



## **PROJECT**

### **Learning Environment for Physics Laboratory Activities**

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| <h3><b>EVALUATION REPORT</b></h3> |
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## Evaluation Report

A report on the results of the evaluation of the didactical and technical aspects of the web-based learning environment developed within the project entitled

### ***Learning Environment for Physics Laboratory Activities - LEPLA***

carried out within the framework of the European Community Socrates – Minerva Programme as Contract 99843-CP-1-2002-1-PL-M, 2002 - 2005

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## **I. Objective of the report.**

This report is aimed at concluding the evaluation activities concerning both the educational and technical aspects of the concepts and tools developed under the LEPLA project. This includes evaluation of the technical framework of the web-based resource of learning materials and tools adopted for the experimental practices as well as the evaluation of the didactical effectiveness and reception of the teaching methods and learning materials developed.

The report is addressed to educators teaching experimental physics at different levels: primary and secondary school, undergraduate university level, teacher training students and teachers from in-service training courses. Teachers who already use or plan to implement hand held technology in teaching practices may also find the present report useful.

Finally, the report may be helpful for educators involved in eLearning and promotion of educational usage of information technology and for education managers and authorities interested in incorporating ICT based methods in education.

## **II. Aims and objectives of LEPLA.**

Minerva Project 99843-CP-1-2002-1-PL-M has been carried out in the period 2002 -2005 by the Consortium of the following EU universities:

Technical University of Łódź, Poland - Coordinating Institution  
University College Cork, Ireland  
Università degli Studi di Padova, Italy  
Università di Bologna, Italy  
University of Malmö, Sweden  
University of Ulster, United Kingdom

The main objective of the project was to develop an internationally available, innovative learning environment based on ICT, multimedia educational material and handheld technology, extending physics laboratory activities to open and distance learning. The platform and materials developed are currently available in English, Italian, Swedish and Polish.

LEPLA is targeted at teachers and students at secondary school and undergraduate university level, in particular in contexts where experimental activities are absent or difficult to implement in teaching physics and science using traditional methods.

The collaborative activities undertaken by the partners resulted in the development of an Internet-based public resource with a set of experimental modules including multimedia learning material, downloadable procedures and programmes and sets of sample experimental data. The physical experiments are designed to be performed with use of specially developed setups based on inexpensive portable, compact data-loggers with compatible sensors, controlled by and used together with programmable graphing calculators or computers.

The LEPLA portal is available at the Web address: <http://www.lepla.edu.pl>

### III. Design of evaluation activities.

Evaluation of the LEPLA project was developed throughout the duration of the project along the lines laid out in the project proposal.

Issues related to evaluation were discussed by the partners from the very first project meeting in Łódź (2003) in order to allow a convenient place for evaluation in the development of the LEPLA platform and to ensure ongoing evaluation and feedback mechanisms. The overall evaluation plan was discussed in the project meetings in Padova and Malmö (2003) and agreed by the partners during the project meeting in Bologna (2004). During the Evaluation Meeting in Jordanstown and Dublin (2004) an overview of evaluation activities and first results was discussed and a final version of the plan was defined as follows:

#### Evaluation of technical aspects

- Hardware and software tools; web server technology; text; data; graphic and multimedia formats and editing tools
- Durability, speed, network safety, compatibility with operating systems, web browsers, language versions
- Website structure, templates, user platform communication tools, reliability.
- Hand held technology (data loggers, calculators, software)

#### Evaluation of educational aspects

##### *(i) Reception and usage*

- Prerequisites for use – minimum technical skills and ICT competence
- Time required for adoption into LEPLA-based experimental practices (both for teachers and pupils)
- Effectiveness of tools (stand-alone and remote usage)
- Perception, balance and usefulness of elements (text, graphics, video clips, plots, tables)
- Completeness of learning materials (volume and nature of additional material required)
- Schemes for student preparation and performance assessment

##### *(ii) Development of student competencies*

- Estimate of competencies needed and acquired in performing experiments
- Estimate of new skills developed in handling and interpreting data
- Rate of build up of skills and knowledge
- Rate of development of scientific methodology (anticipation, planning, criticism, conclusion)

##### *(iii) Development of personality*

- Observation of active participation, motivation, stimulation, initiative and creativity
- Observation of development of self-reliance and preparedness for self-study and exploration
- Observation of progress in overcoming stereotypes, prejudices and fears of experimental activities

##### *(iv) Social aspects*

- Observation of gender differences
- Identification of regional differences (urban/rural, different countries)
- Identification, diagnosis and intervention in relation to undesired attitudes and results

## **IV. Evaluation of the technical aspects of the Web based LEPLA environment.**

### **Purpose of evaluation of the technical aspects.**

The evaluation of the technical aspects of the web based LEPLA platform was aimed on determination of the strengths and weaknesses of the web technology used and the developed portal structure and content.

The evaluation has been performed at three stages:

1. Development of portal prototype
2. Evaluation of the redesigned functional version of the portal
3. Final external evaluation of the portal

### **Methods of evaluation and tools used**

#### I. Regular tests performed independently by staff from partners institutions

Findings were recorded using an error form provided to the portal designers and web administrator at TUL.

The following issues, in particular, have been tested in this mode:

- HTML coding errors
- broken links (to images or pages)
- browser and platform compatibility PC and MAC: Internet Explorer 5.5 and 6; Netscape 4.7, 6 and 7, Mozilla, Opera,
- download time (graphics, multimedia, software).
- wireless connectivity using 802.11g transmission protocol.
- website navigation
- use of graphics, video material. graphics optimization
- resolution compatibility
- spelling and grammar errors.

#### II. Questionnaires. Web based and written forms for students and teachers (separate).

Evaluation forms include questions concerning website functionality, structure and navigation.

#### III. Website evaluation performed by an external evaluators

A report on the web site functionality has been prepared by two external evaluators (one from the Physics Department and one from the Education Department of Bologna University) and crosschecked by professor Lucia Giovannini from the Education Department of Bologna University.

### **Volume of evaluation information collected and analysed**

Approximately 20 academic and technical staff from partners institutions were involved in continuous testing of the technical aspects.

Approximately 400 users (teachers and students) were involved in the evaluation providing information via hardcopy evaluation forms.

### **Procedures for evaluation information analysis and implementation**

Reports of simple errors or other findings by staff involved in continuous evaluation were provided on a day by day basis and sent to the web administrator. All relevant improvements were implemented without delay.

Qualitative comments and recommendations concerning technical aspects were collected by the Coordinator and discussed during Project Seminars (5 meetings).

### **Main results of the evaluation at the Prototype stage**

#### **A.**

The recommendations formulated in the report “LEPLA - Technical Framework Requirements” have been implemented and the appropriateness of the chosen web technology has been confirmed by evaluation. No significant changes in the web technology have been formulated.

The modular construction of the PHP-Nuke portal engine provides tools relevant for satisfying LEPLA portal needs. Those include file Manager, headlines, download manager, frequently asked questions (FAQ) manager, blocks system structure, surveys and reviews system, newsletter, categorized articles and multi language content management. The chosen web technology of the Apache Web server has been proven to work effectively, providing a satisfactory level of durability and web safety.

Studies of the hardware load and network use indicated that the available hard disk capacity and processor power should be increased. Hardware tools for backup of the portal content also needed to be provided.

Available facilities securing continuous accessibility to the portal in the event of a shut down of the server's power were not satisfactory. Provision of a relevant Uninterruptible Power Supply (UPS) was recommended.

A speed up in the development of the mirror server of the portal content was recommended. Problems with diversity of graphic and video formats were noticed. It was recommended that graphic formats be reduced to JPEG or GIF for pictures and MPEG (300x240) for video material.

#### **B.**

In particular, achievements of satisfactory quality of the following important aspects have been noted:

1. All active portal services work well, with satisfactory durability.
2. The in-house Web server developed and continuously maintained at the dedicated computer server at Partner institution (IPL) is effective and robust.
3. The applied security and confidentiality measures based on standard (software) tools against web intruders and viruses have been confirmed to be appropriate. No critical breakthrough into the portal sever have been recorded.
4. The portal can be used effectively by wide range of Internet users: from home users accessing the Internet through modem connections via the local Internet Service Providers (with effective speed of 56 kbps) or ISDN, DSL, cable medium speed connections (up to 2Mbps) up to institutional users accessing through Local Area Networks (up to 100 Mbps Ethernet backbone). Performed tests confirmed portal accessibility via the wireless connectivity tools using 802.11g transmission protocol. Accessibility of the portal via network does not vary with the time of day or week. The efficiency of the available network connection reduces the need of developing multiple mirror sites providing better access for local users.
5. The website is shown to be equally effective with a variety of browsers such as Netscape and Internet Explorer, Mozilla, Opera.
6. The portal can be used effectively in wide range of display resolutions (from 640 X 480 up to 1280x1024).
7. Most graphics and data files can be downloaded quickly.

8. Text and background colours do not clash. Text is easy to read. Background is subdued and coordinates with text colors and graphics.
9. Effectiveness of use of the PHP general-purpose scripting language and HTML simple scripts in development of the LEPLA materials has been confirmed.

### C.

Following usability issues were raised and recommendations for improvement or redesign were implemented:

1. Portal navigation was too difficult. Too many internal links have been noticed, including some duplicated. Current location within the portal was not clearly indicated.
2. Graphic elements of the information pages were too big and it took a long time to download using modem internet access.
3. The opening page was overloaded with graphics and information. Design of new open and main pages was recommended. The side menu bar was too elaborate containing too many (or redundant) elements. The layout was such that this was not always apparent.
4. The process for becoming a registered user was too complicated. Some mail servers block successful registration via e-mail. It was recommended that a separate page for registration be developed.
5. The search facility was not adequate, very little information was being entered into the database.
6. It was recommended that the hierarchical structure of the portal be simplified. Some information was not easy to find (several clicks were necessary).
7. A separate, clearly identified, element presenting content of the portal: "Guided Tour" should be developed and implemented. This should provide information about the didactical concept underlying the practical activities, content of the learning materials and hand held technology.

The results of the first stage evaluation were overviewed during the Prototype Seminar held on in Malmö in November 2003. Redesign indications were implemented during the subsequent period.

### **Most important findings and results of the second stage of evaluation**

The technical aspects evaluation undertaken during the second stage was focused on the portal functionality and quality of the services. The redesigned structure and services have been assessed together with the elements previously accepted.

The methods and tools described above were again applied, stressing the importance of information provided by users from target groups (students and teachers).

### A.

The following advantages and improvements were recognized :

1. Users are now able to move around within the site much better than before.
2. The same basic format is used consistently throughout site.
3. The registration process is clear and easy accessible.
4. Links to other portal pages are appropriate and the structure is clearer and more accessible. Links are easy to identify and grouped in logical order and maintained through all experimental modules.
5. The information is properly labeled and clearly organized.
6. The homepage downloads efficiently using all tested Web browsers.
7. Keyword density and meta tags are improved, facilitating access by the popular Web search engines.



8. Graphic, video files, plots, etc., serve a clear purpose and do not dominate over the content of the pages.
9. Pages formats are appropriate. The majority of sub pages are not inordinately long and not overloaded with content.
10. Multimedia materials are accessible through standard viewers and readers (such as Windows media player, Acrobat reader) with the result that there is not a need to acquire proprietary software (plug-ins or players).
11. Credibility is satisfactory: Portal's ownership and EC as project sponsor is clearly identified. Partners involved in the design and maintenance are clearly presented with their e-mail address.
12. Web administrator is accessible and promptly responds to users inquiries
13. Resource links used to develop content are included.
14. The web portal is free of advertising.

## **B.**

The following disadvantages have been identified and call for further improvements.

1. No problems with access to the portal server have been reported. Technical measures preventing power shut downs require to be implemented - recommendation: to provide efficient UPS.
2. Immediate switch between languages versions of portal content is not possible. This is difficult to be accepted by some users.
3. Some information is still not easy to find (too many clicks are necessary). The search facility is not useful as the volume of the data base is small.
4. A small number of links to other pages within the site are not appropriate.
5. Some out-dated material has not yet been removed.
6. Thumbnail graphics is not used in practice. Less important graphics cannot be downloaded more quickly.
7. The bibliographical information is not clearly labeled and organized. The site does not include enough references to the source bibliography. Students cannot consult these sources to find additional information about the topic and compare the author's content.
8. There is no option available for text only viewing when heavy graphics is used. No information about frames compatibility nor suggested browser for better viewing is included.
9. The portal design is not optimized for use via a text-based browser. So, visually handicapped users cannot use screen readers to access the page.
10. Limited number of links to other useful Web sites are provided.
11. Currency of Web documents is not confirmed. The date of last revision and updating the links is not clearly labeled.

## **C.**

The following critical findings have been identified and immediate measures have been implemented:

1. Dead links in three modules, disappointing lack of elements of experimental modules makes them not usable – these modules should be withdrawn from the list unless major improvement is achieved.
2. Experimental pages containing numerous spelling and grammatical errors have been found. Detailed revision of the language issues needs to be undertaken.

Results of the second stage evaluation have been presented and discussed during the Evaluation Meeting (August 2004) and Evaluation Seminar (Feb 2005). Many of the issues had already resolved or at least improved without major re-design.

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## **Main results of the final web site check up**

An overall evaluation and check up on the web site functionality was performed by two external evaluators from the Physics Department and from the Education Department of Bologna University. Evaluation was performed on the final version both from technical and educational points of view. Both aspects are summarized together here because separation appeared to be inadequate.

External evaluation of the web site has been performed using the following macroindicators:

1. Presentation
2. Structure and navigation
3. Design
4. Interactivity
5. Contents
6. Care of the site

The main findings for each macroindicator are summarized below.

### ***1. Presentation***

Positive aspects:

- the site mission and the names and photos of the authors are clearly indicated in the home page and presentation sections.
- Interaction with the authors is available through different channels.
- The main sections of the web site are presented and access to them is possible by specific links.
- In the home page contents are summarized in few brief sentences
- The look of the presentation is clear and accurate.

Negative aspects: none

### ***2. Structure and navigation***

Positive aspects:

- The web site is clearly structured, simple and easy to navigate: all links are working.
- It is easy to move from one page to the other using the frame at the bottom of each page.
- A local search engine is present in order to help finding a specific section of interest in site.

Negative aspects and suggestions for improvements:

The comparison between the vertical and horizontal menus is slightly unsatisfactory: some items are common but it is unclear whether or not they refer to same content. It would be advisable have the principal items on the horizontal menu – the first that attracts attention in the site – and leave the secondary ones in the vertical menu.

Indication of the minimal configuration needed to access the materials and easily navigate through the web site would also be useful.

### ***3. Design***

Positive aspects:

- Graphic components of the site are simple and effective.
- Videoclips and photos help to make the activities understandable: optimal cooperation between text (on backgrounds that facilitate reading) and images is achieved and immediate pleasant reading is obtained.

Suggestions for improvement:

It would be valuable also to use animations that, though making downloading of pages a little longer, can help overcoming the static layout of the pages and making them more attractive at first look.

#### **4. *Interactivity***

The site contains a series of tools to provide feed-back from the users in terms of questions, contributions and messages. A forum can also be activated among students and/or teachers. No on-line or chat-line activities are allowed the site being designed mainly for guide and support of the experimental activities.

#### **5. *Contents***

Positive aspects:

- All information is available in four languages,
- Information is clearly addressed to the target population, enriched by examples, proposals of activities and suggested links for deeper investigation.
- After registration a lot of material is downloadable from the site.

Suggestions for improvement:

It could be useful to introduce an Archive where interesting examples of the use of LEPLA and/or suggestions of projects based on LEPLA could be collected and made accessible and downloadable. Sections devoted to different kinds of users could also be implemented in order to better match the needs of specific users.

#### **6. *Care of the site***

Positive aspects:

- many tools are implemented to allow the user seek information and provide feedback on site.

Negative aspects and suggestions for improvement:

A FAQ area and a collection of comments are missing. This would allow users to rapidly access useful information about the site and opinions expressed by other users.

In the home page the date of the last updating is missing.

### **Summary and Conclusions**

1. In general, the web site is well presented and has a professional appearance.
2. The site appears to contain most of the information the envisaged target users would require.
3. Software tools, web portal engines, hardware and network facilities are chosen correctly and used efficiently providing appropriate quality of the portal services.
4. Overall performance of the portal indicates that an effective maintenance strategy is in place.
5. However, there are several usability issues described above which could be addressed and improved if the Web learning platform is to achieve all of its goals.

## **V. Evaluation of the handheld technology tools.**

### **Purpose and scope of evaluation**

This evaluation exercise is aimed at determination of the strengths and weaknesses of the technology used for data collection and analysis in the context of learning activities associated with the materials developed within the LEPLA project. A detailed technical evaluation of each hardware and software tool used is beyond the scope of the present project.

#### Scope of the tools used includes:

- Two families of graphic calculators Texas Instruments TI83/83Plus/84 and TI89/92/Voyage200 were used as well as two data loggers: CBL/CBL2 and Vernier LoggerPro.
- Sensors and probes developed by Vernier or equivalent, manufactured by ZENIT, MAD.
- Experimental sets, designed and developed by partners using auxiliary elements.
- Calculator software (freeware) tools: general purpose programmes: Physics, Science, Ranger, LabPro; single purpose - individualised programmes developed by project partners for particular experiments.
- Computer software for PC-calculator communication and data analysis: TIConnect, TI GraphLink, Graphical Analysis, LabPro, TI Interactive, MSExcel.

### **Methods of evaluation and tools used**

#### I. Testing performed independently by staff from partner institutions

The following issues have been tested in particular:

- Reliability of experimental setups.
- Reliability of data collection software.
- Compatibility of hardware tools (sensors, transmission cables).

Findings were recorded and provided to the partner responsible for each experimental module.

#### II. Observations of learning practices performed by teachers with participation of the experts from partner institutions or independently.

The following aspects have been assessed:

- Simplicity of assembling and preparation of sets.
- Ease of data acquisition procedures.
- Availability of software tools for controlling data collection and analysis.
- Convenience of storing, exchanging and downloading software tools.

Observations were provided via questionnaires (including sections of the Web based questionnaires as well as hardcopy evaluation forms for teachers) or directly to the experts via standard communication tools, e.g. e-mail.

In principle, the complete sets and procedures have been evaluated instead of separate evaluation of individual elements (hardware and software). However detailed findings concerning elements have been reported to the designers.

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## Volume of information collected and analysed

All 31 experiments used underwent the evaluation exercise. Approximately 20 person from academic and technical staff of partners institutions were involved in continuous testing  
Approx. 400 users (teachers and students) were involved, providing evaluation information.

## Most important findings and results

The following important aspects have been reported:

1. Experimental setups developed within the project present a successful balance between simplicity and ease of use and reliability and accuracy of measurements.
2. The number of elements, connections to be made by users, assembly and adjustment procedures are reduced which facilitates use by inexperienced users (teachers and students)
3. All experimental sets follow similar basic concepts of arranging and performing data collection which is supported by the common structure of instructions provided by the Web based learning materials.
4. Effectiveness, speed, data storage capacity offered by standard TI83 calculator is limited whereas its successors TI83PlusSE and TI84 offer much better parameters.
5. The TI89/92/Voyage 200 parameters satisfy all needs at the experimental level concerned.
6. Graphic calculators used within project offer connectivity and data exchange between devices and with the PC/MAC computers as well as simple visualization with help of ViewScreen panels (for overhead projectors) and video presentation with help of TI Presenter interface. In this way the easy to prepare, flexible and effective educational presentation system can be assembled.
7. Connectivity and data transmission between calculator and PC offered by both families is satisfactory. However use of TI84 and TI 89 Titanium is recommended as they offer much faster USB connectivity.
8. CBL and CBL2 data loggers offer standard level of frequency range, accuracy and data storage, adequate for experiments at the study level concerned. However when multichannel data acquisition is involved the storage capacity is reduced and this should be taken into account by designers.
9. Autoidentification of standard sensors provided by CBL/CBL2 simplifies preparation of the data collection as troublesome calibration procedures can be avoided. This however, calls for use of the standard probes provided by limited number of manufacturers.
10. The LoggerPro data logger offers higher standard and extended set of basic data collection parameters. It is recommended to use it together with advanced TI89/TI92/Voyage calculators
11. Freely available computer software (TI Connect, TI Graphlink) support hardware connectivity and offer simple and reliable data transmission between calculators and computers. It is recommended to use these tools for storing and exchanging collected data.
12. Calculators use simple programming language (version of Basic) which offers efficient tools for developing a user's own programmes in a very easy way.
13. Single purpose calculator programmes proved to be appropriate, in particular in the case of use by less experienced students.
14. General purpose calculator programmes Physics and Science (IT) can be successfully used in case of more complex (multi-channel) measurements and by more experienced students.
15. Both calculators and CBL/LoggerPro devices offer excellent technical documentation. Technical support offered by manufacturers (Texas instruments and Vernier) is outstanding. An extensive volume of examples of free programmes, concepts, hints etc. is available in the Internet.
16. The appropriateness of choosing the MS Excel as PC software tool for alternative data analysis has been confirmed by inquired users. No problems with transferring data from calculator to PC and performing data analysis were reported.

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**The following usability issues should be emphasized.**

1. An insufficient amount of technical details and availability of the elements of particular experimental setups has been noticed. This reduces the possibility of duplicating and assembling sets by educators.
2. Availability of compatible sensors is limited in some European countries (eg. central and eastern Europe).
3. Incompatibility of data and program formats between the TI83/84 and TI89/92 families calls for development of programmes for control and data analysis independently for each type. This must be followed by development of separate instructions. This incompatibility should be taken into account by educators at the stage of choosing the calculator model.
4. Effective use of general purpose calculator programs (Physics, Science) calls for advance training. It is recommended for more experienced users at ~~the~~ high school user level or for undergraduate students.
5. It has been observed that effective use of developed single purpose calculator programmes is limited by language difficulties. It is recommended that localized versions of these programmes be prepared.
6. Lack of available programme compilers which are able to check in advance syntax and internal coherency of written programmes limits comfort of development of user prepared programmes for experiment control.
7. CBL2 and LoggerPro do not have built-in information display (as the CBL) which makes use of them less comfortable and calls for adoption of single purpose programmes in order to fully control the development of data acquisition.
8. Observation of the use of LoggerPro and LabPro revealed technical advantages of these tools in terms of resolution, frequency range and accuracy. However, problems of availability of these tools and direct incompatibility with much the simpler and cheaper tools CBL/CBL2 and software resulted in focusing on the CBL/CBL2 systems.

**Summary and Conclusions**

- Observations collected confirmed that graphic calculators offer software tools sufficient for performing data analysis and graphic presentation of results at the different levels of education involved.
- The majority of the basic experimental tasks at the levels concerned can be successfully completed with the use of TI83/84 calculators and CBL/CBL2 data loggers. The TI89/92 and LoggerPro devices offer more advanced tools including Computer Algebra System, higher storage capacity and better resolution. These tools are particularly recommended for teaching at the undergraduate level.
- Whenever there is need for use of more advanced computer software tools the collected data can be easily transferred from the calculator to the computer.
- Graphic calculators together with compatible hand held data loggers have proven suitability for educational purposes at the target levels of the LEPLA project. Simple to assemble and use, reliable and small scale experimental sets can be based on these hardware tools. Simple software tools for experiment control and data analysis, available free of charge, together with excellent technical support, facilitates and enhances the inclusion of experimental practices in teaching.

## VI. Evaluation of educational aspects.

The aim of the evaluation of educational aspects was to test the educational potential of the materials produced by the project for encouraging the performance of laboratory activities in physics and to assess the advantages/disadvantages of the access to teaching/learning materials through the internet portal in different educational contexts.

Evaluation of educational aspects has been performed at a first stage through web questionnaires attached to the individual LEPLA modules and to be filled on-line by the user.

A plan for classroom based evaluation activities was later developed, including the testing of individual modules in classroom contexts and systematic feedback collection from the students and teachers involved.

A first provisional plan was developed in Padova (2003). On this basis teachers were engaged for testing modules in both pilot and final version forms. Module testing of pilot materials was carried out in order to collect useful feedback for the further improvement before final versions were developed. At this stage feedback was provided mainly through the web questionnaires, informal reports of the teachers and, wherever the opportunity arose, through direct classroom observation.

The final plan for collection of the evaluation data on the complete LEPLA materials was defined during the meeting in Dublin (2004). At that stage it was agreed that it was necessary to collect data from different sources in order to be able to compare the results obtained. The selected sources of data were the following:

- written questionnaires from students who worked with LEPLA in different contexts
- written questionnaires from teachers who used the LEPLA materials for different teaching purposes
- observation reports from research people not involved in the teaching process
- evaluation questionnaires from colleagues and experienced teachers.

During feedback collection it appeared that asking the teachers to produce a written report – instead of, or in addition to, the questionnaire – could help to better understand their reactions to the use of LEPLA. Therefore a Teachers' Report was added to the list of evaluation instruments.

### Evaluation instruments and procedures

Evaluation data have been collected during all the project development through *Web Questionnaires*. The aim of these web questionnaires was to collect feedback on the use of LEPLA modules concerning both the technical functioning of the platform and the educational approach of the teaching/learning materials. Three kinds of questionnaires were developed: (i) for the generic visitor of the website, (ii) for students engaged in the use of LEPLA materials and (iii) for teachers who used the LEPLA materials.

The questionnaires were developed by the Bologna research group and checked by the Cork group following the decisions taken during the Predesign Seminar in Lodz (2003) the Template Seminar in Padova (2003) and the Module Seminar in Bologna (2004). These were revised and put in their final version during the Dublin meeting (2004).

In accordance with the evaluation plan developed by the partners, specific feedback from students and teachers who used the LEPLA materials in classroom activities has been collected using hardcopy forms specifically designed for this purpose (see annexed Evaluation forms) and described below.

The Students' Questionnaire was aimed at investigating whether students found the material useful in performing the experiments, how easy were instructions to follow and to what extent independent use of the materials was allowed, which aspects of LEPLA the students found most interesting and which ones they appreciated less, to what extent they perceived that working with LEPLA can affect their ideas about physics and about experimental activities.

The Teacher's Questionnaire was directed at collecting teachers' reactions both to their personal experience with LEPLA and to their experience with the students. This questionnaire proved later to be too schematic and was replaced by the Teachers' Report.

The Teacher's Report was designed to evaluate the LEPLA project through the eyes of the teachers whose classes used the LEPLA materials and to check the information collected through the teacher's questionnaire, where relevant. It is divided into two sections. In the first section, feedback on the teacher's personal experience and background is sought, including information on previous experience with technology, the subjects taught and at what level, information regarding previous experience with LEPLA, if any, and what are considered to be the strengths and weaknesses of the material. The second section of the report is designed to provide feedback on the teacher's experience within the classroom, including information concerning the impact of this style of teaching on both the learning outcomes and additional cognitive skills, together with comments on whether or not using this type of material could influence their teaching methodology.

The Classroom Observation Report is meant to be completed by an observer who is present during classroom work with LEPLA materials but is not involved in the teaching/learning process being observed. Beside some general information about the group under observation, it includes comments on the behaviour of the students related to the different stages of the work with the LEPLA materials (the setting of the experiment, data acquisition and analysis, etc.) and some more general comments on the role of the teacher and the attitude of the students during the activities.

The Experts' Questionnaire is designed to collect observations from university colleagues and experienced teachers concerning the different sections of each module, allowing comments to be made on the appropriateness of the theory presented and of the experimental procedures suggested, on the level of detail provided for the students to perform the experiment, on the appropriateness of the methodology proposed for the data analysis, on the usefulness of the sample data, and more in general on the pedagogical/didactical value of the LEPLA approach and the potential of the LEPLA approach for promoting physics.

In order to take into consideration possible national, cultural or social differences, it was agreed that each partner should be free to adapt and modify the general format developed to the needs of the local population being investigated.

### **Volume of evaluation information collected and analysed**

Approximately 430 students, 15 teachers, 2 observers and 8 experts have been involved in the process of evaluation of educational aspects. All partners were involved in the evaluation process. Italy and Sweden also used some of the modules in a foreign language (English) whereas Poland, Ireland and United Kingdom used only localized versions. Table 1 shows the list of written forms received and analysed, grouped according to the nature of the data.

### **Procedures for evaluation data analysis**

All data have been analysed and compared. Because of the differences introduced by the local versions of questionnaires, data have been analysed separately and then combined where appropriate.

Table 2 shows the quantitative results of the questionnaires collected from high school and university students (blue) and from low secondary school students (green) who performed experiments following the LEPLA on-line materials. In the case of the second group, a reduced version of the questionnaire was administered, so data can be compared only on one question.

Table 3 shows the results of the questionnaires given to students who used the LEPLA materials for instruction on Data analysis only or used the educational materials for distance learning.

Table 4 shows the results of the Experts' evaluation questionnaires. Questions have been summarized and answers (open in the original version) codified to allow easier interpretation.

Observation Reports and Teachers' Reports are not suitable for quantitative analysis. Information from these sources are summarized in the section about main findings.



**Table 1 - LEPLA EVALUATION:** supporting documentation

| Document N°  | Nature of documentation   |
|--------------|---|
| IE-1a        | 20 questionnaires (lower secondary school students)   |
| IE-2a        | 20 questionnaires (lower secondary school students)   |
| IE-3a        | 20 questionnaires (lower secondary school students)   |
| IE-7         | 16 web questionnaires (pre-service teachers)  |
| IT-2a        | 24 questionnaires (high school students - light modules, 2004)  |
| IT-3a        | 5 questionnaires (high school students - T89+incline, mass-spring module as independent learning, 2005) |
| IT-1         | 112 questionnaires (university biology students - 2003)   |
| IT-4         | 101 questionnaires (university biology students - 2005)   |
| PL-1a        | 26 questionnaires (university students)   |
| PL-2a        | 40 questionnaires (university students)   |
| SE-1a        | 11 questionnaires (pre-service teachers-distance learning)  |
| SE-2a        | 15 questionnaires (pre-university students-ball bounce)   |
| UK-1a        | 18 questionnaires (university engineering students-incline)   |
| IE-1b        | Teacher's report on IE-1  |
| IE-2b        | Teacher's report on IE-2  |
| IE-3b        | Teacher's report on IE-3  |
| IE-4-5-6     | 3 Teacher's reports   |
| IT-2b        | Teacher's questionnaire on IT-2   |
| IT-3b        | Teacher's report on IT-3  |
| IT-10        | 5 Teacher's questionnaires (from teacher training activities)   |
| PL-4         | 2 teacher's questionnaires  |
| IT-2c        | Observation report on IT-2 (Veronica)   |
| IT-3c        | Observation report on IT-3 (Veronica)   |
| PL-1b        | Observation reports on PI-1   |
| PL-2b        | Observation reports on PI-2   |
| SE-2b        | Observation report on SE-2 (BP,RJ)  |
| UK-1b        | Observation report on UK-1 (KH)   |
| IE-8         | Independent expert's report ( Dublin City University)   |
| IE-9         | Independent expert's reports (O Finlayson)  |
| IT-5-6-7-8-9 | 5 Independent expert's reports (experienced teachers, university researchers)                           |
| PL-3-4-5     | 3 Independent expert's reports  |

**Table 2 - LEPLA EVALUATION:** students performing experiments with LEPLA

| Male | Female |
|------|--------|
| 61%  | 39%    |

Did you find the web format of the LEPLA material helpful in performing the experiments?

Yes **93%** No **7%**

Were the instructions given in the LEPLA material easy to follow?

Very easy **15%** Easy **72%** Difficult **10%** Very Difficult **2%**

When using LEPLA material, how often did you have to ask for help from your teacher?

Very often **1%** Often **20%** Nor very often **57%** Never **22%**

In the following list, tick the advantages and disadvantages that you noticed in using the LEPLA material compared with your usual way of learning physics

|  | High school/<br>University | Low<br>secondary        |
|--|----------------------------|-------------------------|
| More fun   | <b>37%</b>                 | <b>31%</b>              |
| More freedom in choosing one's own path through investigations | <b>30%</b>                 | <b>39%</b>              |
| More detailed information about how to perform experiments     | <b>69%</b>                 | <b>Item non present</b> |
| Allowed me to learn at my own pace                             | <b>46%</b>                 | <b>18%</b>              |
| Too much information given to the student                      | <b>14%</b>                 | <b>7%</b>               |
| Too many computer skills needed                                | <b>10%</b>                 | <b>2%</b>               |
| The experimental set up was too complicated                    | <b>7%</b>                  | <b>3%</b>               |

Did the use of LEPLA materials change the way you think about physics?

Yes **28%** No **72%**

Did the use of LEPLA materials change your approach to scientific experiments?

Yes **58%** No **42%**

**Table 3 - LEPLA EVALUATION:** students using LEPLA for distance learning

| Location  | Date                           | Male | Female |
|---|--------------------------------|------|--------|
| University of Bologna<br>(Physics for Biology students) | December 2003<br>December 2004 | 23%  | 77%    |

Have you used the online materials available for this course?

Never  Occasionally  Frequently

If you have used them sometimes, have they been useful for preparation of the examination?

Yes, a lot  Enough  No

| Have you had difficulties in the use of the LEPLA materials? |                                  |           |                                  |
|--|----------------------------------|-----------|----------------------------------|
| None at all  | <input type="text" value="32%"/> | Some      | <input type="text" value="58%"/> |
|  |                                  | Many      | <input type="text" value="10%"/> |
|  |                                  | Very many | <input type="text" value="0%"/>  |

Point out the principal advantages and difficulties met in the use of the LEPLA materials

| Advantages<br>(most frequent answers)  | Difficulties<br>(most frequent answers) |
|--|---|
| Easy and rapid use<br>Exercises can be made at home                              | Downloading                             |
| Distance learning<br>Material availability<br>More accurate preparation possible | Website registration                    |

**Table 4 - LEPLA EVALUATION: experts' questionnaires**

| Experiments analysed                           | Experts reports received      |
|--|-------------------------------|
| M02 Exploring Faraday's law                    | High School Teachers <b>3</b> |
| M03 Ball bounce                                | University teachers <b>6</b>  |
| M05 RC - charging capacitor                    |                               |
| M07 Directional properties of light            |                               |
| M10 Voltage-Current relationship: Ohm's Law    |                               |
| M20 Jumping on a scale                         |                               |
| M29 Exploring the Inverse Square Law for light |                               |

  

- appropriateness of the theory presented
 

Very good 
 Good 
 To be improved
- appropriateness of the experimental procedures suggested.
 

Very good 
 Good 
 To be improved
- level of detail provided for the students to perform the experiment
 

Very good 
 Good 
 To be improved
- Comment on the appropriateness of the methodology proposed for the data analysis.
 

Very good 
 Good 
 To be improved
- usefulness of the sample data provided in the module.
 

Very useful 
 Useful 
 Useless
- Do you think that the presentation of the module would stimulate students to perform the experiment (rather than simply use the sample data)?
 

Yes 
 No 
 Problematic
- pedagogical/didactical value of the LEPLA approach.
 

Very good 
 Good 
 Problematic
- Comment on the potential of the LEPLA approach for promoting physics
 

Very good 
 Good 
 Problematic

## **Main results of the evaluation of educational aspects**

### *The point of view of the students*

The results in tables 2 and 3 together with the comments added by the students to open questions point out that working with LEPLA has been an interesting experience for the whole population, mainly for the following reasons:

- instructions were easy to follow, being clear and detailed so as to allow students to be independent in performing the learning activities;
- the use of hand-held technology was appreciated in itself and because of the advantages in data collection and analysis that allows for concentration on the interpretation of the results;
- the structure of the investigation proposed provided the students with an adequate balance between freedom and guidance: their initiative in exploring phenomena was not frustrated by their lack of experience or by the inadequacy of the measuring system;
- in general, the resulting level of enjoyment was higher than in traditional classes.

Compared to the younger students, students from high school and university were more sensitive to the advantages of having the opportunity to learn at their own pace, to use the materials for homework and for exam preparation, to explore real phenomena instead of “artificial” laboratory experiments.

Very few students made negative comments or declared that they preferred a more traditional style of laboratory activities. The more frequent negative reactions were the following:

- the materials were too rich in information;
- performance of experiments was too automatic and resulted into mechanical repetition;
- the level of computer skills required was too high.

There is evidence that students having some difficulties with using the technology were often bright students in normal school activities and their relative lack of success in this case clearly affected their attitude towards the LEPLA approach.

The two questions aimed at identifying effects on the students’ attitude towards physics and scientific experiments, in particular, have not given clear-cut results. To the first question many answered No because they felt they already liked the subject; to the second almost the same number answered Yes as No, but it is doubtful if they really understood the question.

Among the students who used LEPLA materials only for data analysis, the vast majority appreciated the opportunity to have the materials easily available through the web. Only a few appeared to react negatively to the LEPLA approach when used for distance learning, probably due to the fact that they had too little experience of actually performing laboratory experiments. A small group of secondary school students who had first used LEPLA in the classroom and later for performing an experiment at home without teacher’s assistance reported that they found it easy to collect and analyse the data even when working on their own and liked the more “professional” approach due to the use of technology.

### *The point of view of the teachers*

Teachers’ reports on classroom activities have been a very rich source of information on both positive and negative aspects of the use of LEPLA in the classroom.

As it might be expected the reactions have been different according to the age level of the students involved and to the level of confidence of the teacher with the hand-held technology.

In more formal contexts, such as in university introductory courses, the reduced time necessary for performing the experiments was certainly appreciated; on the other hand, students’ initial lack of confidence with technology created some problems because the durations of the intervention were less flexible than in schools. In this context, teachers appreciated the opportunities for independent learning

offered by LEPLA but were also concerned with the excess of details present in the instructions - particularly in data analysis - that seemed to reduce the students' curiosity and may tempt students to replace the real experiment with the analysis of sample data downloadable from the LEPLA site. Some instructors felt that too much information was given to the students so that too little remained to be explored. They also noticed that some students, who were used to working with printed instructions, found it difficult to use the guides directly on the web.

Those school teachers who were not confident with technology - but were nevertheless prepared to try this kind of activities - were impressed by the ability shown by their pupils in dealing with data logging and noticed that often it was the less bright pupils – according to ordinary evaluation criteria – who were the quicker to learn how to handle the system. They were surprised of how easy and efficient it became to collaborate with the students on the LEPLA materials, giving them the help they needed for understanding the texts that were sometimes above their competence level and receiving in exchange help in the use of the technology. Spontaneous development of this 'cooperative teaching' can be regarded as the effect the LEPLA concept. These teachers were also impressed by the variety of experiments they could do which were usually not performable in school settings with traditional apparatus.

Those teachers who were confident with the data acquisition system appreciated the amount and variety of information accessible through LEPLA and liked the kind of activities proposed, mainly because they recognized their potential in helping students understand basic physics concepts which were usually difficult to teach and to learn in more traditional contexts. These teachers highlighted how the immediate display of graphs and the easy repetition of the experiment made experiments highly enjoyable to the students and how the system allowed for design and performance of further investigation by the students themselves.

While it was sometimes pointed out that the presence in the different modules of different programs for data logging could be a disturbing element, at the same time there is evidence that LEPLA instructions were equally useful for performing experiments using the program the students felt more confident with, even where it was not the one suggested in the module.

The kind of laboratory work suggested by LEPLA appeared also to be suitable for mixed ability classes and, in some cases, it was also observed that girls appeared to be more confident with LEPLA than with traditional lab work.

## **Summary and conclusions**

### *(i) Reception and usage*

The minimum level of technical skills required appears to be very low. Introduction modules to hand-held technology seem to be enough to allow students to perform any of the experiments proposed, as far as ICT competences are concerned.

The time required for adoption of LEPLA-based experimental practices does not seem critical. All the groups involved in the trials found the LEPLA tools to be sound and effective, including those who had never worked with it before. The format of LEPLA modules and the completeness of the learning materials were appreciated, both in terms of the volume and the nature of the materials. In order to avoid the risk of giving too prescriptive instructions it was proposed that suggestions for further explorations should be added to the basic activities described in detail.

No specific indication for students performance assessment was included in the modules, but the Teachers' Reports documented that laboratory work with LEPLA could provide the teacher with elements important in the assessment of the students competence in the subject.

*(ii) Development of student competencies*

To measure stable competences acquired in working with LEPLA would have required longer periods of monitored activities in the same classes. Competences developed have been checked by individual teachers according to their own criteria. No evidence was found that the work with LEPLA resulted in a waste of time in any of the contexts considered, whereas in many cases – especially at lower secondary school level – teachers were able to notice that working with LEPLA had stimulated a very productive process of discussion and collective construction of meanings within the class. In particular, skills in data handling and data interpretation appeared to be deeply involved in performing experiments within the LEPLA framework: in those classes which participated both in pilot and final testing of the modules, it was observed that the first experience had clearly influenced the performance on the second one by developing both the ability to anticipate the results and to criticize the results obtained.

*(iii) Development of personality*

Observation of classroom work has provided clear data about participation and motivation of students working with LEPLA. In particular the students' enjoyment and interest in performing the activities proposed in the modules proved fundamental in motivating and sustaining students' participation and in the development of their initiative and creativity. Very few negative reactions were reported that probably required a longer period of interaction with the methodology proposed by LEPLA to be overcome.

*(iv) Social aspects*

There was no substantial evidence of differences in the reception of LEPLA in the different countries.

Differences were pointed out between low secondary and high school/university usage, as it was expected. The level of flexibility of the modules was nevertheless high enough to allow LEPLA materials to be used efficiently at different school levels.

As mentioned above, there were some indications that working with LEPLA and particularly using data logging might help to minimize gender differences in attitudes towards experimental work.

No evidence was found that the proposed activities might generate any undesired attitudes. The few cases of negative reactions noted above appeared to be related to peculiarities of the class context and in no case have had negative consequences on the students' learning of the subject.

## VII. Final comments and implications for further developments.

- The information collected during the evaluation exercise has revealed a positive reception from users and has shown the didactical appropriateness of the LEPLA concept in experimental physics teaching.
- The combination of the use of easy to handle modern data acquisition technology and web based learning materials is appreciated both by teachers and students. It has been shown to lead to interesting and flexible activities involving and motivating students much more than using more traditional approaches.
- Graphic calculators together with compatible hand held data loggers have proved suitable for teaching physics and other sciences. This technology together with an associated web based resource of appropriate learning materials facilitates the implementation of ICT in education.
- The combination of the use of modern hand held data acquisition technology and instructive learning materials in practical sessions results in unusual type of 'cooperative teaching' relationship between teachers and students. The teacher becomes the student's partner instead of his/her instructor in practical activities, spontaneously sharing experiences and skills while gaining new ideas from students.
- No negative didactical aspects or fundamental problems in the use or reception of the materials have been reported.
- There is no essential difference in didactical methodology, students' and teachers' expectations, reception and performance practices between users from target groups' countries (IE, IT, SE, UK, PL). This validates the concept of development of internationally available educational resources and justifies the involvement of EU funds in the development of such resources.
- Balance between the complexity and depth of scientific approach and flexibility of adoption for different types and levels of teaching is very difficult to achieve. Experimental procedures and learning materials need to be diversified and adjusted to the level of teaching. This calls for the development of at least two versions of experimental modules addressed to school and university level, respectively.
- Effectiveness of the use of data acquisition and hand held technology devices in teaching practices depends on the user's previous experience. This calls for training activities for teachers and students preceding experimental sessions, in particular in contexts where this technology is not widespread.
- We observed an increase of interest in using English language versions of the learning materials in teaching practices in partner countries (IT, SE, PL). However users from other countries (e.g. France, Germany) express a preference for using learning materials in their native languages. This indicates that the future expansion of the LEPLA materials should involve more language localization.
- The reliability and effectiveness of the portal services are most valuable for users and prevail over the media attractiveness of the content. Reliability of navigation and content should be regarded as an absolute priority in the case of web based educational resources. Continuous ongoing testing is required in order to remove all navigation and language errors.
- The Web based learning materials should not be simple adoption of the standard, written form. The most valuable advantage of the Web format is horizontal and vertical interconnectivity between the content elements. The effective use of this intrinsic mechanism can create a new quality in learning and teaching process. Facilitating that flexibility should be one of the main concerns of the designers of the educational Web services.



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## **IX. Evaluation forms.**

- Web based form - portal evaluation questionnaire
- Web based form – evaluation questionnaire for student
- Web based form – evaluation questionnaire for teacher
- Hard-copy form – module evaluation questionnaire for expert
- Hard-copy form – evaluation questionnaire for student
- Hard-copy form – evaluation questionnaire for teacher

## LEPLA web site evaluation form

Please answer these questions using a radio buttons.

1. Please indicate how you arrived at the LEPLA site:

- ☐ by a search engine  
☐ by a reference in a paper  
☐ by the suggestion of a friend/colleague  
☐ by chance  
☐ I knew the URL

2. Please rate your satisfaction with the following features of LEPLA:

- |                             |                                 |                            |                            |                            |                                 |
|-----------------------------|---------------------------------|----------------------------|----------------------------|----------------------------|---------------------------------|
| - Web Site functionality    | <input type="radio"/> Very good | <input type="radio"/> Good | <input type="radio"/> Fair | <input type="radio"/> Poor | <input type="radio"/> Very poor |
| - Structure of the site     | <input type="radio"/> Very good | <input type="radio"/> Good | <input type="radio"/> Fair | <input type="radio"/> Poor | <input type="radio"/> Very poor |
| - Ease of navigation        | <input type="radio"/> Very good | <input type="radio"/> Good | <input type="radio"/> Fair | <input type="radio"/> Poor | <input type="radio"/> Very poor |
| - Overall design            | <input type="radio"/> Very good | <input type="radio"/> Good | <input type="radio"/> Fair | <input type="radio"/> Poor | <input type="radio"/> Very poor |
| - Reliability of technology | <input type="radio"/> Very good | <input type="radio"/> Good | <input type="radio"/> Fair | <input type="radio"/> Poor | <input type="radio"/> Very poor |

3. Please rate your interest for the following items of the LEPLA main menu:

- |                    |                            |                              |                           |
|--------------------|----------------------------|------------------------------|---------------------------|
| - Home             | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - About            | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Downloads        | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Experiments      | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Feedback         | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Journal          | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Partners         | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Private Messages | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Recommend us     | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Statistics       | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Submit news      | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Surveys          | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Web Links        | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Web Mail         | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |
| - Your Account     | <input type="radio"/> High | <input type="radio"/> Medium | <input type="radio"/> Low |

Clear

Submit

**Module evaluation form for student who worked with LEPLA**

Please answer these questions using the radio buttons.

1. Are you confident with web navigation ?
 

|   |                                     |
|---|-------------------------------------|
| <input type="radio"/> Very Confident      | <input type="radio"/> Confident     |
| <input type="radio"/> Some part Confident | <input type="radio"/> Non-Confident |
  
2. Please rate your satisfaction with the following features of LEPLA:
 

|                          |                                 |                            |                                 |
|--------------------------|---------------------------------|----------------------------|---------------------------------|
| - Web site functionality | <input type="radio"/> Very good | <input type="radio"/> Good | <input type="radio"/> Fair      |
|                          | <input type="radio"/> Poor      |                            | <input type="radio"/> Very poor |
| - Structure of the site  | <input type="radio"/> Very good | <input type="radio"/> Good | <input type="radio"/> Fair      |
|                          | <input type="radio"/> Poor      |                            | <input type="radio"/> Very poor |
| - Ease of navigation     | <input type="radio"/> Very good | <input type="radio"/> Good | <input type="radio"/> Fair      |
|                          | <input type="radio"/> Poor      |                            | <input type="radio"/> Very poor |
  
3. Did you have any previous experience of using the web in physics lessons before you used LEPLA materials ?
 

|                             |                                    |                                 |
|-----------------------------|------------------------------------|---------------------------------|
| <input type="radio"/> Never | <input type="radio"/> Occasionally | <input type="radio"/> Regularly |
|-----------------------------|------------------------------------|---------------------------------|
  
4. In case you did, please specify which of the following:
 

|  |
|--|
| <input type="radio"/> Downloading information from the web |
| <input type="radio"/> Visiting physics web sites.          |
  
5. In the following list tick the advantages and disadvantages that you noticed in using the LEPLA compared with your usual way of learning physics:
 

|   |
|---|
| <input type="checkbox"/> More fun   |
| <input type="checkbox"/> More freedom in choosing one's own path through investigations |
| <input type="checkbox"/> More detailed information about how to perform experiments     |
| <input type="checkbox"/> Allowed me to learn at my own pace                             |
| <input type="checkbox"/> Too much information given to the student                      |
| <input type="checkbox"/> Too much confidence needed in using the computer               |
| <input type="checkbox"/> Too much complexity for use to perform experiments             |
  
6. How did you enjoy working with LEPLA ?
 

|  |  |
|--|--|
| <input type="radio"/> Very enjoyable   | <input type="radio"/> Enjoyable        |
| <input type="radio"/> Fairly enjoyable | <input type="radio"/> Little enjoyment |
| <input type="radio"/> No enjoyment     |  |

Clear

Submit

## Teacher's Evaluation Questionnaire

For teachers who may or may not have used LEPLA with his/her students.

1. Are you confident with web navigation ? ☐ Yes ☐ No
2. Do you use web materials for your teaching ? ☐ Never ☐ Occasionally ☐ Regularly
3. Did you use any LEPLA materials with your students ? ☐ Yes ☐ No
4. In case you did, please specify for which of the following activities:
  - ☐ Performing experiments
  - ☐ Analysing sample data
  - ☐ Working with materials downloaded from the site
5. Did you yourself work on any LEPLA material ? ☐ Yes ☐ No
6. In case you did, please specify for which of the following activities:
  - ☐ Performing experiments
  - ☐ Analysing sample data
  - ☐ Working with materials downloaded from the site
  - ☐ Collecting interesting materials
7. Did you find the LEPLA materials easy to select for your own purposes ? ☐ Yes ☐ No
8. Please rate your satisfaction with the following features of LEPLA resources:
 

|  |                                    |                               |                               |                               |                                    |
|--|------------------------------------|-------------------------------|-------------------------------|-------------------------------|------------------------------------|
| - Range of experiments                     | <input type="checkbox"/> Very Good | <input type="checkbox"/> Good | <input type="checkbox"/> Fair | <input type="checkbox"/> Poor | <input type="checkbox"/> Very Poor |
| - Style of presentation of the experiments | <input type="checkbox"/> Very Good | <input type="checkbox"/> Good | <input type="checkbox"/> Fair | <input type="checkbox"/> Poor | <input type="checkbox"/> Very Poor |
| - Access to sample data                    | <input type="checkbox"/> Very Good | <input type="checkbox"/> Good | <input type="checkbox"/> Fair | <input type="checkbox"/> Poor | <input type="checkbox"/> Very Poor |
| - Suggestions for data analysis            | <input type="checkbox"/> Very Good | <input type="checkbox"/> Good | <input type="checkbox"/> Fair | <input type="checkbox"/> Poor | <input type="checkbox"/> Very Poor |
| - Projects                                 | <input type="checkbox"/> Very Good | <input type="checkbox"/> Good | <input type="checkbox"/> Fair | <input type="checkbox"/> Poor | <input type="checkbox"/> Very Poor |
| - Movies                                   | <input type="checkbox"/> Very Good | <input type="checkbox"/> Good | <input type="checkbox"/> Fair | <input type="checkbox"/> Poor | <input type="checkbox"/> Very Poor |
| - Encyclopaedia                            | <input type="checkbox"/> Very Good | <input type="checkbox"/> Good | <input type="checkbox"/> Fair | <input type="checkbox"/> Poor | <input type="checkbox"/> Very Poor |
9. How would you describe the level of enjoyment of your students working with LEPLA:
 

|   |                                       |   |
|---|---------------------------------------|---|
| <input type="checkbox"/> Very enjoyable   | <input type="checkbox"/> Enjoyable    | <input type="checkbox"/> Fairly enjoyable |
| <input type="checkbox"/> Little enjoyment | <input type="checkbox"/> No enjoyment |   |
10. Which were the major educational outcomes of students' work with LEPLA:
  - ☐ Motivation to performing the experimental work
  - ☐ Confidence in using the data acquisition technology
  - ☐ Confidence in using the software to analyse data
  - ☐ Ability to perform an investigation

☐ Increased understanding of subject matter

11. How would you rate your level of enjoyment when working with LEPLA ?

☐ Very enjoyable

☐ Enjoyable

☐ Fairly enjoyable

☐ Little enjoyment

☐ No enjoyment

12. How likely is that you will use LEPLA in your teaching of physics in the future ?

☐ Very likely

☐ Likely

☐ Fairly likely

☐ Rather unlikely

☐ No likelihood

## MODULE EVALUATION

|         |       |
|---------|-------|
| Module: | _____ |
|---------|-------|

|                     |            |          |      |
|---------------------|------------|----------|------|
| Name of the teacher | Occupation | Location | Date |
|                     |            |          |      |

Please answer the following questions. If you answer 'No' to a question, please explain.

1. Is the theory correct?

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2. Is the experimental procedure appropriate for the aim of the investigation?

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3. Is the experimental procedure described in sufficient detail to allow students to perform the experiment?

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4. Is the proposed methodology for the data analysis appropriate?

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5. Comment on the usefulness of the sample data provided in the module.

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6. Do you think that the presentation of the module would stimulate students to perform the experiment (rather than simply take the sample data and analyse it)?

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7. Comment on the pedagogical/didactical value of the LEPLA approach.

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8. Comment on the potential of the LEPLA approach for promoting physics?

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The LEPLA team appreciates very much your help with this evaluation. Thank you!!



## EVALUATION FORM

for the student who worked with LEPLA

| Location | Date | Male-Female |
|----------|------|-------------|
|          |      |             |

Please tick the answer you select.

1. How good are you at surfing the web ?

Very good ☐

Good ☐

Not good ☐

1.b What do you usually use the web for ? \_\_\_\_\_

\_\_\_\_\_

2. How often have you used the web for learning physics before using LEPLA materials?

Never ☐

Occasionally ☐

Frequently ☐

3. If you have used the web for learning physics, please specify which of the following you have used:

Visiting physics  
web sites ☐

Downloading information  
from the web ☐

Other(please specify):

\_\_\_\_\_

4. How often did you carry out experiments in physics before you used LEPLA materials?

Never ☐

Occasionally ☐

Frequently ☐

5. If you do carry out experiments in physics lessons, how many students are there usually in each group?

1 ☐

2-3 ☐

4-6 ☐

more than 6 ☐

6. How often have you used datalogging before you used LEPLA materials?

Never ☐

Occasionally ☐

Frequently ☐

7. Did you find the web format of the LEPLA material helpful in performing the experiments?

Yes ☐

No ☐

Please explain your answer: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

8. Were the instructions given in the LEPLA material easy to follow?

Very easy ☐

Easy ☐

Difficult ☐

Very difficult ☐

9. When using LEPLA material, how often did you have to ask for help from your teacher?

Very often ☐ Often ☐ Not very often ☐ Never ☐

10. In the following list, tick the advantages and disadvantages that you noticed in using the LEPLA material compared with your usual way of learning physics

More fun ☐

More freedom in choosing one's own path through investigations ☐

More detailed information about how to perform experiments ☐

Allowed me to learn at my own pace ☐

Too much information given to the student ☐

Too many computer skills needed ☐

The experimental set up was too complicated ☐

11. Which aspects of the LEPLA experiments did you find most interesting and useful for your learning of physics? Please explain:

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12. Did the use of LEPLA materials change the way you think about physics?

Yes ☐ No ☐ Please explain your answer: \_\_\_\_\_

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13. Did the use of LEPLA materials change your approach to scientific experiments?

Yes ☐ No ☐ Please explain your answer: \_\_\_\_\_

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Additional comments (if any):

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The LEPLA team appreciates very much your help with this evaluation. Thank you!!

**EVALUATION FORM**

for the teacher (who may or may not have used LEPLA with his/her students)

| Location | Date | Male-Female |
|----------|------|-------------|
|          |      |             |

Please tick the answer you select.

1. How good are you at surfing the web ?

Very good ☐

Good ☐

Not good ☐

1.b What do you usually use the web for ? \_\_\_\_\_

\_\_\_\_\_

2. How often do you use web materials for your teaching?

Never ☐

Occasionally ☐

Frequently ☐

3. If you have used the web for teaching physics, please specify which of the following you have used:

Visiting physics  
web sites ☐

Downloading information  
from the web ☐

Other(please specify):

\_\_\_\_\_

4. Please rate your satisfaction with the general features of LEPLA (functionality, structure, navigation).

Very good ☐

Fair ☐

Poor ☐

Very poor ☐

How might this site be improved ? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

5. Did you find the LEPLA materials of use for your own teaching purposes?

Yes ☐

No ☐

Please explain your answer: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

6. For which of the following activities did you use LEPLA material with your students:

Performing  
experiments ☐

Analysing sample data ☐

Other(please specify):

\_\_\_\_\_

\_\_\_\_\_

7. Please outline any difficulties encountered using LEPLA material (website/ exercises/experiments/ hardware/classroom management)

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8. Please rate your satisfaction with each of the following features of LEPLA resources:

|  | Very good                | Good                     | Fair                     | Poor                     | Very poor                |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Range of experiments                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Style of presentation of the experiments | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Access to sample data                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Suggestions for data analysis            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Projects                                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Movies                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

9. Did you find the web format of the LEPLA material helpful in performing the experiments?

Yes ☐ No ☐ Please explain your answer: \_\_\_\_\_

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10. Did you find the instructions given in the LEPLA material easy to follow?

Very easy ☐ Easy ☐ Difficult ☐ Very difficult ☐

11. Which were the major educational outcomes of students' work with LEPLA (tick as many as apply):

- Increased motivation to perform experimental work ☐
- Increased confidence in using data acquisition technology ☐
- Increased confidence in using software to analyse data ☐
- Increased ability to perform an investigation ☐
- Increased ability to manipulate and analyse data ☐
- Increased understanding of subject matter ☐
- More positive attitude to physics ☐

Other, please specify: \_\_\_\_\_

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12. Do you think that the use of LEPLA material can improve students' ability to form opinions and judgements based on scientific evidence and experiments?

Major improvement ☐ Some improvement ☐ Little improvement ☐ No improvement ☐ Don't know ☐

13. How likely is it that you will use LEPLA in your teaching of physics in the future?

Very likely ☐ Likely ☐ Fairly likely ☐ Rather unlikely ☐ No likelihood ☐

Please explain your answer: \_\_\_\_\_

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14. In what way do you think working with LEPLA materials might influence your physics lessons in the future?

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15. What were the major benefits or drawbacks you observed from the use of the LEPLA material?

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16. How would you describe the level of enjoyment of your students working with LEPLA?

Very enjoyable ☐ Enjoyable ☐ Fairly enjoyable ☐ Little enjoyment ☐ No enjoyment ☐

17. How would you rate your own level of enjoyment when working with LEPLA?

Very enjoyable ☐ Enjoyable ☐ Fairly enjoyable ☐ Little enjoyment ☐ No enjoyment ☐

18. Have you observed any effects of working with LEPLA on social aspects (for example gender differences, equal opportunities for disabled persons, interpersonal skills)?

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Additional comments (if any):

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The LEPLA team appreciates very much your help with this evaluation. Thank you!!