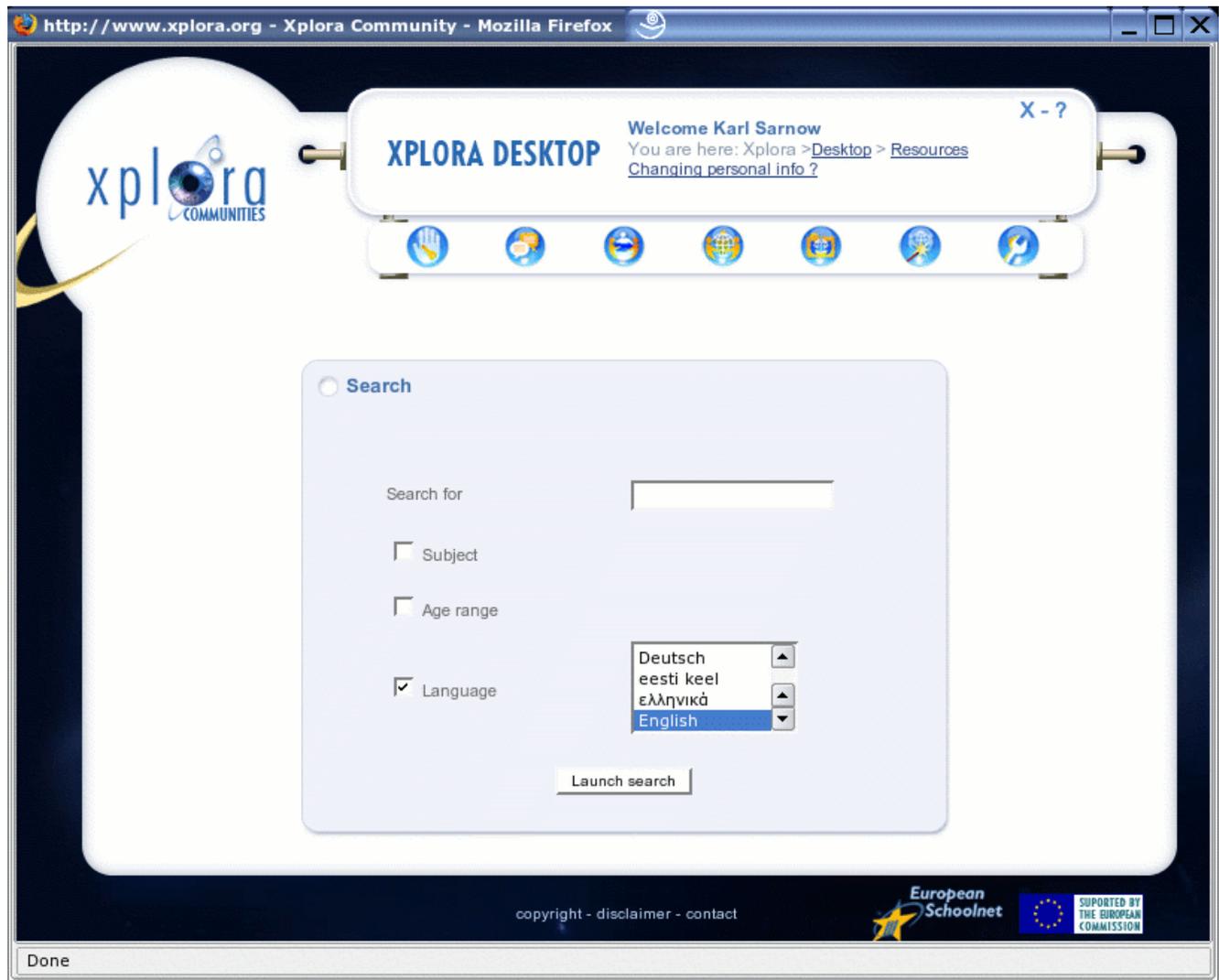


Figure 7: Finding resources in the Xplora repository is possible without registration

When a criterion is ticked, a field appears to input a selection. By default the language field is selected with the English language active. The different fields are AND connected, while within a field multiple selections are OR connected. Searching for all documents fitting a certain term to be input in the text field Search for requires that the user un-ticks the language field. Having specified the search, a click on Launch search starts the search and ends in the resources window (figure 7) filled with the

found documents.

Uploading a resource (for registered users)

Uploading a resource requires the user to provide additional information about the resource (metadata), which allows finding the information in a meaningful way. EUN has great experience in defining and using metadata, which is going into the data fields for upload, thanks to their previous Information Society Technologies research projects specifically on this topic. The registered user clicks on the upload link and enters into a sequence of three frames, needed to supply the necessary metadata for the resource.

Basic information

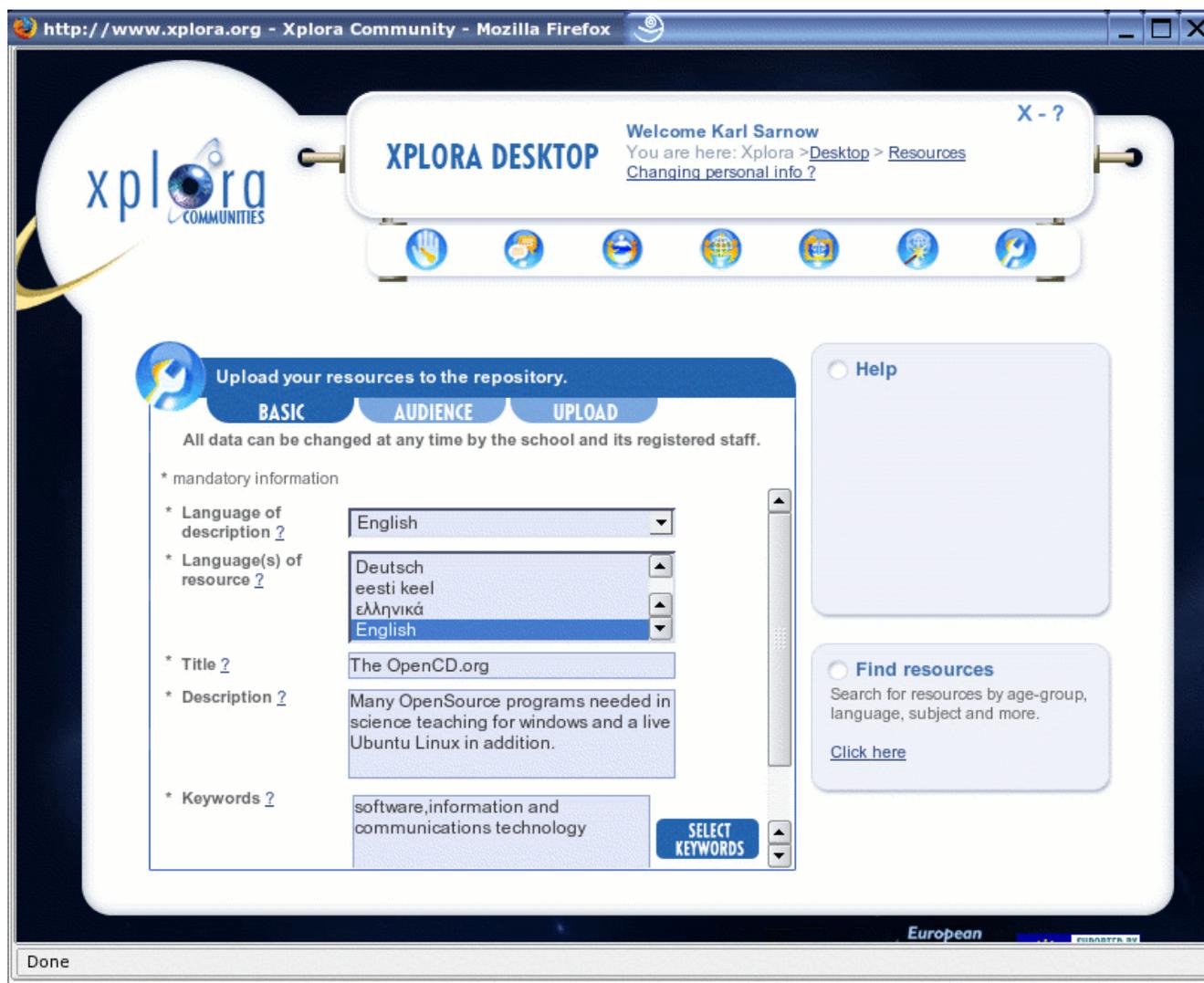


Figure 8: The basic information window for uploading resources

In figure 8 the user fills in the following fields:

* Language of description: the language in which the description (text field Description) in the Xplora repository is given.

- Language(s) of the resource: The language which the resource is written in. If the author of the resource has designed a multilingual resource, this can be indicated the usual web way: using the Ctrl-key of the keyboard while clicking with the mouse on the entries to multiple select. For resources that are language independent (e.g. a photo or an audio file), the user can choose no text.
- Title: a title for the resource, given by the uploading user. It should be carefully selected to attract but not mislead potential users.
- Description: the user gives an explanation of the resource in about three sentences in natural language. The user should try to include crucial keywords in the description only if they are not in the micro thesaurus.
- Keywords: a multilingual thesaurus is called to ensure educators use consistent keywords. Figure 9 shows the use of it. A user might click through the hierarchy on the left hand side or simply input a keyword in the search field. The various incarnations of the keyword are then shown in the right part of the page. Clicking on one puts the keyword in the upper line. All keywords in the upper line are accepted and will be inserted into the keyword field. Erroneously added keywords can be removed by clicking on them.

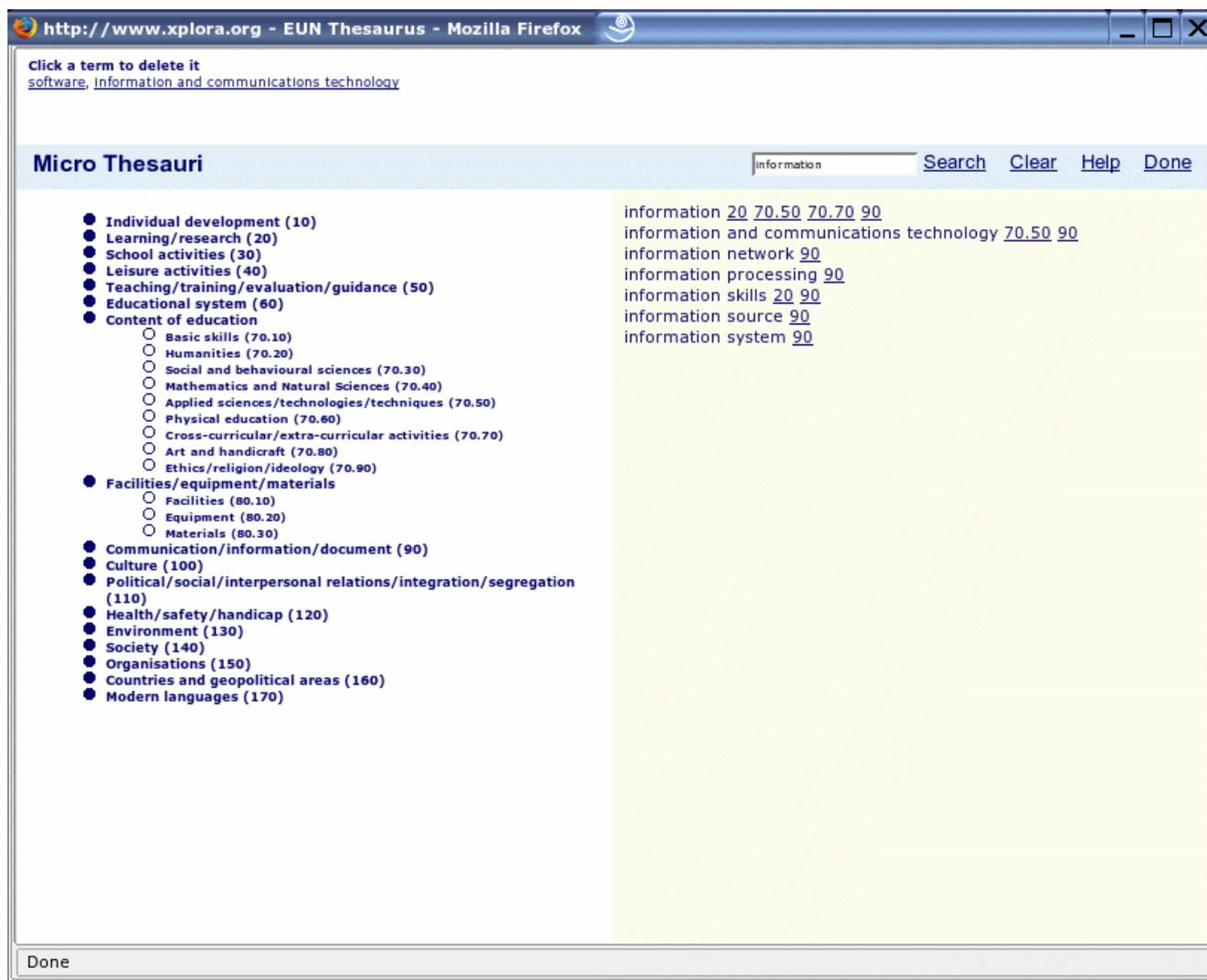


Figure 9: The thesaurus

The audience information

When the Save button is pressed, the uploading user advances to the audience section (figure 10). Here goes the information about the target group, which should be able to profit from the resource. The following fields are provided:

- Target audience: a multiple selection field to choose from;
- Pupils' age: the age range of pupils, who might profit from the resource. This is a very rough estimate, as the same topic covered by the resource might be taught at varying ages in different countries. So a user should not be too narrow in the age range and keep in mind the intellectual properties needed to make use of the resource. A teacher will normally be there to moderate the use of the resource, as Xplora is promoting material for classroom use.
- Educational context: the environment that the resource is intended for. It is useful to distinguish

between resources for compulsory education and high school education, for example.

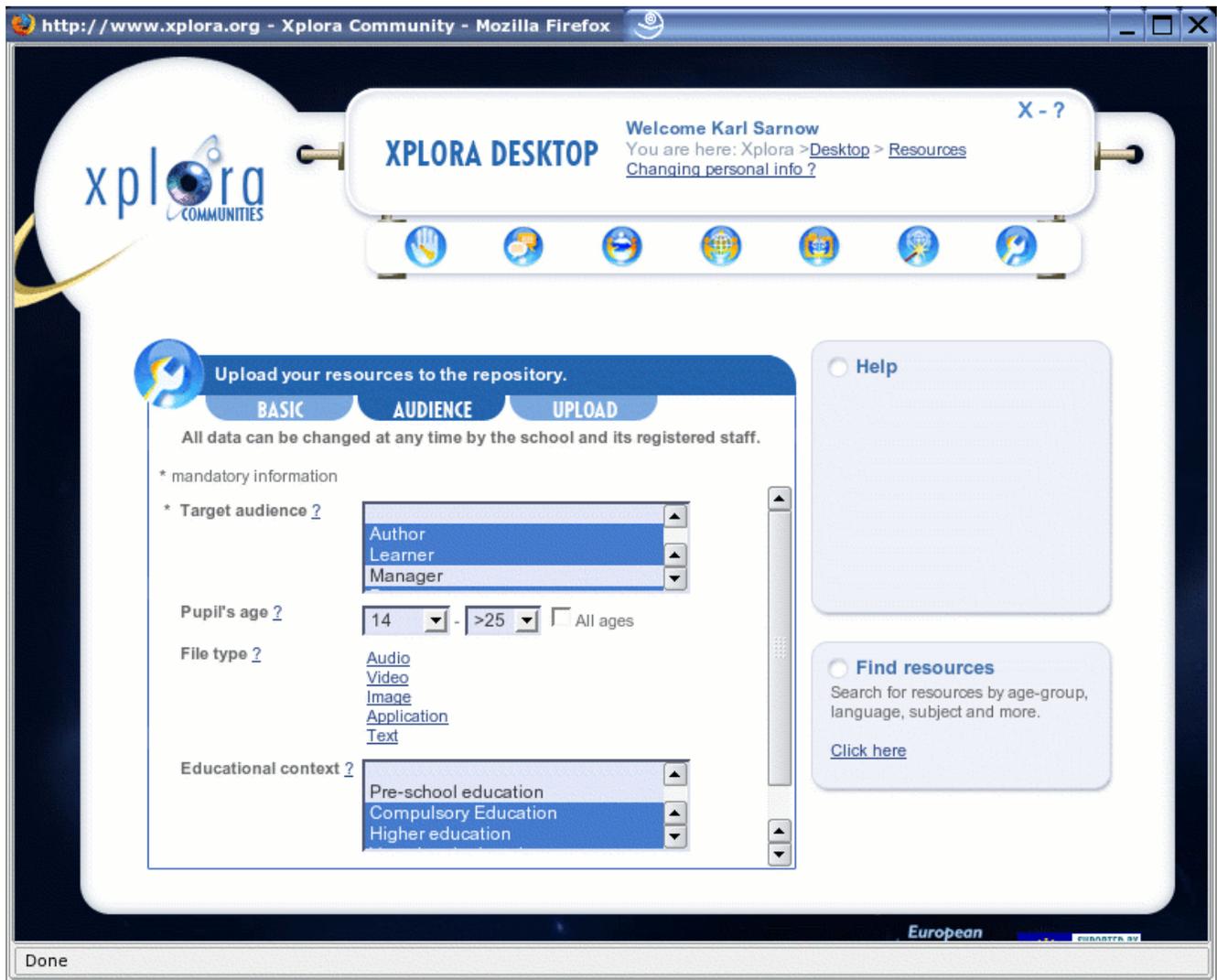


Figure 10: The audience section of resources upload

The upload information

This includes the location of the resource via a link to a web site or a file to be uploaded and the license information. Xplora recommends the use of Open Source material, as this allows free distribution of the needed material to students and to colleagues. On the other hand we do not want to limit resources in any way. If there is useful material with commercial licensing, we will support this in the same way.

Modifying a resource

The most obvious reason for modifying a resource is the availability of an improved version of a text or a program, or a moved link. This functionality is given to the registered user by clicking on the link Manage your resources. The desktop now displays a list of the resources that this registered user has uploaded before (figure 11). He is then able to select the appropriate resource and starts a modified version of the upload procedure. All values are hold unmodified, so the editing process can focus on changing the required parts only.



Figure 11: The editing procedure allows a registered user to modify his previously uploaded resources

3.3 Web experiments

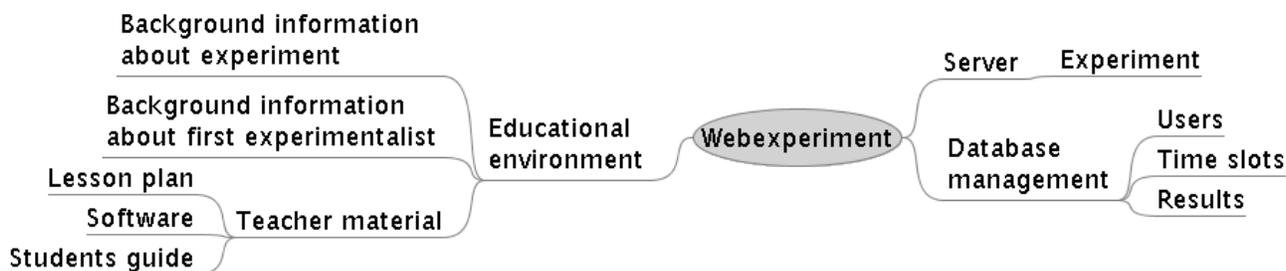


Figure 12: Web experiment mind map

Xplora takes special attention to web experiments. Web experiments, also known as Virtual or Remote Controlled Laboratories (RCL), are real experiments hosted in a laboratory somewhere in the world. Instead of operating the hardware of the experiment by directly touching it, in a web experiment the hardware is manipulated by a web server controlled by a pupil using a web browser. A mind map of a web experiment is shown in figure 12. One of the first web experiments available for schools is the experiment of electron diffraction [10], setup and maintained by AG Jodl [9] at the University of Kaiserslautern, Germany.

Although we are giving this specific example a closer look, we will try to elaborate the advantages of web experiments in general.

3.3.1 Electron diffraction

The experimental setup and hardware are well known and available in many schools ([11], figure 13). An electron beam is accelerated by an acceleration voltage and hits a graphite foil. The inter-planar distances of the graphite foil act as a diffraction grating for the particle waves of the electrons. From the diffraction pattern, the wavelength of the electrons particle wave can be calculated and compared with the De Broglie wavelength resulting from the acceleration voltage and mass of the electron.

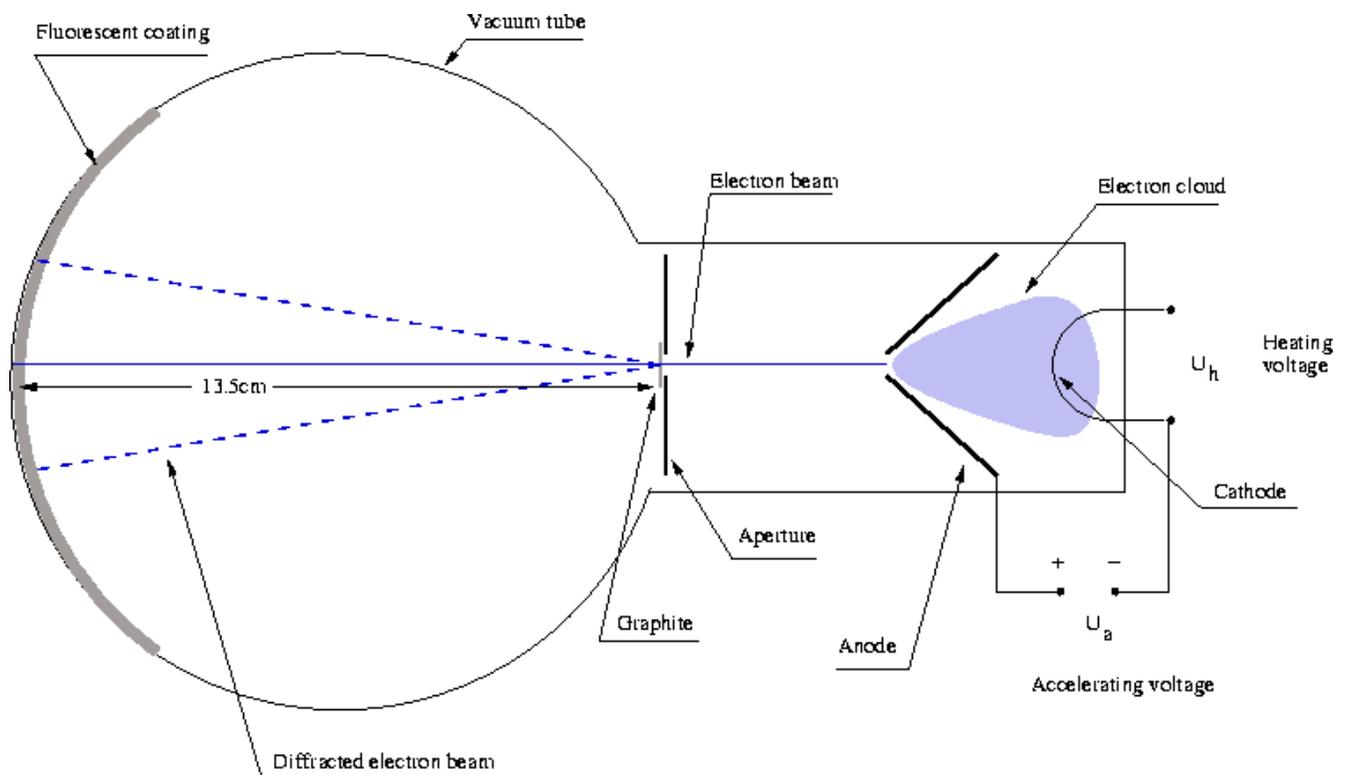


Figure 13: The hardware of the web experiment electron diffraction is built around the electron diffraction tube

The experiment is done by setting the acceleration voltage and taking a screen shot of the diffraction pattern. The screen shot is used to calculate the wavelength of the electron particle wave, while the acceleration voltage is used to calculate the De Broglie wavelength. The student then can check that De Broglie's thoughts are true regarding particles having wave properties.

3.3.2 Student guides

Xplora is publishing ready to use material for teachers. For the web experiment electron diffraction we have developed teachers material and a student guide. The material is downloadable from the Xplora repository. Search for the word Webexperiment. The student guides as well as all teacher material follow the Xplora main usability criteria (table 1) by proposing Open Source software as tools. The needed and proposed software tools are:

- * Screen shot and image analysis software. Proposal: The GIMP [12];
- * Spreadsheet for calculating the results. Proposal: OpenOffice.org [13];
- * Text processor for creation of the notes. Proposal: OpenOffice.org [13] or LyX [14].

This software is available for free on all major computer platforms. This implicates that a teacher can give instructions to the student, knowing that he will be able to realise the request. Obviously, while

Xplora strongly supports the use of a common base of software tools for all its projects, everybody is invited to use his software of preference. Xplora simply wants to ensure that every student will be able to access the software needed to use Xplora resources.

The general work-flow for the students is:

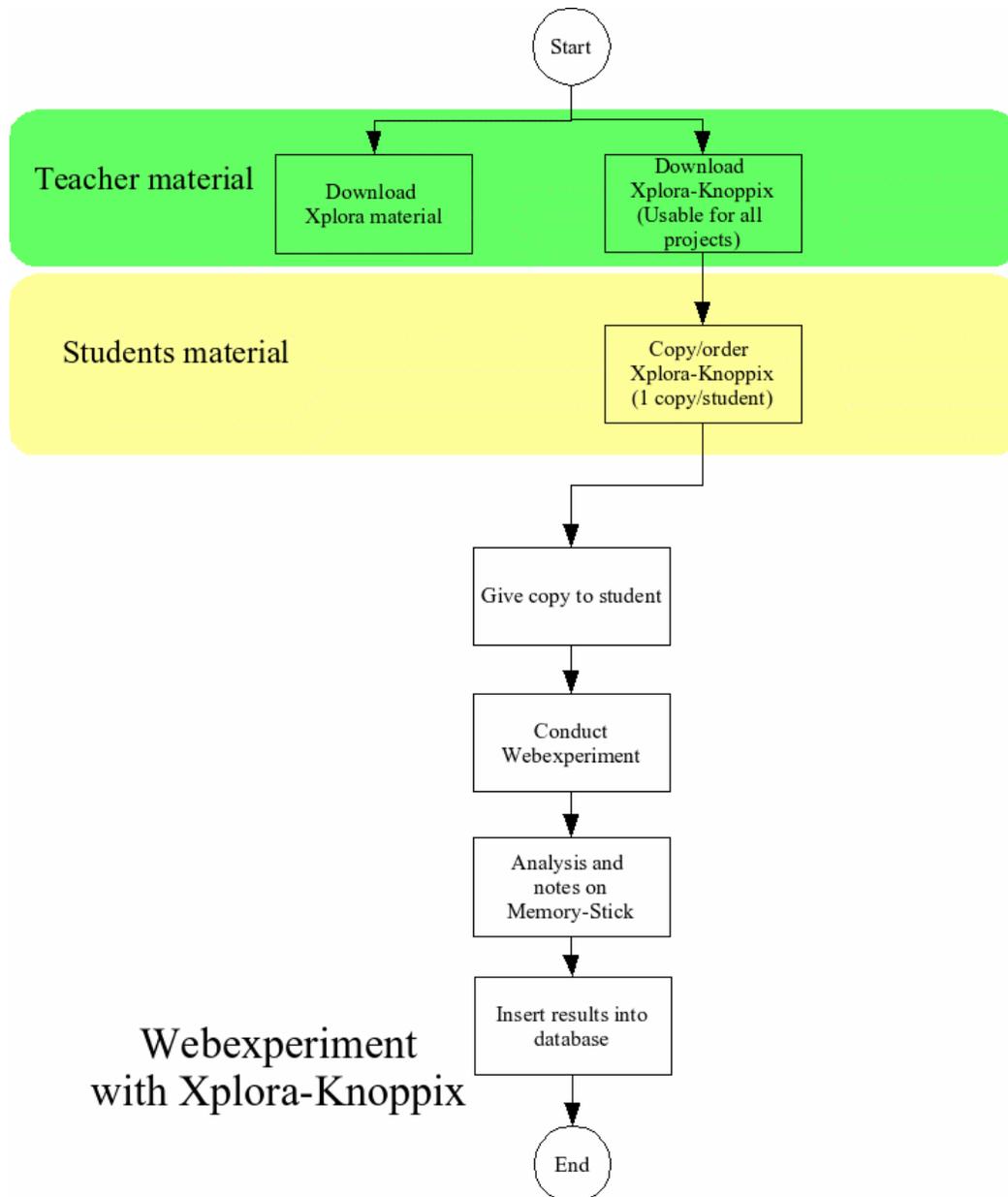
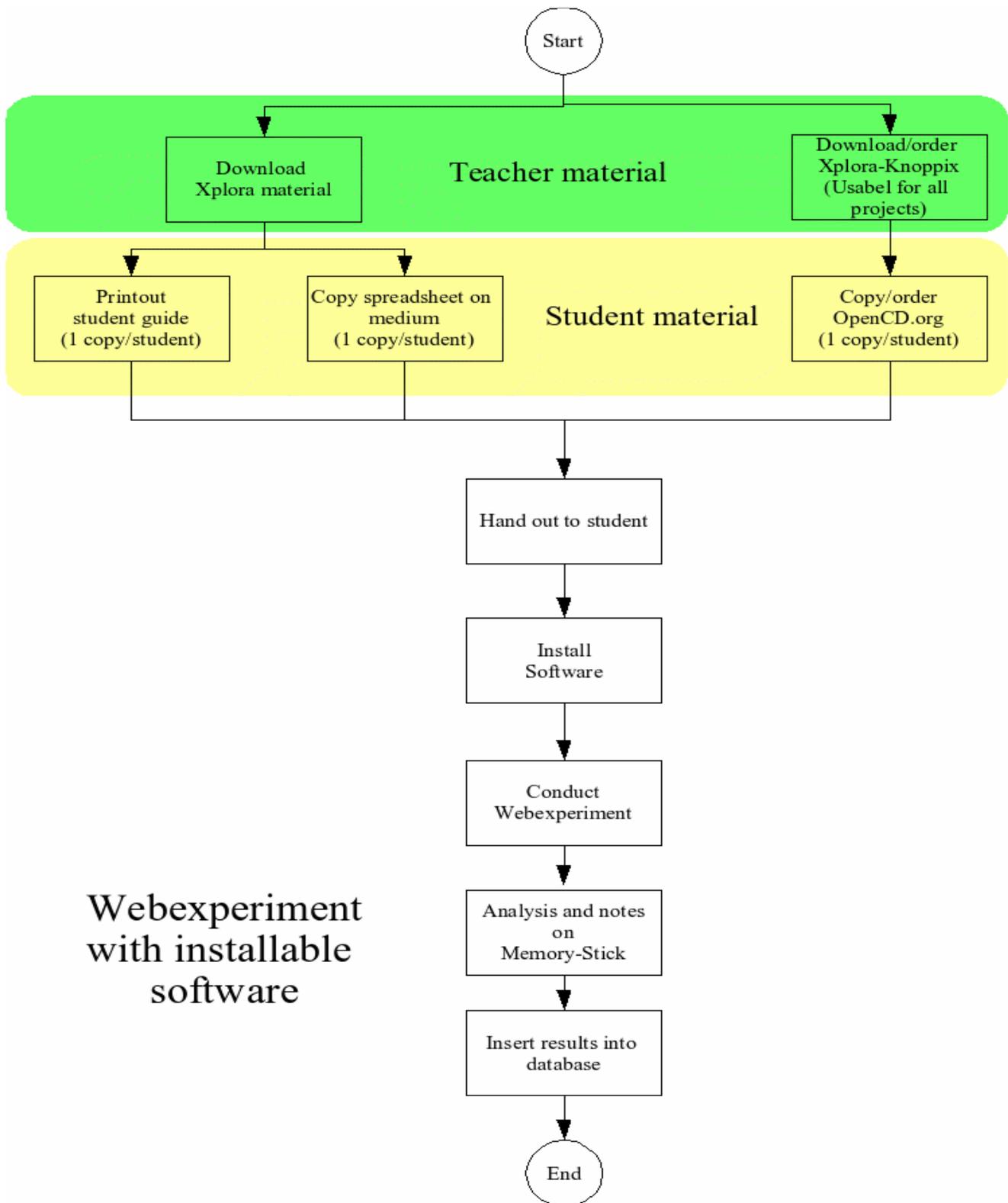


Figure 14: The work-flow in a web experiment using Xplora-Knoppix

1. Students get the software installed. Either the teachers hands out a burned CD-ROM with the software on it ready to use or to install. Or the students have a chance to download the software directly from the Internet. According to this scenario, we have three options:
 - a) Hand out a self booting CD-ROM with operating system and all required software installed on it for example one of the many Knoppix versions around. A specially for science teaching published Knoppix version is GI-Knoppix [15]. You can also find it in the Xplora repository. The advantage of this concept is that no installation of software is needed. The disadvantage is that the user is forced to use LINUX, which is unfortunately not common to all students. At the moment of this writing, Xplora is preparing its own version of Knoppix, Xplora-Knoppix, which will contain the required software and the instructions necessary to run a web experiment. Having this special version of Knoppix makes the preparation of the web experiment in the lessons much easier for the teacher, as he has all materials for the student ready on one CD-ROM or DVD (See figure 14). As copying a CD-ROM is a time consuming task, a teacher might want to give this task to someone else. Therefore Xplora plans to offer a service for teachers, where they can receive the CD-ROM/DVD for free by post, while at the same time offering the ISO-images for free download. Once a student owns a copy of Xplora-Knoppix, he will no longer need any other software for school use in science, which makes the ordering a very efficient and time freeing option for the teacher.
 - b) Hand out a CD-ROM with the required software for all common operating systems on it. The student then has to install the software on his computer system. The advantage of this concept is that the student can stick with his favoured operating system. The disadvantage is that he has to follow an installation procedure, which can be a hassle to him. For the teacher this means, that the student could fail following his order. If the teacher would like to follow this approach, there is a link to the "OpenCD.org" [17], which contains both, a live version of UBUNTU Linux with the needed software on it and the required software for Windows. Nevertheless, using this approach the integration process for classroom use is more complicated (figure 16).
 - c) Let the student download the software from the Internet. This concept is only acceptable in special conditions, where broadband connections are accessible by the student at a low price (e.g. where a flat rate is available). It requires the least preparation from the teacher but the most action and financial engagement from the student.
2. Run the web experiment. The student needs an Internet connection and graphics software to create the screen shots. The screen shots are the primary results of the web experiment, which have to be processed to get numerical results. Normally web experiments are designed open, and no registration is required. But during a physics course, access at predefined times is necessary in order to avoid many students trying to use the setup at once. For this case Xplora proposes a procedure, which should be the standard procedure in all similar cases (For a test version see [18]). This procedure should be prepared in the computer room with the teacher and all students present:
 - a) The student logs in on a web experiment server;

- b) He arranges in coordination with his classmates and the teacher a time slot for his experiment. This time slot will be reserved for him and blocked for others;
 - c) When the time slot is active, the student logs in to the web experiment itself.
3. Turning the screen shots into numerical results. For this procedure the GIMP's measuring tool is suitable, returning the diffraction ring diameters in pixels. After a simple calibration procedure, the spreadsheet program returns the diameter in cm.
 4. Calculating the particle wavelength and De Broglie wavelength using the delivered spreadsheet or calculating it manually, according to the teacher's decision.
 5. Comparing the results and preparing the experimental notes for classroom discussion.
 6. Storing the data in the web experiments database.



Webexperiment
with installable
software

3.3.3 Common principles of web experiments

Looking at the description of the electron diffraction web experiment, some basic principles should become obvious:

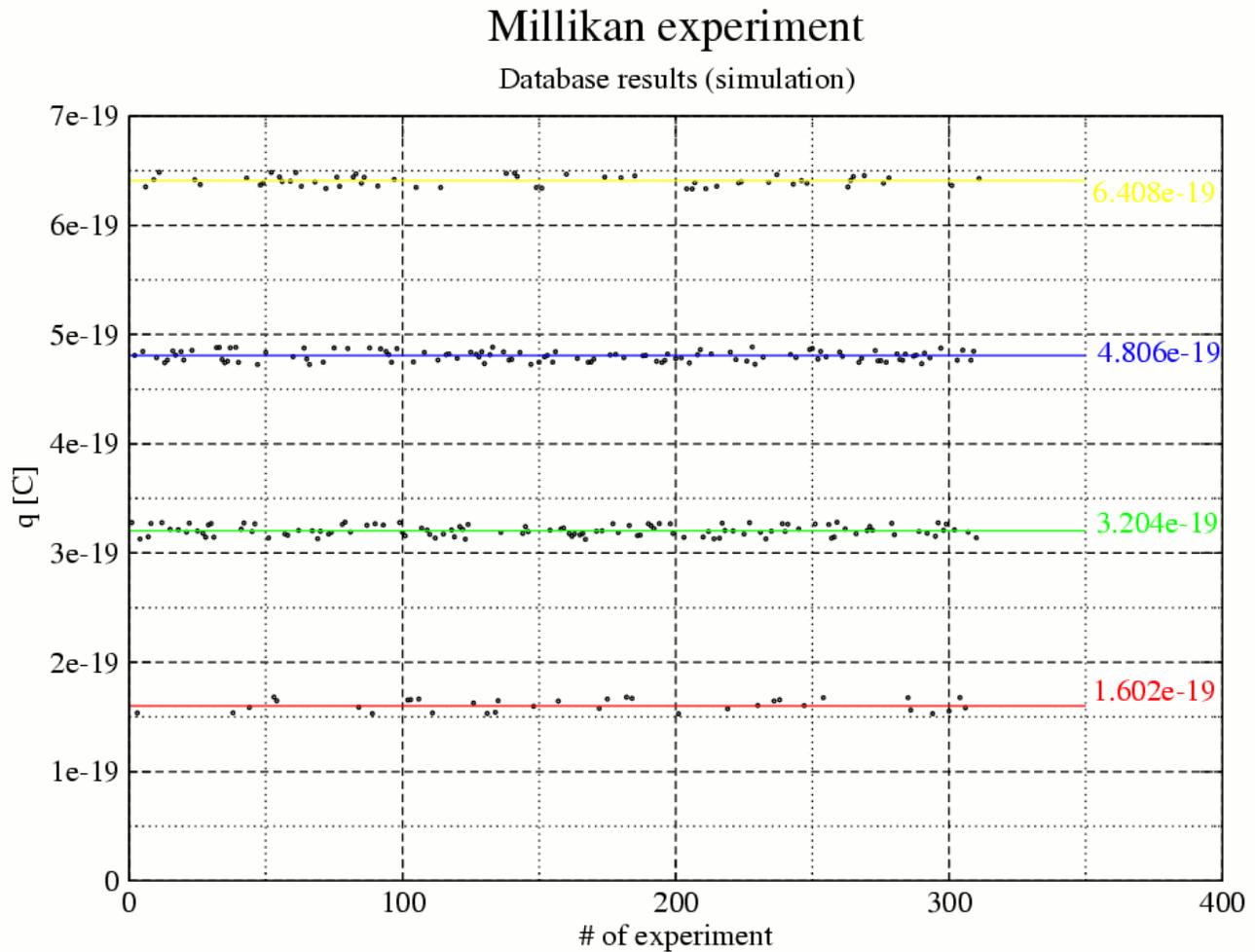


Figure 17: A simulation of a web experiment with the Millikan apparatus allows the reasoning of Millikan for students of physics in the classroom

- As web experiments are publicly available at a distant location, expensive, dangerous or fragile experiments can be given directly to pupils;
- Sharing the experiment with classmates and students from all over the world allows the collection of a rich set of data, while under standard conditions in the school laboratory only a single value is available. This feature has an enormous impact on experiments, especially when the conclusion of the experiment is visible only from the statistics of the results. An extreme example of this type of

experiment is the Millikan experiment. Under school lab conditions, the student is happy if he gets a single result more or less close to a multiple of the elementary charge. In a web experiment with a coupled database of results, the original reasoning of Millikan is now available for students (figure 17). It is also worth mentioning that comparing data from other students avoids frustration on "bad results", when a student becomes aware that his results are within the range of others;

- Students learn to use ICT in a science propaedeutic way. Properly choosing software will allow them to profit from their web experiment during their whole academic career. One of the factors of sustainability is the availability of high performance Open Source software, which is frequently originating from a research environment, like for example Grace [16];
- Relief for science teachers: the web experiment is setup and maintained by an external institution, so the teacher does not need to set up, justify or maintain the experiment by himself. There are no surprises by burnt components, when a professional experimental team is engaged to care for the set up;
- No cost: this allows schools of all social levels to benefit from hands on activities of their students;
- Offer for given schools: schools with a good Internet connection and an engaged team of teachers and students have a chance to setup their own web experiments. The teachers would profit from the public respect they earn for themselves and for their schools. The students would be able to sharpen their profile and demonstrate their engagement, and finally the school would support the science community of underprivileged schools.

3.3.4 Workflow for web experiment participation

Like in all web experiments, active participation requires registration. Here we outline the workflow in the electron diffraction web experiment.

1. Register on the Xplora portal: this step is only needed once, when you start to contribute to Xplora actively;
2. Login to Xplora: you are now on the Xplora desktop;
3. Click on the Web experiments button in the button field of the desktop;
4. Click on the button Electron Diffraction to start the web experiment activity;
5. Click on the Reserve a time slot for the web experiment button;
 - (a) The occupied time slots are shown in red. The green time slots with a radio button in are selectable. Click on one to reserve the time slot;
 - (b) The program prints a reminder. The user is invited to take the reserved time slot into his

personal calendar;

6. At the reserved time, go back to the web experiment using steps 2-4;
7. Click on the button Conduct the web experiment to start conducting it;
 - (a) Click on the link Show grid to get the length scale shown;
 - (b) Click on Set accelerating voltage to set the voltage to the wanted level;
 - (c) A template appears to let you input the desired voltage. Some personal data are needed. Click on the button Set to set the voltage;
8. Take a screen shot of the browser and store it;
9. Repeat steps 7-8 for as many times you need to get data;
10. Calibrate the images;
 - (a) Load one image into the GIMP graphics program;
 - (b) Measure the length of the grid with the GIMP measuring tool;
 - (c) Insert the length in pixels and cm into the spreadsheet file `diffraction_calc.xlsx` in the students material folder of the Xplora information about the web experiment electron diffraction at the positions B3 and B4. The calibration factor is calculated in cell B5;
11. Measure the diameter of one diffraction ring with the GIMP measuring tool;
12. Insert the diameter in pixels and the acceleration voltage into a pair of cells in the range of A9:B14 in the spreadsheet. The missing fields in the spreadsheet line are calculated and shown;
13. Repeat steps 11-12 for each image taken during the conduction of the web experiment. A new calibration is not needed;
14. Go back to the web experiment page and click on the button Input results to database. Now transfer the results of your spreadsheet into the form, line by line;

3.4 Database projects

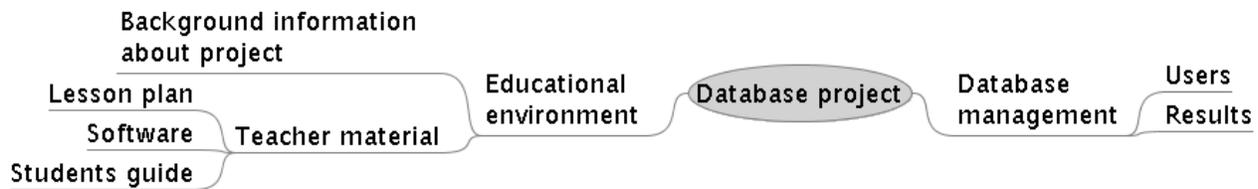


Figure 18: The mind-map of a database project

The use of web-databases is an enormous advantage for schools, as they do not have to care about the installation, configuration or maintenance and just benefit from the fruits of database use. The only tool a web-database user needs is an Internet browser, while the operating system has no impact. This frees teachers, as they do not need to worry about SQL queries and server administration - this is handled by the Xplora team. The mind-map structure of a database project is shown in figure 18.

The first database project is the sunset project, proposed by Bernat Martinez [19] from the Xplora teacher team. In this very simple project, targeted at very young children, children observe a sunset and note the coordinates of the location (latitude and longitude) of the observation, the time of the sunset happening (local time), and the compass direction where to see the sunset.

To join this database project, a teacher needs to teach his children the principles of location on the globe, read the time from a clock and read a compass. For younger children this is quite a challenging job which has the potential for a dive into astronomy and related topics like cosmology later on, when the children are hopefully moving towards a science career.

Like with the web experiments, the results are available for everyone without registration. Only active participation requires registration.

3.4.1 Workflow in the sunset project contribution

We present the workflow of this particular project in order to make the general principle of database projects in general more clear.

1. Do the observations;
2. Register to Xplora. This step is needed only once. Later on a teacher can skip this step.;
3. Login to Xplora;
4. Click on the Database Projects icon within the desktop of Xplora;
5. Click on the Sunset project link;
6. Select the location. If you regularly contribute to the sunset project, a user might select a given location from the list of known locations. Otherwise he selects New entry from the list and follows

the input procedure below:

- (a) Input the name of the location. The user should use a recognisable name, not too specific.
 - (b) The latitude, longitude and the altitude of the location. These data can be obtained by a GPS instrument or from the web by searching for the name of the location and the keyword longitude or latitude.
 - (c) The URL of a web-site describing the location. This can either be the official web-site of the city of observation or a web-site within the project documentation of the participating teacher or school.
 - (d) The country with country code. Only the country code is stored.
7. Confirm the selected location;
8. Input date, time and direction of the sunset.

From the resulting data, a variation in time and direction of the sunset can be observed, giving reason for thinking about the causes for these effects. These observations can be used in geography as well as in astronomy or physics lessons.

3.5 Collaborative projects

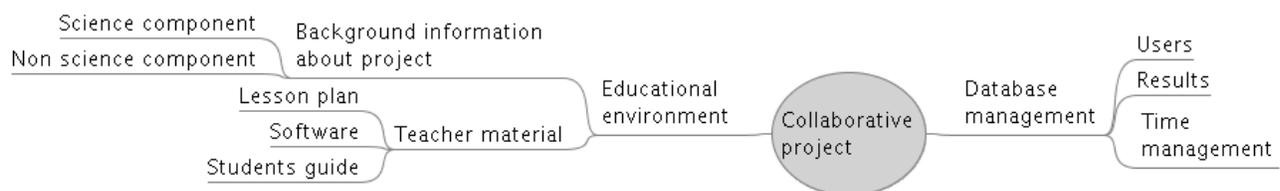


Figure 19: The mind-map of a collaborative project

In collaborative projects database technology is used to store results of observations. So these projects are normally related to database projects, but they can also deal with other approaches, which do not involve experimental observation, e.g. making presentation of famous scientists. But in addition to this, a collaborative project contains at least some common synchronous activity among the actual participants. In many cases society and cultural issues are added to the portfolio of topics, leading to a cross-curricular style of teaching, where collaboration with non-science topics is useful.

3.5.1 The four seasons project

One of the first collaborative project offers from Xplora is the "Four seasons project", where students participate in the sunset database project (see chapter 3.4) on certain dates. The main activities in the project is about the festivals of at least three of the four astronomical events:

- * Spring equinox - Easter festivals;
- * Summer solstice - Midsummer night festivals in northern countries;
- * Autumn equinox;
- * Winter solstice - Christmas festivals;

This gives very young pupils a chance to join in a science project for the first time. The younger pupils will probably focus on the festivals while the older students go out and do their sunset observation. More advanced students might find it useful to work on the history of the festivals, why they were placed there and when. In the science corner of the collaborative project advanced students might work on the reasons for solstices and equinoxes, and compare data for different locations and dates.

3.5.2 Workflow in the four seasons project

The workflow is wider than in database projects, as a time management is needed to bring all participants together at four dates in a year. Some of the dates are near or in holidays, so participation needs some preparation. Therefore Xplora proposes the following workflow:

1. An interested class, course or other group signals interest by subscribing to one of the yearly events.
 - (a) The subscription data includes:
 - i. Name of contact person.
 - ii. E-mail address of contact person.
 - iii. Topic and title of the groups contribution.
2. From the registration onwards, the participating teacher prepares the contribution framework of his group:
 - (a) Publication facilities for the non science contributions (one or more of the following options).
 - i. Web space on the school server.
 - ii. Printed media.

iii. CD-ROM preparation.

A. Download from FTP servers as ISO images and burn it on CD-ROMs.

B. Sent by mail via CD-ROM distributors ready burned.

(b) Preparing a student guide: Xplora will be assisting in this, but many participants might be willing to bring in new ideas.

(c) Preparing background material: this might also be part of the student guide, but as the student guide normally has a longer lifetime than actual background material, it is a wise idea to split it into two parts.

3. The time management system sends a reminder to all registered participants 1 month in advance;

4. At the event date, the groups start a coordinated action:

(a) Non science partners publish their results on the web. In case of problems with web space, Xplora is able to support groups;

(b) Science partners contribute to the sunset project;

(c) All groups summarise the event in a common web-protocol.

4 Partners

One of the fundamental ideas of the PENCIL project is a policy of open doors not only to teachers and schools, but for institutions outside the school system. These are mainly science museums and research laboratories.

4.1 Nucleus

Nucleus is a cluster of EU projects funded by the European Commission's Directorate General for Research, as part of the European Science Education Initiative. The cluster comprises: PENCIL, ESTI, CISCI, Scienceduc and Volvox.

4.1.1 PENCIL

PENCIL (Permanent European Resource Centre for Informal Learning) [3] combines field programmes and academic research with the aim of identifying the keys of success that transform informal science activities into innovative quality tools for science teaching. 14 science centres/museums are creating mini-networks involving schools, pupils, teachers associations, research laboratories, educational authorities, education and science communication specialists to run "pilot projects" on new ways to conduct science teaching.

4.1.2 European Science Teaching Initiative (ESTI)

Coordinated by the EIROforum, ESTI combines three elements: Science on Stage (SOS), a new Journal of European Science Teaching (JESTI) and the Volvox network for biosciences.

4.1.3 Cinema and Science (CISCI)

CISCI will combine the two most popular media among youngsters, namely movies and the Internet, aiming to raise the attractiveness of science while dispelling widely-spread misconceptions that arise from pseudo-science. CISCI is coordinated by the Vienna University of Technology, and will be set up by the CISCI-consortium of 11 partners including partners from the new and old European countries as well as the U.S.A.

4.1.4 Scienceduc

The development of society requires meeting one absolute prerequisite, the intellectual and moral development of the man. From this point of view, an early education in Science, inquiry based should be of great help, not only in order to give children basis in technical knowledge, but also to aim at universalism, research, openness, modesty and civic responsibility, so highly requested in our times of instability and violence.

4.1.5 Volvox

The Volvox network will provide teachers with authoritative briefings, proven laboratory protocols, classroom activities addressing the social impact of bioscience, accounts of the careers of young scientists and numerous other educational resources to help motivate them and their students.

4.2 Science museums

4.2.1 The Bernard M. Bloomfield Science Museum

The Bernard M. Bloomfield Science Museum is an informal cultural and educational institution that presents exhibitions consisting of active exhibits on subjects in the fields of science and technology and which integrates these exhibits into a context including a wide range of educational activities.

4.2.2 Teknikens Hus - A house full of technology

Teknikens Hus offers a whole world of technology from the industries around us. The mountain rises high above a mine where you can mine and load iron ore. Then, you haul the black ore by train to the steelworks where it is processed into gleaming steel.

4.2.3 National Marine Aquarium

The National Marine Aquarium is an important UK charitable institution dedicated to raising awareness of the oceans, the life they contain and the ways by which humans affect them. Its main vehicle for attaining these aims is through Britain's largest aquarium, containing Europe's deepest exhibit tank; it carries out programmes of conservation, research and education.

4.2.4 Deutsches Museum

Founded in 1903 by the engineer Oskar von Miller, the Deutsches Museum in Munich is now one of the most important museums of science and technology worldwide.

4.2.5 Universeum Science Discovery Centre

Universeum is Sweden's national science discovery centre, which serves as a meeting place for various fields of scientific study, the academic world, the private sector and the school system a national and international crossroads for young and old alike.

4.2.6 Fondazione IDIS

THE FONDAZIONE IDIS-Citta della Scienza is an organisation whose mission is to create fertile ground for embracing scientific culture and innovation in order to contribute to overcoming the serious economic and productive difficulties that characterise the South of Italy.

4.3 Content Partners

In addition to the main partners in Nucleus, including the research labs and museums, Xplora has a number of content partners. These partners contribute high quality content to the portal.

4.3.1 Planet Science, UK

Planet Science brings fun and science together in games, features, competitions, teaching resources and e-newsletters. It's for everyone from young children and their parents to science teachers. It's free and fully funded by NESTA, the UK's National Endowment for Science Technology and the Arts.

4.3.2 Virtual Physics Laboratory, National Taiwan Normal University, China

This academic group focuses on the important topic of "Conceptual Learning of Science". They offer hundreds of physics related java simulations for ludo-educational activities.

4.3.3 Bionet Online, Europe

BIONET is produced by 8 European science centres and museums and by ECSITE. The web-site focuses on new discoveries in life sciences, and invites visitors to explore the science and debate the issue.

4.3.4 Schlumberger Excellence in Educational Development, Europe

Schlumberger Excellence in Educational Development (SEED), is focused on students aged 10- to 18-years old. Established as a non-profit organisation in 1998, the SEED philosophy is founded on generosity.

4.3.5 Maths for More, Spain

Maths for More is a mathematical software company based in Barcelona. Their main goal is to offer advanced calculation and presentation tools for mathematics education with emphasis on Internet technology solutions.

4.3.6 BioNet eV, Germany

BioNet eV is a German non-profit organisation, supporting the use of ICT in teaching science. The focus of BioNet is science teaching via database projects, which involve outdoor scientific observations combined with a computer lab activity, where students feeding their results into the project database.

4.3.7 Nobelprize.org Educational Outreach, Sweden

The educational outreach program which offers interactive multimedia documents for high school and college students is popular among young visitors and teachers.

4.4 Patrons

Xplora is extremely proud to announce that two patrons have pledged their support to the portal. The patrons are Benoit B. Mandelbrot, discoverer of fractals, and Ray Kurzweil, world-leading expert in artificial intelligence.

4.4.1 Benoit B. Mandelbrot

Benoit B. Mandelbrot is Sterling Professor Emeritus of Mathematical Sciences at Yale University and IBM Fellow Emeritus (Physics) at the IBM Research Centre.

He is best known as the founder of fractal geometry - the first broad attempt to investigate quantitatively the ubiquitous notion of roughness. He had no formal teacher but was strongly influenced by Paul Levy, Norbert Wiener and John von Neumann. He seeks a measure of order in physical, mathematical or social phenomena that are characterised by abundant data but wild variability, and speaks eloquently for the unity of knowing and feeling.

4.4.2 Ray Kurzweil

Ray Kurzweil has agreed to be the second patron for Xplora, we are happy to announce. He is a world-leading expert on artificial intelligence, winner of the "Inventor of the Year" from MIT, and has written many best selling popular science books on artificial intelligence including "The Age of Spiritual Machines, When Computers Exceed Human Intelligence".

4.5 Teachers

In order to make Xplora fulfil science teachers' needs, teachers are involved to give feedback on the design and development of the portal's tools and services, local acquisition and identification of resources, support of teachers in native language and for content contribution.

References:

- [1] The European Schoolnet, <http://www.eun.org>.
- [2] Xplora, the European Science Education Gateway, <http://www.xplora.org>
- [3] Permanent European Resource Centre for Informal Learning (PENCIL), <http://www.xplora.org/pencil.htm>
- [4] Nucleus, <http://xplora.eun.org/nucleus.htm>
- [5] European Collaborative for Science Industry and Technology Exhibitions (ECSITE), <http://www.ecsite.net/new/index.asp>
- [6] European Science Education Initiative, http://fp6.cordis.lu/fp6/event.cfm?EVENT_ID=66
- [7] Xplora thematic chats, http://www.xplora.org/ww/en/pub/xplora/events/online_chats.htm
- [8] http://www.xplora.org/ww/en/pub/xplora/events/online_chats/astronauts_chat.cfm
- [9] Informationen about AG Jodl: http://pen.physik.uni-kl.de/w_jodl/
- [10] The web experiment "Elektron diffraction": <http://131.246.237.97/rlab/web/index.shtml>
- [11] The Hardware of the experiment: <http://www.leybold-didactic.de/phk/a.asp?a=555626&L=1>
- [12] The GIMP: <http://www.gimp.org>
- [13] OpenOffice.org: <http://www.openoffice.org>
- [14] LyX: <http://www.lyx.org>

[15] GI-Knoppix: <http://gymnasium.isernhagen.de/giknoppix/GI-Knoppix-RC9.iso>

[16] Grace: <http://plasma-gate.weizmann.ac.il/Grace/>

[17] OpenCD: <http://www.theopencd.org/>

[18] Testversion of time slot negociation: <http://www.bionet.schule.de/~karl/Xplora/electrdiffr/>

[19] http://www.xplora.org/ww/en/pub/xplora/practice/favourites/practice_examples.htm

[20] <http://insight.eun.org>

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