

Considerations Regarding the Advisability of the Training Modules “Virtual Instrumentation in Science Education” Organized in the Frame of the VccSSe European Project

GABRIEL GORGHIU¹, MIHAI BÎZOI¹, LAURA MONICA GORGHIU², ANA-MARIA SUDUC¹

¹ Electrical Engineering Faculty

² Faculty of Sciences and Arts

Valahia University Targoviste

18-24 Unirii Boulevard, 130082 Targoviste

ROMANIA

ggorghiu@yahoo.com, mihaibizoi@yahoo.com, laura_monica@yahoo.com, anasuduc@yahoo.com

<http://www.ssai.valahia.ro>

Abstract: - Nowadays, it is an evidence considering the *Knowledge Society* as a result of advances in *Information and Communication Technologies (ICT)* where people from all over the world have many benefits from the technological progress. In this sense, it is clear that the introduction of *ICT* in education has changed the traditional way of teaching and learning and forced the teachers and students to adapt their technical abilities and knowledge of *ICT*. Generally, the *ICT* support can be retrieved in teacher training programmes, education management and information systems, educational content, distance learning, education policy, media outreach and assistance for equipment and related facilities. But the implementation of *ICT* in the teaching/learning process mainly conducted to the change of the educational perspectives and instruments. One of the best examples is given by the e-learning technology which promotes modern methods of interaction by using *ICTs*.

E-learning technology is also proposed as an educational technology in many educational projects where initial and in-service teachers are the main actors who work inside different e-platforms. Courses, training modules, tasks and homework, surveys and assessment forms have been proposed together with other solutions that enhance the participation of teachers for working in a collaborative way. In this respect, the three years European Socrates Comenius 2.1 Project “*VccSSe - Virtual Community Collaborating Space for Science Education*” (128989-CP-1-2006-1-RO-COMENIUS-C21) tried to promote the use of virtual instrumentation and virtual experiments in educational environment, like new and modern teaching methods for the Mathematics and Science teachers. Taking also into consideration that the training sessions were developed using the *Moodle* course management system, the paper illustrates some considerations related to the training process made in the frame of the mentioned project and other aspects regarding the advisability of the training modules “*Virtual Instrumentation in Science Education*”, on the basis of the participants’ opinions emphasized in the project web-assessment forms.

Key-Words: - virtual experiment, training modules, Sciences education, e-learning, Moodle, virtual interaction, Comenius 2.1 project

1 Introduction

In the actual *Knowledge Society*, the Internet allows the exchange of information possible at high speed rates but let open to find favorable solutions for knowledge sharing and know-how broadcasting, two important aspects of the nowadays education [1, 2]. Anyway, in the last decade, it can be seen easily the intensification of the Internet uses that opened a new perspective and made clear the emergence of a new educational paradigm characterized as constructive, socio-cultural and transcendent [3]. More, the *World Wide Web* was designed with features that enabled a very fast expansion of the communication

infrastructure, reaching a large number of users and a huge quantity of content available [4]. In this direction, one of the strategies qualified for the web in the teaching/learning process is represented by *e-learning*, a technology based on *virtual interaction*, included by some authors as a specific component of distance learning evolution (figure 1).

Distance Learning has a long history which started in Europe since the beginning of the XX century. The earlier forms of distance learning were very simple and embraced the form of correspondence courses. In this case, paper documents were prepared and sent to students by

postal service, and learners provided their feedback in the form of filled questionnaires and documents to the teachers for the examination [5]. Of course, in the *Knowledge Society*, the mentioned procedure seems to be over fulfilled, even that some correspondence courses are still organized in accordance to the distance learning old meaning.

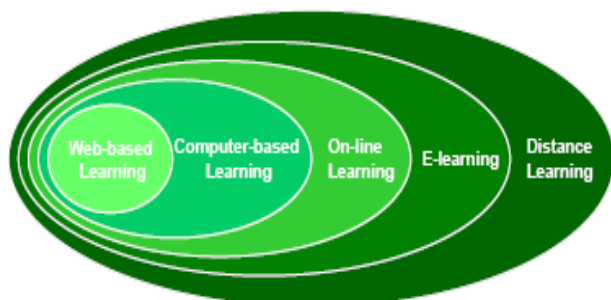


Fig.1 *E-learning* place in the evolution of *Distance Learning* (source: [5])

As an important part of *Distance Learning*, the *Virtual Learning (e-learning)* is represented by the interaction between the teaching/learning process and *Information and Communication Technologies - ICT*. Electronic educational materials have become a real reference and imaging presentation for preparing the lessons or solving the tasks.

To assure an efficient learning, it is compulsory that e-learning materials have to include multimedia contexts and the trainer/ tutor has to find the image that best represents the information necessary to be transmitted. In fact, one of the focus areas when developing the training materials is given by the identifying and defining the illustrations that best capture the essence of the associated concepts. This deep-level approach to the learning process is focused on understanding, on what is significant (concepts) and what is not, relating previous knowledge to new knowledge [6, 7]. In this way, the participants can benefit of training using the modern facilities proposed by *ICTs*.

Generally, the teaching/learning process is extremely complex since it involves people with different abilities, needs and expectations. Furthermore, when the teaching/learning process occurs by means of e-learning systems, additional aspects must be carefully considered: cultural technological, environmental, economical, political and regulatory. Related to the last one, it is clear that, as many innovative tools and practices, e-learning is waiting for complete regulations. Still today there is a great debate in some EU countries on the legal validity of certifications obtained by e-

learning courses, also in comparison with certifications obtained by traditional courses [5].

However, there are more and more educational institutions worldwide operating exclusively through the Internet and promoting e-learning, offering either a full cycle of education or specialized courses addressed to a very large range of users [8]. Moreover, notwithstanding several e-learning universities (universities providing exclusively e-learning courses) have been organized and regulated by specific rules, their effectiveness is still to be completely verified [9].

2 The Educational Web Environment

As known, the traditional training claims a prerogative for the direct dialogue between teachers and students, which creates an optimal framework for modeling the personality, more obvious to maintain the spirit of competition, but also the necessary psychological support [10]. Without claiming exclusivity, the *virtual education* offers new opportunities for training and communication and it becomes very popular more and more. The concept of *virtual education* is deeply linked with the *educational Web environment* one.

The educational Web environments (*Web-Base Course Environment - WBCE*) represent complex didactic systems, having also a special platform for Web learning. Some institutions design their own educational Web environment, but in general, a well-known e-learning platform is adopted (*Blackboard, Lotus, WebCT* etc.). In many cases, the platform is used not only in the area of distance education, but also for daily courses. In this sense, it can be said that Internet became a support for the educational process in any field [11].

An institution that proposes an educational Web environment is active on multiple plans in the virtual education area: it organizes courses for different levels, develops an educational support (programs, courses, materials, counseling, examination or assessment) for other similar institutions, and participates in consortia or partnerships with other academic organizations. Near the teachers of different specializations who have the mission of training the students, a team consisted on psychopedagogy and *ICT* specialists supervise all the training materials prepared by the above-mentioned teachers, following the requirements claimed by the functionality and human-computer interaction in the *World Wide Web* space [12, 13].

Without doubts, the factors that have considerable effects on learning have also the same

important role in e-learning. They multiply the role of multimedia in the process of creation of the training materials, but also they influence the learning style of the participants, when using the educational Web environment (the *e-learning site*). In this direction, the following factors can be mentioned [14]:

- *Visual and auditory inputs* - they are often considered to be of great assistance in providing more effective learning outcomes. However, if the learners are focusing their attention on one single media resource at a time have better results than those to whom more complex delivery has been offered.

- *Interaction* – it is important to distinguish between functional interaction and learning interaction. The first one includes functions like volume control, audio and video queuing, search tools, navigation, and configuration parameters. The latter is the interaction provided for specific learning outcomes.

- *Learner styles* - multiple views of information can be provided rather than assuming a single information structure. This way of presenting information supports effective alternatives for different learning styles. The four *Kolb learning styles* [15] are: *diverging* (feeling and watching), *assimilating* (watching and thinking), *converging* (doing and thinking) and *accommodating* (doing and feeling). The learner preferences are: *active, passive, visual, verbal*.

- *Content delivery and content exploration* - *Content delivery* refers to educational materials like textual course notes and other supporting media where learners go through the course materials in the specific way of “old” distance education. *Content exploration* has more interactive fashion like: *simulations, games* and other complex environments. At the same time, interactive systems should facilitate various learner styles and provide opportunities for learner control.

Human interaction is also an important aspect in e-learning and the platform must provide the related capabilities in this sense. Of course, an *e-learning site* offers support for organizing of an education system solely through the Internet, having a specific structure and complex functionalities. But, as a compulsory aspect, it should include a public area, generally accessible having an informative character, and also private section for students, teachers and administrative staff.

The section accessible to a student (after authentication) includes [8]:

- accessing the appropriate information related to the courses in which is enrolled;

- offering facilities for viewing and making the tasks, including on-line support;

- browsing the on-line announcements related to the courses;

- managing a calendar for marking the own activities (meetings with teachers / other students, deadlines for different tasks);

- managing own directories or files, e-mail account, personal profile.

The section related to a particular course should be accessible only to enrolled students and teaching staff (course owner, teaching assistants, content editors etc.). Its content includes [8]:

- presentation of the curriculum;

- information about the agenda of the course and other related educational activities (seminars, labs etc.);

- information for students or groups of learners;

- possibilities for accessing the training materials and resources (textbooks, software tools, Web sites etc.);

- facilities for communication between teachers and learners using synchronous and asynchronous channels.

News and other important information, like the deadlines for solving the tasks or the date for examinations, can be automatically included in the homepage of each student.

The private section of a teacher involved in educational activities should include facilities for [8]:

- on-line editing of teaching materials (courses, tests, laboratory tasks etc.);

- adding / removing of students from the course;

- uploading of general announcements or particular information related to the course;

- establishing the calendar for the course, seminars and laboratories;

- setting the work themes / tasks (editing the information on minimal requirements, scores, ways of achieving, additional resources etc.);

- planning the schedule for virtual lectures or videoconferences;

- indicating of useful resources for fulfilling the course (references, web documentation);

- managing the examinations;

- managing the on-line catalogue;

- generating the related numerical or graphic statistics.

Several *e-learning platforms* were installed and used as suitable tools in the frame of educational projects. In the last years, various projects targeted to develop training courses that involved a big amount of work made on web environments which presents the structure (sections) mentioned above.

3 The VccSSe Project and the “Virtual Instrumentation in Science Education” Training Modules

“VccSSe - Virtual Community Collaborating Space for Science Education” (<http://vccsse.ssai.valahia.ro>) is a three years Socrates Comenius 2.1 European Project, which started in 2006, being proposed in the European context offered by the contribution of teacher education and training to the Lisbon strategy (“Education and Training 2010”) [16, 17]. Targeting to the permanent improvement of the teaching profession, from initial teacher education to continuing professional development, especially for Mathematics and Science teachers, the VccSSe project tried to adapt, develop, test, implement and disseminate training modules, teaching methodologies and pedagogical strategies based on the use of *Virtual Instruments*, with the view to their implementation in the classroom, through ICT tools [18].

Together with 8 educational institutions from Romania, Spain, Poland, Finland and Greece, the coordinating institution - Valahia University of Targoviste, Romania - assumed the role of promoting of the virtual experiments in the educational environment. In this sense, the partnership designed and created specific training modules and materials related to the use of *Virtual Instrumentation in Science Education*. Basically, the developed materials were dedicated to in-service teachers from primary and secondary schools involved in Sciences subjects in the partners’ countries.

The training modules and materials - created for the *Virtual Instrumentation in Science Education* training modules - have been focused on presenting of four specific *Virtual Instrumentation environments* (*LabVIEW*, *Crocodile Clips*, *Cabri Geometry* and *GeoGebra*) [19]. Those environments were chosen to be used after an analysis phase, considering their features and educational facilities and also the wide experience proved by the project partnership in their using [20].

LabVIEW is a graphical programming mainly designed for measurement and automation. It allows (using the *drag and drop* technique) to create user interfaces for the applications with pre-built objects [21]. The application functionality can be specified by assembling *block diagrams*. The intuitive graphical nature of *LabVIEW* allows students to focus on the theory being taught and not on the tool manipulation and on the programming nuances [22]. The time to develop complex applications is shorter than using a general programming language.

Because *LabVIEW* is specifically design for engineers and scientists, being used in a wide range of areas, the students’ transition from school to industry is smoother. *LabVIEW* is a very useful tool in the teaching process for the development of interactive applications such as simulated experiments from very simple ones (as phenomena demonstration) to advanced experiments based on electronic instrumentation [23].

An important *LabVIEW* last versions advantage is represented by the possibility to remotely control the applications, a facility that opens new horizons in the technical distance learning [24]. This possibility has been emphasized in the VccSSe project, and included as a special sub-section (that contains 3 *LabVIEW* virtual experiments) in the *On-line/Remote Simulating Laboratories Exhibition* [25].

Crocodile Clips simulation packages are developed specifically for education [26] and allow students and teachers to recreate experiments, model mathematical theories or simulate real life quickly and easy. *Crocodile* simulators let students experiment in a safe, accurate environment [27], and come with a wealth of ready-made simulations and models. *Crocodile Clips* includes four packages: *Crocodile Physics*, *Crocodile Chemistry*, *Crocodile ICT* and *Crocodile Mathematics*. In the frame of *Virtual Instrumentation in Science Education* training modules, just the two first packages were proposed.

The main *Crocodile Clips* advantages are related to the user-friendly interface and the primary and secondary school curricula focus features. In order to easily learn how to use these tools, the *Crocodile Clips* developers provide many useful free training videos.

Mathematics teachers had also the opportunity to use the *Cabri Geometry II Plus* environment [28, 29]. *Cabri* allows the dynamically exploration of Euclidian, transformational and coordinate geometry. *Cabri* makes tough math’s concepts easier to learn thanks to its kinesthetic learning approach. It is easy to create a geometric figure, an equation or graph a function on the *Cabri* screen - which comes alive as a manipulable object. *Cabri II Plus* is an environment recognized by experts in pedagogy, specifically for its simplicity of use and solid educational foundation.

Dedicated also for mathematicians, *GeoGebra* is dynamic mathematics software for all levels of education that joins arithmetic, geometry, algebra and calculus [30]. It offers multiple representations of objects in its graphics, algebra, and spreadsheet views that are all dynamically linked.

While other interactive software (like *Cabri Geometry*) focuses on dynamic manipulations of geometrical objects, the idea behind *GeoGebra* is to connect geometric, algebraic, and numeric representations in an interactive way.

According to the training requirements of the *Virtual Instrumentation in Science Education* training modules, the participants, function of their background, had to select one of the presented software environments with the view to understand its main capabilities and facilities, and then - as a following step - to create a learning object which has to propose at least one virtual experiment.

The training session duration was scheduled for approximately 42 hours, including initial, final and impact web evaluation. As structure, the modules proposed 3 seminars and 3 laboratories, each of them being finalized with specific tasks.

The training modules were developed as e-learning courses under the *Moodle* platform. A number of 363 teachers, together with 32 tutors, started the training modules also as *Moodle* users.

4 The Moodle Platform

As generally known, *Moodle (Modular Object-Oriented Dynamic Learning Environment)* represents a *Course Management System (CMS)* as a free *Open Source* software package designed using sound pedagogical principles, to help educators create effective on-line learning communities [31].

Moodle is used mainly in education and aims to improve the teaching experience, through the enriching of the traditional training and assessment methods with the ICT-based ones. By using *Moodle*, the students have the opportunity to access learning materials, interact with teachers and colleagues and receive specific tasks as home-works.

Moodle presents multiple characteristics which made it to become in short time a representative e-learning platform. Some of its features can be synthesised as follows [31, 32]:

- creating and managing content / lessons / resource management;
- class or learning groups management;
- forums, chats and messaging;
- assignments for courses and users;
- blogs and wikis;
- databases;
- survey engines;
- support for more than 60 languages;
- convenient way for administrating the users and roles within a course.

In addition, four major concepts arise behind *Moodle: constructivism, constructionism, social constructivism, connected and separate* [33]. Those concepts recommend *Moodle* as an e-learning environment where each participant at a course can be a teacher as well as a learner.

A very helpful feature of *Moodle* is represented by its tools for administrating the training modules (course), both for the contents developed by the trainers and for allowing the students to enter in the site [34].

Orar săptămânal	
<ul style="list-style-type: none"> News forum News forum Bine ati venit la cursul nostru! Ghidul Studentului Ghid Moodle 	
11 Februarie 17 Februarie	<input type="checkbox"/>
Agenda Modulor de Formare VccSSE	
18 Februarie 24 Februarie	<input type="checkbox"/>
Evaluare inițială	
25 Februarie 2 Martie	<input type="checkbox"/>
Seminar 1	
Sarcina 1 (secțiunea "Teme rezolvate", prin încărcarea fișierului de lucru)	
3 Martie 9 Martie	<input type="checkbox"/>
Seminar 2	
Sarcina 2 (secțiunea "Teme rezolvate", prin încărcarea fișierului de lucru)	
10 Martie 16 Martie	<input type="checkbox"/>
Seminar 3	
Sarcina 3	
Macheta Word	
Macheta web1	
Macheta web2	
17 Martie 23 Martie	<input type="checkbox"/>
Laborator 1	
Predare / Invatare folosind Cabri Geometry	
Predare / Invatare folosind Crocodile Clips	
Predare / Invatare folosind LabVIEW	
Predare / Invatare folosind GeoGebra	
Sarcina Laborator 1	
Valoarea experimentelor virtuale in educatia in domeniul Stiintelor	
24 Martie 30 Martie	<input type="checkbox"/>
Laborator 2	
Sarcina Laborator 2 (secțiunea "Teme rezolvate", prin încărcarea fișierului de lucru)	
31 Martie 6 Aprilie	<input type="checkbox"/>
Laborator 3	
Sarcina Laborator 3 (secțiunea "Teme rezolvate", prin încărcarea fișierelor de lucru: "Aplicatia mea VI" si "Macheta lectie")	
7 Aprilie 13 Aprilie	<input type="checkbox"/>
Evaluare finală	
Chestionar referitor la impactul utilizării VI in clasă	
Chestionarul de feedback al elevilor	
14 Aprilie 20 Aprilie	<input type="checkbox"/>
Discuții Finale	

Fig.2 Moodle space organization for the VccSSE project training modules "*Virtual Instrumentation in Science Education*" (Targoviste category)

Moodle was selected as *Course Management System* for providing the training in the *VccSSE* project, for the following main reasons:

- it is a free *Open Source*;
- it is easy to install and administrate;
- it has a continuing growing popularity and is used by a large number of users;
- it has advanced tools for content creation (web pages, lessons, quizzes and multimedia contents).

In this respect, even a great part of *VccSse* project tutors and teachers took contact with *Moodle* for the first time, they experienced the *Moodle*'s organization and features with great interest and expressed their opinions in related discussions. A specific organization of the *VccSse* training modules, inside the *Moodle* space, is illustrated in Figure 2.

5 The Training Content

The *Virtual Instrumentation in Science Education* training modules contributed to the training of the following types of competences:

- Use and application of specific Virtual Instrumentation software in teaching of Mathematics and Science subjects;
- Educational design abilities for including Virtual Instrumentation applications in Mathematics and Science lessons;
- Use of *Moodle* e-learning platform.

The access to the *VccSse Moodle* platform was realized on the basis of an account and password. To be able to open an account and to access the training materials, the platform administrator provided the necessary information and the particular key for enrolling the participants to the training modules.

After opening the account, the access was made without restrictions, including also the possibility to see the specific calendar which displayed the activities planned for specific days.

The structure and the format of the training modules were framed as weekly type. In this case, the tutor added information and resources in each week and stipulated the necessary time allocated for study.

In general, this type of schedule is very practical and most widely used because it is based on the distribution of the materials in the static format (*doc*, *pdf*) and also on the direct setting of important dates for the students.

The training materials were uploaded in the central part of the *Moodle* interface and positioned in the specific frames for the defined weeks. In this way, both information and navigation were clear and simple to be accessed by any participant.

The training syllabus proposed useful and easy tools for creating Mathematics and Science virtual experiments to be used in the teaching process at different levels. In this respect, as *Virtual Instrumentation software environments*, there were designed training materials for *LabVIEW*, *Crocodile Clips*, *Cabri Geometry II* and *GeoGebra*, on the considerations described above [20].

6 Results and Discussions

During the final session of the *Virtual Instrumentation in Science Education* training modules, the trained teachers were asked to design at least one virtual experiment ready to be used in their classrooms. The virtual experiment was referred by a lesson plan, both of them constituted a learning object which was uploaded in a special database (*Teachers' Products Matrix*) created for hosting the teachers work and results. Finally, a number of 206 teachers uploaded their products in the *Matrix*, some of them proposing more than one experiment.

In the end, the trained teachers were asked to express their feed-back concerning the pedagogical use of virtual experiments in the educational process. Some of the questions were addressed also in strong relation with the proposed software environments [35].

From the initial selected target group of Dambovita County (which consisted of 45 teachers, including primary education school-teachers), 24 Romanian in-service teachers attended the training modules. The educational levels were very good represented: 33% of teachers came from primary education level; the rest were teachers at lower and upper secondary levels. The group included Mathematics (37%), Chemistry (17%) and Physics (13%) teachers (figure 3).

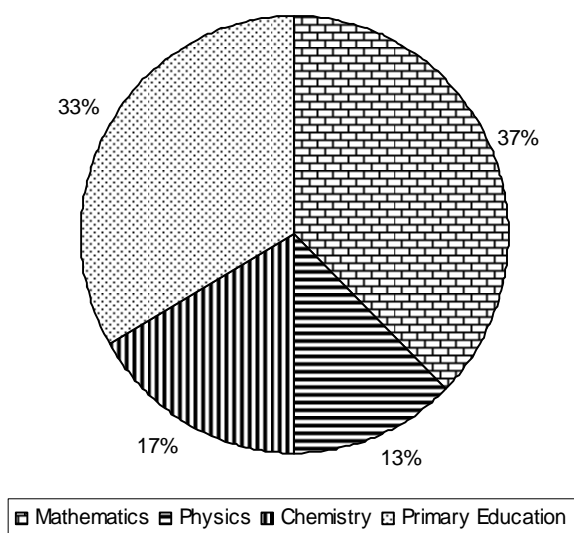


Fig.3 Distribution of the graduating teachers related to their specific areas

The teachers offered a very good feedback (92% of them) related to the usefulness of the didactic materials necessary for solving the tasks (figure 4). In addition, 87% of them appreciated also at a high level the usefulness of the source texts and links provided in the training materials (figure 5).

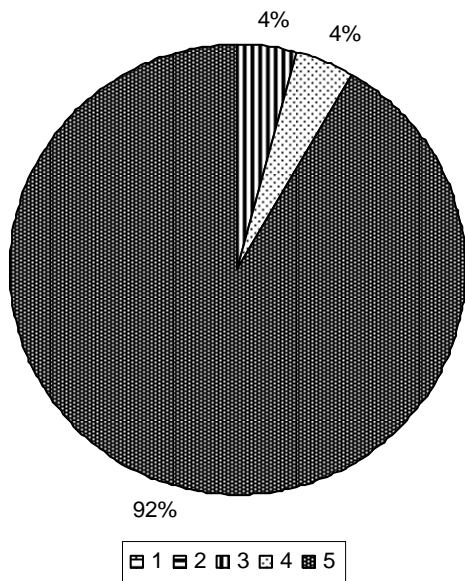


Fig. 4 Rates for the usefulness of the didactic materials necessary for solving the training modules tasks (scale: 1(poor) - 5 (excellent))

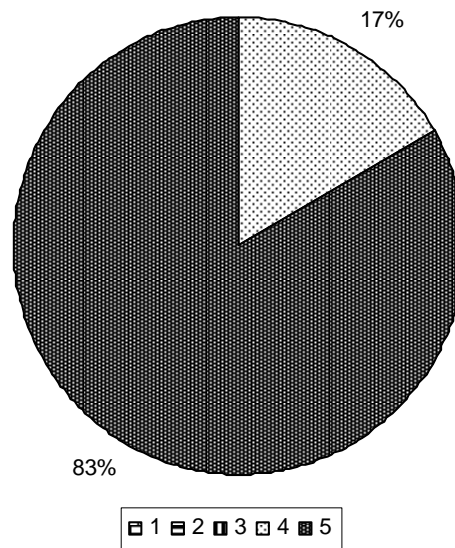


Fig. 6 Rates for the usefulness of the theoretical content (seminars) for the implementation of virtual experiments in the lessons (scale: 1(poor) - 5 (excellent))

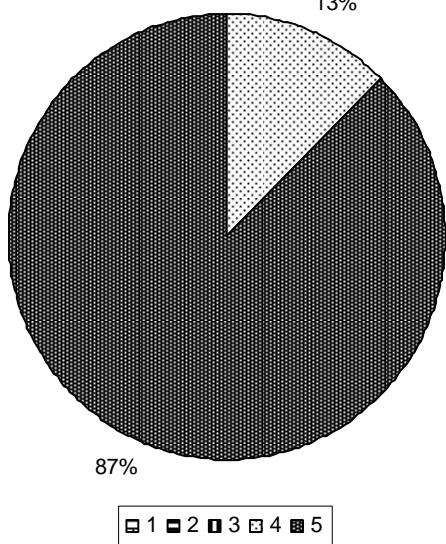


Fig. 5 Rates for the usefulness of the source text and links provided in the training materials (scale: 1(poor) - 5 (excellent))

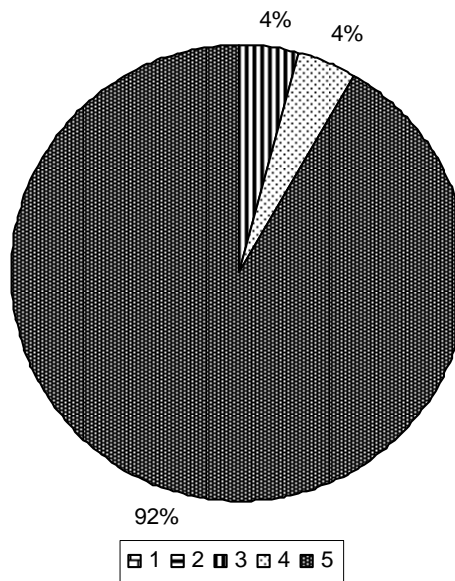


Fig. 7 Rates for the usefulness of the practical content (laboratories) for the implementation of virtual experiments in the lessons (scale: 1(poor) - 5 (excellent))

As mentioned before, the training modules embraced the form of an e-learning course developed inside the *Moodle* platform. Due to the fact that the modules structure proposed 3 seminars and 3 laboratories, it was interesting to hear teachers' voices related to the usefulness of seminars and labs for the implementation of virtual experiments during the lessons. In this respect, 83% of teachers offered a very good feedback concerning the role of the seminars content (figure 6) and 92% of them appreciated at a high level the importance of laboratories for the implementation of virtual experiments in the classrooms (figure 7).

It is important to emphasize also that teachers learnt to use the *Moodle* platform, and due to the fact that many platforms are designed on the same usability principles, it can be concluded that the trained teachers are able now to transfer the abilities and skills acquired in this context, in future e-learning situations.

Communication was also an important aspect of teachers' collaboration. At the platform level, the communication between the trained teachers

involves their interaction as individuals. It had a random character and appeared as a result of personal initiatives, being done especially by e-mail and chat facilities.

On the other hand, pupils (students) have also provided a feedback, collected from the “*Pupils’ Feedback Questionnaire*” designed by the project *Evaluation Group* after the implementation process [36, 37]. Table 1 illustrates the distribution of the answers related to the software applications (for designing virtual experiments), collected at various educational levels.

Used Software	Area	Educational Level	Answers (Pupils)
<i>LabVIEW</i>	Physics	Upper Secondary	20
<i>Cabri Geometry II Plus</i>	Physics	Lower Secondary	12
	Mathematics	Lower Secondary	121
		Upper Secondary	50
	Primary Education	Primary School	93
<i>Crocodile Chemistry</i>	Chemistry	Lower Secondary	87
		Upper Secondary	101
<i>Crocodile Physics</i>	Physics / Technology	Lower Secondary	40
	Physics / Nature Education	Primary School	17
<i>GeoGebra</i>	Primary Education	Primary School	18
	Mathematics	Upper Secondary	26

Table 1 Distribution of the pupils’ (students’) answers related to the virtual experiments designed with specific software applications which were used in the classrooms

Performing an analyse on the pupils’ answers, it can be emphasized that despite the existent differences between the pupils ages, the answers seems to be the same when considering the advantages of virtual experiments for being used in the classroom. In this sense, figure 8 shows that almost half of the questioned pupils considered the use and implementation of the virtual experiments in the teaching/learning process very useful and found it as a suitable way for a better and easier

understanding of different Mathematics and Science subjects. It is important to mention also that a very small part (3%) did not express any gain or positive reaction related to the use of the virtual experiments in the teaching process.

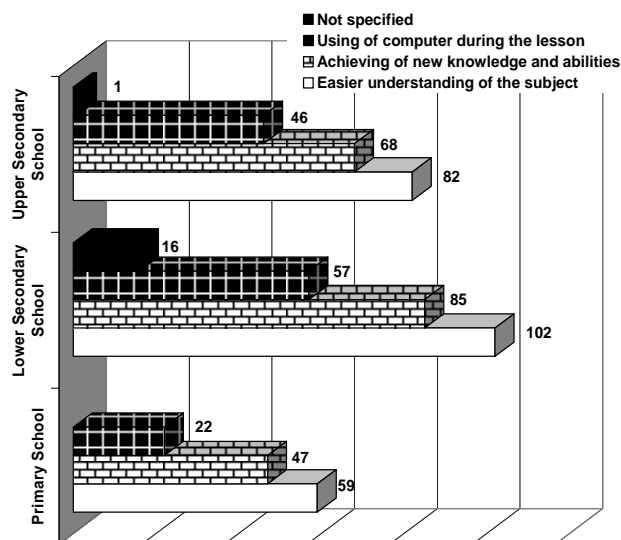


Fig. 8 Pupils’ (students’) perception concerning the positive aspects of the virtual experiments using in the classroom

Of course, some negative aspects were emphasized by the pupils. They are related mainly with the low number of computers which exist in the classroom and the minimum time used for understanding of all the concepts presented in the lessons.

7 Conclusions

Nowadays, it is obvious that *ICT* tools can be implemented successfully in various educational contexts, including distance education, even for areas like *Mathematics* and *Science* which involve practical activities. It is also easy to find out that in the last several years, in education, a great attempt was devoted to the experimental training of the pupils and students (near the theoretical one) with the view to update the learning programs and improve the related teaching methods.

The actual European frames promoted the development of the projects which target to the continuous improvement of the teaching methods and professional development, especially for *Mathematics* and *Science* teachers. In this respect, the project “*VccSse - Virtual Community Collaborating Space for Science Education*” answered to this desideratum and tried to make

known the *virtual experiment* to the educational community, through the results of *Virtual Instrumentation in Science Education* training modules.

Developing the training in a virtual learning environment and using the *Moodle* platform as a *Course Management System*, the project participants (starting with the coordinator and finalizing with the trained teachers) had the opportunity to improve their knowledge and work in a collaborative way for almost two years. Due to its multiple facilities and especially its easy accessibility - even for the beginners - the *Moodle* platform proved to be a powerful educational web environment for promoting related e-learning activities. More than that, as many platforms are designed on the same usability principles, the teachers who were enrolled in the *VccSSe* training modules and registered as *Moodle* platform users could easily transfer their abilities and skills acquired in the distance training practice, in future e-learning situations organized on other educational web environments.

8 Acknowledgements

This work was funded through the Socrates-Comenius 2.1. European project 128989-CP-1-2006-1-RO-COMENIUS-C21: "*VccSSe - Virtual Community Collaborating Space for Science Education*". The support offered by the *European Commission, Education and Training, School Education: Socrates: Comenius* and the *Education, Audiovisual and Culture Executive Agency* as responsible for the management of EU's programmes in the fields of education, culture and audiovisual, through the project mentioned above is gratefully acknowledged.

References

- [1] Athreye, S. S., On Market of Knowledge, *Journal of Management and Governance*, vol. 1, 1998, pp. 231-253.
- [2] Bertot, J. C., The Multiple Dimensions of the Digital Divide: More than the Technology 'Haves' and 'Have Nots', *Government Information Quarterly*, vol. 2003, pp. 185-191.
- [3] Moraes, M. C., *O Paradigma Educacional Emergente*, Papirus Publishing House, São Paulo, Brasil, 2001.
- [4] Reis, R., Gomes, T., Reis, B., Integration of Information Technology in Vocational Schools, *Fifth WSEAS / IASME International Conference on Engineering Education*, Heraklion, Greece, 2008, pp. 278-283.
- [5] Campanella, S., Dimauro, G., Ferrante, A., Impedovo, D., Impedovo, S., Lucchese, M. G., Modugno, R., Pirlo, G., Sarcinella, L., Stasolla, E., Trullo, C. A., E-learning Platforms in the Italian Universities: The Technological Solutions at the University of Bari, *WSEAS Transactions on Advances in Engineering Education*, issue 1, vol. 5, 2008, pp. 12-19.
- [6] Stoian, R., Perișoară, L. A., Pavel, R. F., Răileanu, A. V., Developing a System View Approach for the Multimedia Communication Systems Course, *WSEAS Transactions on Advances in Engineering Education*, issue 8, vol. 6, 2009, pp. 237-246.
- [7] Savander-Ranne, C., An Active Role for Students in the Learning Process in Engineering Education, *Ph.D. dissertation*, Department of Material Engineering, Tampere University of Technology, Tampere, Finland, 2003.
- [8] Brut, M., Buraga, S., *Prezentari multimedia pe Web. Limbajele XHTML+TIME si SMIL*, Polirom Publishing House, Iasi, Romania, 2004.
- [9] Kennedy-Lovells, G., E-learning - Intellectual Property Issues in E-learning, *E-Learning, Computer Law & Security Report*, vol. 18, no. 2, 2002, pp. 91-98.
- [10] ***, Distance education at a glance, College of Engineering, University of Idaho, 2003, <http://www.uidaho.edu/eo/distglan.html> (accessed September 25, 2009).
- [11] Brut, M., *Oportunități de comunicare în cadrul unui sit de e-learning. Interacțiune om-calculator*, Printech Publishing House, Bucharest, Romania, 2004.
- [12] Pribeanu, C. (coord.), *Introducere în interacțiunea om-calculator*, Matrix Rom Publishing House, Bucharest, Romania, 2003.
- [13] Trăușan-Matu, S., *Interfațarea evoluată om-calculator*. Matrix Rom Publishing House, Bucharest, Romania, 2000.
- [14] Encheva, S., Tumin, S., Multimedia Factors Facilitating Learning, *WSEAS Transactions on Advances in Engineering Education*, issue 10, vol. 4, 2007, pp. 203-209.
- [15] Kolb, D. A., *Experiential Learning*, Englewood, Cliffs, N.J.: Prentice Hall, 1984.
- [16] ***, Joint interim report of the Council and the Commission on the implementation of the detailed work programme on the follow-up of the objectives of education and training systems in Europe: "Education & Training 2010", Council of the European Union, Brussels, 3 March, 2004,

- http://ec.europa.eu/education/policies/2010/doc/jir_council_final.pdf (accessed September 25, 2009).
- [17] ***, Report from the Education Council to the European Council: "The concrete future objectives of education and training systems", Council of the European Union, Brussels, 14 February, 2001, http://ec.europa.eu/education/policies/2010/doc/rep_fut_obj_en.pdf (accessed September 25, 2009).
- [18] ***, Project "VccSSe - Virtual Community Collaborating Space for Science Education", <http://vccsse.ssai.valahia.ro> (accessed September 25, 2009).
- [19] Gorghiu, G. (coord.), *Applications of Virtual Instrumentation in Education*, Bibliotheca Publishing House, Targoviste, Romania, 2007.
- [20] Suduc, A. M., Bizoi, M., Gorghiu, G., Virtual Instrumentation Environment Used in the VccSSe Project, *Postępy eedukacji - Praca Zbiorowa Pod Redakcją Zespołu Ośrodka Kształcenia Na Odległość OKNO PW (Oficyna Wydawnicza Politechniki Warszawskiej)*, Warsaw, Poland, 2008, pp. 364-370.
- [21] ***, NI LabVIEW - The Software That Powers Virtual Instrumentation, National Instruments, <http://www.ni.com/labview/> (accessed September 25, 2009).
- [22] ***, Virtual Instrumentation - Developer Zone, National Instruments, <http://zone.ni.com/devzone/cda/tut/p/id/4752> (verified September 25, 2009).
- [23] Tłaczała W., Szymanski M., Gorghiu G., Zagórski A., Zaremba M., Virtual Physics Laboratory - Selected Topics. *Electronic Proceedings of 12th International Conference on Multimedia in Physics Teaching and Learning (MPTL 12)*, Wrocław, Poland, 2007, <http://www.mptl12.ifd.uni.wroc.pl/papers/49.pdf> (accessed September 25, 2009).
- [24] Tłaczała, W., Zagórski, A., Zaremba, M., Distance Learning with LabVIEW, *Virtual Instruments and Tools in Sciences Education - Experiences and Perspectives*, Educația 21, Special Number, Colecția Științele Educației, vol. 54, Casa Cărții de Știință Publishing House, Cluj Napoca, Romania, 2009, pp. 135-145.
- [25] ***, VccSSe Exhibition, VccSSe Team, <http://www.vccsse.ssai.valahia.ro/main/exhibition?lang=en> (accessed September 25, 2009).
- [26] ***, About Crocodile Clips, Crocodile Clips Ltd., <http://www.crocodile-clips.com/> (accessed September 25, 2009).
- [27] ***, Road Ahead Group Partners webpage, <http://www.roadaheadgroup.com/partners.htm> (accessed September 25, 2009).
- [28] ***, Cabri: Maths Software for Students. 3D Geometry and Algebra Software. Learn Mathematics with Cabri, Cabrilog SAS, <http://www.cabri.com/> (accessed September 25, 2009).
- [29] ***, Cabri Geometry II Plus - Dynamic Interactive Geometry Software, <http://www.chartwellyorke.com/cabri.html> (accessed September 25, 2009).
- [30] ***, GeoGebra, <http://www.geogebra.org/cms/> (accessed September 25, 2009).
- [31] ***, Moodle - A Free, Open Source Course Management System for Online Learning, <http://moodle.org> (accessed September 25, 2009).
- [32] Cole, J., *Using Moodle: Teaching with the popular open-source course management system*, O' Reilly, 2005.
- [33] ***, Philosophy - MoodleDocs webpage, <http://docs.moodle.org/en/Philosophy> (accessed September 25, 2009).
- [34] Seidel, L., Benito, R. M., Camara, M. E., Losada, J. C., Arranz, F. J., Development of an Interactive Learning Environment for Introductory Physics in Engineering, *WSEAS Transactions on Advances in Engineering Education*, issue 5, vol. 5, 2008, pp. 306-315.
- [35] Gorghiu, G., Gorghiu, L. M., Suduc, A. M., Bizoi, M., Dumitrescu, C., Olteanu, R. L., Related Aspects to the Pedagogical Use of Virtual Experiments, *Research, Reflections and Innovations in Integrating ICT in Education*, vol. 2, 2009, Lisbon, Portugal, pp. 809-813.
- [36] Dumitrescu, C., Olteanu, R. L., Gorghiu, L. M., Gorghiu, G., Some Aspects Concerning the Use of Virtual Experiments in the Teaching/Learning Process, *Virtual Instruments and Tools in Sciences Education - Experiences and Perspectives*, Educația 21, Special Number, Colecția Științele Educației, vol. 54, Casa Cărții de Știință Publishing House, Cluj Napoca, Romania, 2009, pp. 35-40.
- [37] Gorghiu, L. M., Gorghiu, G., Dumitrescu, C., Olteanu, R. L., Suduc, A. M., Bizoi, M., Considerations on Pupils' Feedback Concerning the Use of Virtual Experiments in Science Teaching, *Research, Reflections and Innovations in Integrating ICT in Education*, vol. 1, 2009, Lisbon, Portugal, pp. 357-361.