Chapter 10
Collaboration within Multinational Learning Communities:
The Case of the Virtual Community Collaborative Space for Sciences Education European Project

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ABSTRACT

This chapter focuses on the investigation of essential features of a multinational virtual community that can promote effective collaboration and research among its members so as to overcome space, time, and language barriers. Specifically, a multinational Virtual Community Collaborative Space for Sciences Education has been formed in the context of the Socrates Comenius 2.1 European Project: “VccSSe – Virtual Community Collaborating Space for Science Education.” In this project, researchers from five European countries (Romania, Spain, Poland, Finland, and Greece) participated in a multinational learning community where blended collaborative learning courses were formed in order to train teachers from these countries in the use of Information and Communication Technologies (ICT) in their real teaching practices. Within this framework, a number of specific software and pedagogical tools were formed to support collaboration and learning for the teachers and the researchers who participated in this virtual community. After the end of these courses, the teachers were asked to design their own virtual experiments and lesson plans and then to implement them in their classrooms. The analysis of the data shows that the researchers-partners of VccSSe effectively used various collaborative methods to produce the previously mentioned software and pedagogical tools. It has been also shown that teachers who participated in the VccSSe project were encouraged—by the use of the collaborative tools provided and the aforementioned collaborative blended course—to develop interesting virtual experiments and use them in their classrooms. Finally, it is worth noting that students who participated in those classes provided favourable feedback related to the implementation of virtual experiments in their everyday learning experiences.

INTRODUCTION

How should one define computer-supported collaborative learning? In a nutshell, Computer-Supported Collaborative Learning (CSCL) is focused on how collaborative learning supported by technology can enhance peer interaction and work in groups, and how collaboration and technology facilitate sharing and distributing of knowledge and expertise among community members (Lakkala, Rahikainen, & Hakkarainen, 2001). In the field of CSCL, technology meets psychology, philosophy, and pedagogy. Instructional designers and software developers, educational psychologists, learning theorists, computer scientists, and even sociologists are interested in this area of research.

Recent studies of e-learning have pointed out that involving learners in collaborative learning activities could positively contribute to extending and deepening their learning experiences, test out new ideas, improve learning outcomes and increase learner satisfaction, at the same time decreasing the isolation that can occur in an e-learning setting (Palloff & Pratt, 2004). Furthermore, collaborative learning situations can provide a natural setting for demanding cognitive activities such as explanation, argumentation, inquiry, mutual regulation etc., which can also trigger collaborative learning mechanisms such as knowledge articulation as well as sharing and distributing the cognitive load (Dillenbourg, 1999). Within the context of online collaborative learning, learners could also be provided with opportunities to be motivated to actively construct their knowledge and to enhance their diversity and their understanding of the learning concepts in question as well as to acquire a sense of belonging online (Scardamalia & Bereiter, 1996; Haythornthwaite, Kazmer, Robins, & Shoemaker, 2000). In addition, online learning has provided education with many benefits in terms of flexible opportunities to learn anytime and anywhere as well as to communicate and collaborate virtually throughout the world (Harasim, Hiltz, Teles, &
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Turoff, 1995). On the whole, CSCL has been recognized as an emerging paradigm of educational technology (Koschmann, 1996).

Appropriately designed educational software can also catalytically affect the changes in the whole learning context in terms of learning content, learning activities and the roles of both teachers and learners (Soloway, 1993; Noss & Hoyles, 1992; Jonassen, Carr, & Yueh, 1998). In particular, computers provide wide opportunities for the construction of various, different, linked and dynamic representation systems such as: texts, images, equations, variables, tables, graphs, animations, simulations of a variety of situations, programming languages and computational objects (Kaput, 1994). The use of Multiple Representation Systems (MRS) is acknowledged as crucial in encouraging the expression of learners’ different kind of knowledge regarding the subject to be learned (Dyfour-Janvier, bednarz, & Belanger, 1987; Janvier, 1987). In addition, multiple and linked representation systems provide learners with opportunities to study how variation in one system can affect another. In this way, each learner can make connections between different aspects of a learning concept and develop broad views about it (Lesh, Mehr, & Post, 1987; Janvier, 1987). In addition, richly endowed computer environments can embody powerful scientific ideas which students can explore and reflect on, giving them also the opportunity to conceptualize, and construct for themselves, scientific concepts that have already been formulated by others. Such computer learning environments can provide opportunities for the learners to actively construct their knowledge as well as to develop their problem solving skills (Dubinsky & Tall, 1991; Jonassen, Carr, & Yueh, 1998). Most importantly, in the context of ICT, modern social and constructivist perspectives of teaching and learning can be realized (Papert, 1980; Balacheff & Kaput, 1996; Noss & Hoyles, 1996; Jonassen, Carr, & Yueh, 1998).

On the whole, the rapid evolution and the achievements of ICT opens up endless possibilities of the design and implementation of innovative teaching and learning models (Looi, Ogata, & Wong, 2010), ranging from conventional personal computer labs to perpetual and ubiquitous learning (Mifsud & Morch, 2010), authentic and contextualized learning (Wong & Looi 2010), seamless learning (Roschelle, Patton, & Tatar, 2007; Looi, Seow, Zhang, So, Chen, & Wong, 2010), rapid knowledge co-construction (Lin, Liu, & Nimamtran, 2008) and it is acknowledged that we are now at the onset of a digital classroom wave which will bring significant changes to education (Chan, 2010). However, teachers who wish to update and upgrade their teaching and learning designs using new learning technologies have some difficult issues to confront (Laurillard, 2010). In fact, teachers should develop wholly new ways of conducting teaching and learning, should develop new digital materials and online activities ahead of the start of the course, should build 21st century skills into the curriculum as well as should learn to be ahead of their ‘digital native’ students even though they have not been trained themselves. Taking into account all the above, the need for training primary and secondary level education teachers in the use of ICT in education is of vital importance not only for their integration into the modern social and educational context created, but also for the integration of ICT into education (European Commission, 1997). The necessity of training teachers in ICT concerns the acquisition of basic technical and pedagogical skills related to the use of ICT so that they will be capable of integrating it into their real teaching practices (Davis & Tearle, 1998).

Blended learning is an approach suitable for teacher training as it aligns learning undertaken in face-to-face sessions with learning opportunities created online (Littlejohn & Pegler, 2006). The aim of blended learning is basically to join the best points of classroom or face-to-face learning with the best points of online learning as well as to compensate the pitfalls and weaknesses of the one type of learning with the benefits of the
other type and vice versa. On the one hand the opportunities presented by online learning in terms of flexible opportunities to learn anytime and anywhere as well as to communicate and collaborate virtually throughout the world (Harasim, Hiltz, Teles, & Turoff, 1995; Palloff & Pratt, 2004; Roberts, 2005; Van Eijl & Pilot, 2003) are essential for teacher training because teachers are adults with many constrains in terms of time and space. On the other hand, several constraints of online collaboration such as: not appropriate perceptions about e-learning, negative attitudes, lack of on-line collaborative skills, not appropriate knowledge about the basic technological skills needed for participation in online learning and a sense of difference between online learning and reality (Nel & Wilkinson, 2006) can be eliminated through face-to-face sessions.

Based on the above, a multinational Virtual community collaborative space for positive sciences education was formed in the context of a European project: “VccSSe – Virtual Community Collaborating Space for Science Education,” (project number 128989-CP-1-2006-RO-COMENIUS-C21). This project, designed to last for three years, started in October 2006 and was carried out by 9 partner institutions from 5 different European countries (Romania, Spain, Poland, Finland, and Greece). It has as its main purpose to adapt, develop, test, implement and disseminate training modules, teaching methodologies and pedagogical strategies based on the use of well-known educational software, in terms of virtual experiments and tools in teaching and learning of positive Sciences: Mathematics, Physics and Chemistry. Within the context of VccSSe, a blended teacher training framework and a virtual multinational community of teachers and partners were formed. To this end, one of the main targets of this project was to encourage teachers to develop their own Learning Objects (LO) consisting of: (a) specific constructions based on the use of appropriate educational software—henceforth called “Virtual Experiments” (VEs)—and (b) appropriate lesson plans. Then, these teachers were encouraged to implement those LO in their classrooms. To support collaboration among the participants, various software and pedagogical tools were developed. This chapter focuses on the investigation of the essential features of the multinational virtual community - formed within the context of VccSSe - that has promoted effective collaboration among its members, so that to fulfill the aims of this project at the same time overcoming space, time and language barriers. This chapter also focus on the collaboration among the researchers who participated as partners within the context of VccSSe in order to: (a) produce appropriate software and pedagogical tools for teacher education, (b) effectively manipulate the collaboration within the whole VccSSe community including the tutors and the teachers-participants, (c) successfully manage the teacher-education courses within VccSSe and the implementation of the teachers’ products in their classrooms and (d) analyze and evaluate the results of this 3-year study and crystallize best practices for teacher education in order to use Information and Communication Technologies in their real practices. To this end, it is worth noting that, the education reform could be encouraged by putting together the researchers’ community and the schools community—including teachers and students—as researchers seek new knowledge and produce new tools while schools ask for new solutions to operational problems (Looi, So, Toh, & Chen, 2010). In fact, this chapter is about Collaborative and Distributed e-research viewed as an ongoing process that takes place together with the real experiment. This is the contribution of this chapter.

This chapter is organized as follows: In the following section the main ideas inspiring the creation of VccSSe and the design of software and pedagogical tools will be presented followed by the description of the project and the tools developed. The results emerged from the implementation of the aforementioned collaborative teacher training course in the said multinational
context will be also presented with an emphasis on the collaboration models and tools used. Then, these results will be discussed in terms of the previously mentioned theoretical framework. Finally, the lessons learned from this collaborative experience will be addressed and proposals for future research plans will be drawn.

**BASIC IDEAS INSPIRING THE CREATION OF VCCSSE**

In 2001, the Education Council of the European Union presented a Report addressed to the Council the EU entitled “The concrete future objectives of education and training systems” (5980/01), where it was indicated—as the first strategic objective for the subsequent 10 years—“to increase the quality and effectiveness of education and training systems in the European Union.” In this sense, as a main direction, the document mentioned the necessity of ‘ensuring access to ICT’s for everyone.’ The developing use of ICT within society has meant a revolution in the way that schools, training institutions and other learning centers could work, as indeed it has changed the way in which many people in Europe work. ICT is also of increasing importance in open learning environments and e-learning. “As far as the education and training systems are concerned, the ability to respond to the rapid developments and the need to stay competitive will continue to play an important role. In addition, flexibility will be needed for individuals to acquire ICT skills throughout their lives.” (Council the European Union, 2001).

Another direction, specified by the Council the EU, was oriented on the increase of the recruitment in scientific and technical studies: “Europe needing an adequate throughput of mathematicians and scientific specialists in order to maintain its competitiveness. In many countries interest in mathematics and science studies is falling or not developing as fast as it should. This can be seen at school, where the uptake of these subjects by pupils is lower than could be expected; in the attitude of young people and parents to these subjects and later in the level of new recruitment to research and related professions.” (Council the European Union, 2001).

In respect to the aforementioned directions, 9 institutions from EU coming from 5 different European countries joined their efforts and explored a common interest and urgent need in their countries for innovative ways to provide in-service teacher training in the area of positive Sciences education using ICT. The following institutions participated: (1) Valahia University Targoviste (Romania; the coordinating institution), (2) Centro de Formación del Profesorado e Innovación Educativa Valladolid II (Spain), (3) Centro del Profesorado y de Recursos de Gijón (Spain), (4) Centro de Profesores y Recursos de Zaragoza I (Spain), (5) Politechnika Warszawska (Poland), (6) Regionalny Ośrodek Doskonalenia Nauczycieli “WOM” w Bielsku-Białej (Poland), (7) Joensuun Yliopisto (Finland), (8) Babes Bolyai University Cluj Napoca (Romania), and (9) University of Patras (Greece). Thus, the partnership concluded that one appropriate solution to increase the participation in Mathematics and Science studies should be realized by the promotion of ICT in the teaching and learning of the Sciences in the primary and secondary levels of education. To this end, it was decided to encourage the design and implementation of appropriate Virtual Instruments (VIs) and Virtual Experiments (VEs)—as educational resources—in order to support the in-service education of the teachers, so as to enable them to develop innovative ICT-based teaching methods in their classrooms (Gorghiu, 2009).

It was evident that most of the projects which promoted the use of virtual instrumentation were addressed to University level teachers (especially focused on engineering topics) and few were targeted on Science in-service teacher training. In fact, that was the point of starting the transnational European Socrates Comenius 2.1 project (“VccSSe – Virtual Community Collaborating...
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Space for Science Education”; webpage http://www.vccsse.ssai.valahia.ro [Figure 1], code: 128989-CP-1-2006-1-RO-COMENIUS-C21), its approval (in summer 2006) offering a chance for the partnership to put in practice their ideas and knowledge with the end goal to encourage teachers of the Sciences to exploit the great potential given by ICT—in terms of virtual instruments and virtual experiments—in their real teaching practices.

The design of the activities performed during the project life emerged as a result of: (a) focusing on theoretical ideas—which have been already reported within the framework presented in the “Introduction” section of this paper—concerning constructivist learning, collaboration and the unique role of ICT in the learning process, (b) a thorough analysis of the curriculum in the participating countries, and (c) an analysis of the attitude of the schools—in the aforementioned countries—towards ICT-based teaching and learning.

Analysis of the curriculum: As it was emerged from the partnership investigations, the field of the Sciences in European education comprises of curriculum contents related to the following school subjects: Mathematics, Physics, Chemistry, Biology, and Geology. In a limited number of cases, such as the case of Spain, the area of the Sciences includes integrated school subjects like science, technology and society, a subject aimed to study the social aspect of the science and their impact in the past, in the present, and in the future of our society. All these subjects are included in lower and upper secondary curriculum with a different number of teaching hours at different levels. The curricula vary in different European educational systems in terms of:

- Contents’ structure and degree of contents integration
- Types of competences targeted and trained
- Recommended teaching methodologies
- Types of learning experiences to be organized

One of the main objectives of VccSSe was to identify the most suitable and up to date tools that could offer teachers in different European...
countries the possibility to effectively meet national curriculum requirements, while proposing dynamic and relevant learning situations based on scientific reality experimentation, through the use of well known educational software within an appropriate e-learning collaborative context. Consequently, a thorough analysis of the curriculum requirements was performed, in terms of their aims and objectives, values and attitudes, contents, and typical learning situations. Added to this, the partnership detailed the trends in European countries in teaching of scientific subjects and learning in terms of innovative:

- Teaching methodologies and pedagogical strategies
- Roles for the students
- Ways of evaluation
- Technologies and materials
- Curricular recommendations and trends

At a general analysis of the positive Sciences' curriculum programs, some conclusions were extracted regarding the types of competence desired, types of contents and their organization as well as types of values and attitudes promoted. Specifically, throughout Europe, the curriculum of Science is focused on:

- Systemic acquisition of knowledge
- Training of the main research competences
- Development of a critical attitude towards the effects of science on the technological and social development and of the interest for the environmental protection
- Values such as respect for truth and diversity, respect for individual needs and nature, curiosity and initiative, openness for the opinions of others and disposition to modify own perspectives in the light of new facts

- Exploration of concepts such as: motion and force, energy and electricity, heat, substances around us, natural structures
- Content integration either at a thematic level (see for example Finnish curriculum) or at the abilities level (see for example the Spanish curriculum).

Analysis of the attitude towards ICT-based teaching and learning: Certain trends in Science teaching that are relevant for the actual impact of ICT in education were also visible:

- In some countries, ICT instruments tend to become a routine: virtual environments, interactive and multimedia which can be accessed through a network, e.g. Spain
- There is a need for multi-sensory teaching with a wide use of multimedia and virtual experiments e.g. Poland
- The education process should be widely assisted by new technologies which allow for the common usage of multimedia
- Achievement of educational goals should be assisted by school libraries with updated sources, using Internet, multimedia and other ICT based tools
- E-learning is also recommended to play a more significant role in education, being a component of the traditional teaching and learning (blended learning).

The design of both; the activities and the tools provided by the VecSSe project for the participants and for the teachers was based on the ideas described above. The work done in the project was organized in four project stages (Gorghiu, et al., 2009) which are reported in the next section of this chapter, with a special focus on the collaboration activities performed by the aforementioned community throughout each stage, and on the role of the tools provided for the achievement of the goals of the project.
STAGES OF DEVELOPMENT AND COLLABORATION WITHIN VCCSSE

The VccSSe Project has as declared objective to adapt, develop, test, implement, and disseminate training modules, teaching methodologies, and pedagogical strategies based on the use of ICT in terms of VIs and VEs, for the teaching and learning of positive Sciences: Mathematics, Physics and Chemistry. For the implementation of the aforementioned objective a transnational e-learning community was formed by the partnership. The main goals of the project have been achieved taking also into account the specific particularities of different countries involved in the partnership.

The work done throughout the project was divided into four stages, namely: (1) Creation stage, (2) Training stage, (3) Implementation stage, and (4) Evaluation and Dissemination stage. The project activities have been designed on targeting on the following three groups (Gorghiu, et al., 2009):

- **Leading staff**: local coordinators (who acted also as tutors), tutors, researchers and educational local authorities—even that in the proposal phase of VccSse—the number of tutors and researchers has been approximated at 27, it reached 32 finally. Along with the 18 representatives of local authorities in education, this group comprised of 50 people.
- **In-service teachers** from primary and secondary schools involved in Sciences teaching areas—the initial target group was estimated at 180 teachers but 363 teachers started the training modules proposed by the project.
- **Pupils** – they participated actively to the lessons proposed by the teachers involved in the project, based on the developed pedagogical methods and strategies. Even the initial number of pupils was approximated around 3500, the final number was under 3000 due to the limited number of pupils which formed a study group during the Sciences lessons (Mathematics, Physics, Chemistry).

The description of the aforementioned stages will be described in the following section with an emphasis on the collaboration realized among the members of the community and the role of tools used.

**Creation Stage**

The activities performed during this stage were focused on: (a) identifying, analyzing, and selecting a number of suitable virtual instrumentation environments for the development of appropriate VEs for the teaching and learning of concepts related to the positive Sciences, (b) creating training modules appropriate for teacher education about essential issues for the integration of Virtual Instrumentation in the positive Sciences’ Education, (c) implementing an e-learning platform to support the teacher training activities, and (d) developing a Virtual experiment space (e-Space)—a repository of VIs and VEs to be used like examples during the teacher training sessions. The aforementioned activities are further described below:

a. **Identifying, analysing and selecting suitable virtual instrumentation environments for positive Sciences education**: As one of the project’s objectives targeted at offering in-service Sciences teachers a particular technology that can enhance the learning process in specific Science lessons and laboratories, the partnership designed the training modules “Virtual Instrumentation in Sciences Education,” with a duration of 40 hours, consisting of 3 seminars and 3 laboratories. The labs were equipped with the following specific educational software applications for developing virtual educational experiments: *Cabri Geometry*, *LabVIEW*, *Crocodile Clips* and *GeoGebra,*
each participant expressing his/her interest on using one application, according to the own needs. The selection of these pieces of software performed after face-to-face collaboration among the partnership during a 3-day transnational meeting. The formation of specific seminars and laboratories was performed through asynchronous collaboration. In fact, specific partners took charge for the formation of a first draft regarding these specific seminars and labs and then, the partnership arrived to the agreement of their final form after negotiations and corrections performed through e-mail. All the materials produced for training were initially designed in English and then translated in the partner’s national languages: Romanian, Spanish, Polish, Finnish, and Greek.

b. Creating training modules: Given the tendencies and needs identified in Sciences teaching at the level of the participating countries, the partnership decided to use the blended learning model for designing and implementing the teacher training course. The reasons for this decision were related to the work of the partnership on one hand, and on the training of teachers, on the other hand. The Moodle open source educational platform was selected to facilitate this course. The partnership came to this decision through face-to-face collaboration during a 3-day transnational meeting. The preparation of the training modules “Virtual Instrumentation in Science Education” was realized in respect of two directions: the first one targeted the creation of the content of the training modules, related training materials and assessment tools; the second one focused on the development and implementation of the VIs and VEs that could effectively support the teacher training (Gorghiu, et al., 2009). The training modules introduced specific concepts of virtual instruments, available educational software packages and web examples, pedagogical methods and also particular and didactical elements for the selected educational software applications. For each selected educational software application, specific video-training materials (in English) were formed and uploaded in the Outcomes section of the project webpage. The training modules developed in the frame of this project aimed also to help participating teachers acquire interdisciplinary skills. In addition, the training modules included Internet searching exercises, as well as other different pedagogical activities, such as creating complex evaluation rubrics, or designing different teaching and learning situations that allowed the use of VIs and VEs (Gorghiu, 2009). The formation of the aforementioned training modules was realized through asynchronous collaboration—among the partnership—as it was described in the previous section. All the materials produced for training were initially designed in English and then translated in the partner’s national languages: Romanian, Spanish, Polish, Finnish, and Greek.

c. Implementing an e-learning platform to support the course activities: The training activities took place with the support of Moodle—open source—course management system. Moodle includes tools to support various educational activities such as content presentation, and evaluation as well as tools for collaborative work for the teachers. Here, it is worth noting that a course was formed as a model in English using the Moodle platform and then this course was translated in the partners’ languages and placed in a specific space within Moodle. Thus, the trainee teachers in each institution constituted a specific community within Moodle. All of these communities also constituted the trans-national community of teachers in the context of VccSSe. An example of the organization of the training modules inside
the particular space of Moodle course management system—dedicated for teachers trained by the Babes-Bolyai University at Cluj Napoca—is presented in Figure 2.

By interacting within Moodle, teachers were also provided with the opportunity to get familiarized with the use of this e-learning platform and, given the fact that most e-learning platforms require similar core technical skills, it is expected that they should be able to transfer the skills acquired in this context, to similar e-learning situations. The phpGroupWare platform was also used to appropriately facilitate communication and collaborative work within the project partnership. This platform was chosen due to its flexibility and simplicity and to the fact that it’s free of charge (Bîzoi, et al., 2009).

d. Developing the Virtual experiment space (e-Space): Consequently, in the first stage of the project the partnership not only tried to exploit the educational facilities proposed by various software applications but also to create a common space (called e-Space – Figure 3) for collaboration among the partnership but also for the teachers who participated in the teacher training course. The e-Space specific software was developed with the end goal to help all the participants within the VccSse community to retrieve the necessary information, and also, to help the project partners to upload the virtual experiment samples. The e-Space structure is divided into areas (Mathematics, Physics, Chemistry, and Technology) but related categories were also included. In addition, a search engine which allows the searching of examples by: description, author, keyword and language—English, Romanian, Spanish, Polish, Finnish, and Greek—was designed (Suduc, Bîzoi, & Gorghiu, 2008).

Figure 2. The organization of the Moodle space for the training module “virtual instrumentation in science education” (edition 2 – participants from Cluj Napoca, Romania)
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In fact, e-space can function as a repository of VIs and VEs as examples in the context of teacher training, a database equipped with a specific web interface which can be accessed from the project website. Those tools are used in order to manage the information which is included in the web-site, and particularly in the e-Space. Thus, the e-space can provide a proper environment for posting and discussing the ICT-based applications created by the teachers, and consequently, the trainers could directly and individually supervise the activity of the participants. The most important tools included within the aforementioned e-space are presented below:

- **e-Space browser** - it can be used for exploring the space of virtual experiments available on the project web system. This is possible because e-Space stores the experiments in repository files and the information related to those files is recorded in a MySql database. This browser could be a useful tool for accessing the knowledge of others regarding specific subject areas and encouraging possible collaboration among them.

- **e-Space up-loader** - it was used by the project team members for enhancing the e-Space with several virtual experiments.

- **e-Space translator** – it is an on-line tool for e-Space translation. It was used by the project team members. The instrument provided a web-form for each page necessary to be translated. Each translator is restricted by the software application to translate the page in one single language. The role of the e-Space translator is essential in helping teachers from different countries to overcome language barriers and to effectively participate and collaborate within the VccSSe project.

- **Teachers’ Products Matrix** – it is a database where teachers’ LO including VEs and lesson plans can be uploaded. Teachers’ Products Matrix (TPM) was developed as an open resource tool for all the teachers interested in introducing VEs in their lessons. TPM is included in the VccSSe website, being accessible via Internet, using the following link: http://www.vccsse.ssa.valahia.ro/main/matrix. TPM can act as a tool of enforcing collaboration among teachers as they can download the LOs created by
their colleagues—within VccSSe—in order to enhance their knowledge. Teachers can also communicate with the authors of the LOs they liked most and exchange the ideas that inspired their design and information about their implementation in the classroom. TPM now contains 218 final products designed by 206 teachers who finalized the training sessions. Together with 50 representative video-experiments related to the implementation of virtual experiments in lessons and 9 On-line/Remote Simulating Laboratories (produced by the project partnership), all of them grouped as VccSSe Exhibition, it closes the open educational space created in the frame of the VccSSe project and dedicated to the promoting of Virtual experiments in European Sciences education (Bîzoi, Suduc, & Gorghiu, 2010).

This educational space, even mainly dedicated to teachers of scientific subjects, is also a space of resources for any person searching for an understanding of different Science concepts. The partnership collaborated synchronously—in the previously mentioned sense—for the design of the aforementioned e-Space.

Training Stage

The main activities in this stage were focused on in-service teacher training using the materials as well as the VIs and VEs developed in the first stage. The face to face meetings allow discussing the possibilities for action at the local level and getting direct feedback for the trainer.

The duration of the training sessions covered an amount of approximately 42 hours, including the evaluation through the projects’ web-page. It is worth noting that the face-to-face teaching sessions provided teachers with opportunities to clarify some complicated issues related to the construction of VEs using the selected educational software, to exchange ideas about didactical issues using ICT, to be motivated to construct their own VEs and implement them in their classrooms, and most importantly, to overcome their fears and doubts about the introduction of innovative technology in real educational practices. In fact, these face-to-face sections played a crucial role in the teachers’ progress in creating and implementing virtual experiments in their classrooms. Various types of communication also helped teachers to make progress in their work, such as telephone calls to their tutors, e-mails to their tutors and their colleagues as well as asynchronous communications via forum and synchronous communications via chat.

The course was implemented in two editions and started at different moments, depending on each partner. This offered the opportunity to improve some elements of the course based on the partial evaluation made at the end of the first edition. After they had finished the training course, the teachers implemented the new learned methodologies in the classroom and this activity involving children was also evaluated.

Implementation Stage

The activities related to this stage consisted of the design and implementation of LOs by the teachers in their lessons. Assessment tools for evaluating the quality of the in-service teacher training process were also developed. A number of 363 in-service teachers involved in lower and upper level of secondary education as well as in primary education were trained through the previously mentioned blended learning approach on how to create, use and implement ICT based lessons in their real teaching practices. These in-service teachers were required to choose one of the software environments for understanding its main functions and creating at least one LO (that had to include also at least one VE for students with a significant level of interaction, for specific Sciences disciplines: Mathematics, Physics and
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Chemistry). Their lesson plans—designed under a specific Template—proposed explanations on the concepts to be learned.

Number of VEs produced: The VccSSe project involved in the two editions of the course Virtual Instrumentation in Science Education a number of 363 teachers of Mathematics, Physics, Chemistry, and integrated sciences that teach in lower and upper secondary schools of the participating countries. As a result of the course, a number of 218 LOs were designed, each of them including a virtual application of a different type (demonstration, experiment or exercise) associated with a specific lesson plan. Data indicating relevant number of products for each discipline/per partner institution and in total is presented in Table 1.

Here, it is worth noting that, teachers designed a variety of types of VEs supporting various learning activities. For example, mathematics teachers designed VEs supporting the following types of learning activities: (1) Forming/verifying conjectures by focusing on the alteration of an interactive geometrical construction using the drag-mode operation; (2) Forming/verifying conjectures by focusing on the numerical data automatically collected during the alteration of a geometrical construction using the drag-mode operation; (3) Verifying a formula by focusing on the numerical data automatically collected during the alteration of a geometrical construction using the drag-mode operation; (4) Multiple Representation-based activities; (5) Constructions simulating real-life problems; (6) Black-box activities; (7) A scenario-based approach emphasizing the formation of networks of learning concepts; (8) Multiple-solution activities. It is also worth noting that, all teachers also took ideas from the VIs and VEs uploaded in the e-Space by the partnership in order to design their own LOs. All teachers also visited the LOs uploaded in the TPM and enhanced their ideas about the design and implementation of VIs and VEs within real classrooms. Some teachers were also motivated to construct their own VEs by their intention to try new ideas in their classrooms as well as to improve their knowledge of modern educational technologies.

Evaluation and Dissemination Stage

The main activities of this stage were oriented on evaluating the project activities and its outputs and also on disseminating the project results through different channels: webpage, posters, scientific articles, exhibition, DVD edition, web / external dissemination, etc.

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<tr>
<th>VccSSe Institutions</th>
<th>Number of LOs</th>
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<tbody>
<tr>
<td></td>
<td>Math</td>
</tr>
<tr>
<td>Valahia University of Targoviste</td>
<td>16</td>
</tr>
<tr>
<td>Teacher Training and Educational Innovation Centre Valladolid II</td>
<td>0</td>
</tr>
<tr>
<td>Teachers Training Centre of Gijon</td>
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<tr>
<td>Teachers Training Centre of Zaragoza 1</td>
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<tr>
<td>Warsaw University of Technology</td>
<td>2</td>
</tr>
<tr>
<td>Regional In-service Teacher Training Centre “Wom” in Bielsko-Biala</td>
<td>21</td>
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<td>University of Joensuu</td>
<td>10</td>
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<tr>
<td>Babes-Bolyai University Cluj Napoca</td>
<td>8</td>
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<tr>
<td>University of Patras</td>
<td>19</td>
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<tr>
<td><strong>Total Number of LOs for Each Discipline</strong></td>
<td><strong>113</strong></td>
</tr>
</tbody>
</table>
Evaluation: In order to assess the formative impact of the training materials an experimental design was associated with the training process that included an initial and a final survey based on questionnaire. The questionnaires focused on teachers’ understanding and attitude towards the use and efficacy of ICT, specific educational software and virtual instrumentation tools in Science education, as well as on their feedback related to the teacher training course and aspects that made it effective. To this end, a set of assessment tools was created during the different stages of the project.

The first group of Assessment Tools consisted of instruments for the evaluation of the quality of the teacher training process (Teachers’ Initial Evaluation; Teachers’ Final Evaluation). A particular topic included in the Teachers’ Initial Evaluation questionnaire was related to the training needs for teachers, as they were declared in terms of the field of new technologies and of the educational software. While this questionnaire included general questions related to the previously mentioned subjects, the Teachers’ Final Evaluation questionnaire included more specific items referring to virtual instrumentation in education and its educational value as it is perceived by the teachers.

In the following Stage (Implementation Stage), the impact of the Learning Objects created during the training process by the teachers was assessed (Teachers’ Impact Questionnaire and Pupils’ Feedback Questionnaire). This category of evaluation instruments was dedicated to different phases and target groups involved in the teacher training stage of the project. The questionnaires were composed mainly from multiple choice items, a fact that allowed for a statistical processing of data. With a small number of exceptions, open questions were avoided due to the language barrier in the discourse analysis process (Gorghiu, et al., 2011). The aforementioned questionnaires were translated in all the partnership countries languages using the e-Space translator and were delivered online at the initial and final stage of the teacher training course, so that these could be directly accessed by the teachers through the Moodle course management system.

The analysis of the data gathered from the aforementioned questionnaires shows that a great number of the teachers regarded virtual instrumentation applications as a source of inspiration for their teaching actions that should be used as an alternative to traditional tools, and as a means for improving students’ understanding of abstract concepts. However, teachers did not find direct correlations between use of VIs and improvements in students’ learning skills. A part of the Spanish teachers reported that even though the term Virtual Instruments is not very well known to them, they enjoy and find natural to use computer simulations and virtual applications as long as they are motivating for students.

In fact, the best scores were obtained to the feedback item regarding the improvement of students’ motivation for learning. Most of the teachers in different countries reported that VI applications and VEs were the most useful for creating and maintaining students’ interest for scientific topics as well as in obtaining better results in evaluations. This last aspect correlates with good scores given to improved understanding of concepts. Good scores were registered also in students’ interactive learning mediated by Vis and VEs.

As for most of the teachers using virtual science applications in the classroom was one of the first experiences of this type, difficulties were reported in management of the classroom especially in: evaluation of students performance as well as in access to hardware or general management of students.

A number of teachers that work in more structured and less flexible curriculum systems (for example, the Romanian teachers) were concerned with meeting curriculum requirements through such special lessons. Indeed, displaying and working with virtual experiments in teaching and learning may be time consuming in certain school
settings, for instance in case of a low number of computers for individual intervention, or in the case of teacher or students’ low computer use abilities, or in the case of absence of hands on intervention for all students with consequences for their learning motivation.

Nevertheless, most of the teachers declared that lessons that included VIs and VEs were successful or rather successful and that they would decide to use such educational applications again, provided that they would have better and constant access to computers and would be able to involve students more in the creation and modulation of virtual learning spaces and experiments.

Dissemination: In the knowledge dissemination process, collaboration is the primary function. The dissemination technologies which support collaboration are: World Wide Web, groupware, on-line access, video conferencing, and document management. In the selection of a specific dissemination technology, it is important to consider the particular characteristics of the target group: small or large groups, intermediate or advanced computer skills etc. The selected technology should meet the capabilities of the user and the nature of the use (Gray & Tehtani, 2003). Thus, for reaching as many individuals of the target group as possible, who may have different specific characteristics, it is necessary to combine and use different dissemination methods.

Taking into account the above, various ways were considered for the dissemination of the results of this project, such as: the project webpage, posters, scientific articles, exhibition, DVD edition, web/external dissemination, and web conferencing. Adobe Connect Pro was selected for a number of the partners of the project on-line meetings (videoconference) in the last year of the project as well as for the dissemination of the project products. In this dissemination event participated many attendants including project national partners, teachers, researchers and national educational authorities. Adobe Connect Pro was selected as the specific software suitable to sustain the meeting of 100 persons. Web conferencing may be considered as a project results dissemination method due to its many benefits. Two main benefits, compared with other dissemination methods, are as follows: (1) in comparison with face-to-face dissemination methods, virtual meetings eliminates the physical limitations of distance and the expenses for dissemination meeting organization are lower; (2) unlike the paper material dissemination, the videoconference allows direct interaction with the presenters (e.g. the partnership that developed a project and disseminate the outcomes through a web conference), so the responses to the questions are offered immediately (Suduc, Bizoi, & Filip, 2009).

DISCUSSION AND CONCLUDING REMARKS

Upon examining the results of the reported 3-year project, it is clear that the main aims of VccSSe project have been adequately met. Specifically, a large number of researchers and educational specialists from different European countries—the partners of VccSSe—collaboratively designed appropriate training materials and Virtual experiments using appropriate Virtual instruments and well known educational software. For the design of these training materials specific characteristics...
regarding with the Science curricula of each country were taken into account. The partnership collaborated synchronously within face-to-face meetings and asynchronously using e-mails and the phpGroupWare platform for the design of the aforementioned educational materials and tools. This platform helped the partnership to organize their training materials by dedicating a specific space for the materials written in English. Those materials acted as a model for all partners for the development of custom language-specific spaces, where their own materials would be stored.

The Moodle collaborative platform played an important role during the teacher training stage as it facilitated the organization of the teacher training course by providing synchronous and asynchronous communication as well as content and assignment delivery. The e-Space also played an essential role during this stage in terms of providing appropriate VIs and VEs for teacher training as well as a specific search engine for searching within the e-Space contents. In fact, teachers collaborated with their tutors and their colleagues through the Moodle platform as well as through the e-Space. During the implementation stage, teachers collaborated with their colleagues through the use of the Moodle platform as well as through the TPM. Teachers collaborated with the members of the partnership, their colleagues and other authorities during the dissemination stage through the use of videoconferencing. However, the formation and the work of the trans-national community formed in the frame of VccSSe would be totally impossible without the use of the Translation tool. In fact, the existence of this tool helped teachers from different nationalities to overcome language barriers and fully attend the teacher training course delivered online in their own language.

On the whole, the implementation of this trans-national community of researchers, teachers and educational professionals seemed to succeed in its aims due to various ways of collaboration among its participants. This collaboration took place synchronously and asynchronously. Synchronous collaboration has been supported through face to face interaction as well as through the use of chat and videoconferencing tools. Asynchronous collaboration helped most by the use of appropriate tools encouraging translation, searching, sharing and showcasing of educational materials as well as through various means of communication, including e-mail and forums. The organization of this trans-national community in specific sub-communities in each partner institution also helped the participants to conceptualize clearly the aims of VccSSe project and to successfully fulfill them. The general model of the teacher education course that was formed taking into account essential theoretical issues about modern theories of learning and the use of ICT in education taking also into account the specific characteristics of learning curricula in the partners’ countries seemed also appropriate in terms of meeting the participants needs.

This chapter concludes by highlighting some implications regarding the creation of successful collaborative e-learning trans-national communities. The experience gained through this 3-year European project emphasizes the fundamental contribution of collaborative platforms for the support of synchronous/asynchronous activities through the provision of features for document and file sharing and translating, shared desktop access, simultaneous editing and other electronic forms of communication allowing data to be shared, edited and copied during a web meeting by various groups. More work is needed towards an easier integration of videoconferencing facilities in the collaborative work of trans-national communities as well as support of multi-language communities and automatic monitoring of the participants’ progress in terms of tasks at hand and project aim fulfillment.

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Collaboration within Multinational Learning Communities

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REFERENCES


Collaboration within Multinational Learning Communities


ADDITIONAL READING


KEY TERMS AND DEFINITIONS

Virtual Instruments: Computer based instruments that can be used by the students to perform scientific experiments.

Virtual Experiments: Specific interactive constructions -formed using specific pieces of educational software- which can assist students’
experimentation and active participation in their learning of a specific subject matter

**Learning Object:** A set consisting of a lesson plan and appropriate Virtual experiments and Virtual Instruments

**Blended Learning:** Face to face learning in combination with online learning settings

**In-Service Teachers:** Teachers who are active members of an educational system and teach in real classrooms

**Innovative Teaching Methods:** Teaching methods emphasizing modern social and constructivist learning theories as well as the appropriate use of digital technologies

**Virtual Community:** A community of people who collaborate online synchronously and asynchronously, to achieve specific goals.