e-COMODE Services for the Implementation of Collaborative Modelling Environments in Schools

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Abstract: e-COMODE is an open digital learning environment, which assists young students (10-17 year old) in creating models. e-COMODE services aim to offer a collaborative modelling environment, including pedagogical, technical and implementation support services. The market validation of the different services has been performed in different environments, private and state schools, from different geographical areas; Greece, Spain and North Ireland in the UK, in order to confirm the business model developed and the services acceptance. Outcomes show that e-COMODE services benefit schools by providing mechanisms to solve the lack of sufficient and appropriate teacher's support to incorporate new technologies in their teaching practices, to implement collaborative learning in the educational systems and the learning via computer based modelling. Although end-users (teachers, students) have already adopted the e-COMODE facilities, the barriers for the exploitation of the services are at the level of the public administration. Therefore, the business model proposed is being revised in function of the experience gathered during the market validation.

1. Introduction

The e-COMODE offers to schools an open digital learning environment, which assists young students (10-17 year old) in creating models. This computer-based environment supports learners in expressing their ideas, building, designing and testing models of various situations with rich visualisation and simulation tools. Moreover, the e-COMODE eLearning Environment encourages and supports collaborative problem solving and online communication with peers and teachers, promoting the acquisition of these skills, which are also extremely important for young students' future.

The distinguishing characteristic of e-COMODE is that it combines a full set of learning and teaching facilities with technical, pedagogical, and organisational support focusing on modelling learning in a complete portfolio of services. The completeness and versatility of the service is new in the European market and it is expected that in future years, e-COMODE will efficiently support traditional teaching methods, thus enhancing the quality of education.

The e-COMODE service allows the access to a software environment including pedagogical materials, use manuals, collaborative support via ASP and helpdesk. In addition, e-COMODE provides associated services such as teachers' training and organisational, technical, and pedagogical consultancy. The environment can run on standard personal computers

The e-COMODE environment is running in five different sites, covering two private schools networks - one in Spain and one in Greece - and three networks of state schools - one in the UK and two in Greece - with the objective of performing a market validation of the service. This market validation study supports the elaboration of plans for the future market deployment of the service.

2. Objectives

In 2000 the size of the European Education market estimation was of 80 millions pupils and students, 4 million teachers and about 320'000 establishments - including various kinds of education and training institutions, as well as universities [1].

Furthermore, due to the development of Information and Communication Technologies (ICT) it is now possible to use tools for assisting the process of learning beyond the boundaries of the classroom, due to the developments in ICT. The use of technology prepares learners for participation in a networked, information society where knowledge is the most critical resource for personal, social and economical development. *School children and students increasingly need to acquire the individual and the group learning skills for use in learning societies and learning organisations* [2]. There is a need for schools to find a way to optimise their teaching of modelling, and thus helping teachers to stimulate the Critical and Creative Thinking of their students [3]. *"Critical and Creative Thinking can be described as qualities of good thinking processes and as types of thinking. Creative thinking is generally considered to be involved with the creation or generation of ideas, processes, experiences or objects; critical thinking is concerned with their evaluation"* [4].

Scientific activity involves to a great extend creation, validation and application of appropriate models of the phenomena, systems or situations under study [5] [6] [7]. Models appear in most scientific areas (economics, history, biology, meteorology, archaeology etc.), as well as in our everyday life.

Based on those premises, the main objective of e-COMODE services is to offer to schools a new effective way to teach and learn the most important concepts needed nowadays to survive in the knowledge-based society. Technology and pedagogical support allow teachers to convey reasoning and modelling concepts, while it permits to learners to express themselves and create in an appropriate environment. Collaboration and communication, which are extremely important skills for the students' future, are vigorous elements of the learning environment.

To address this main objective, e-COMODE combines software and technical services, as well as pedagogical and organisational consultancy services. The full option services aim to offer:
1. A collaborative modelling environment
2. Collaboration and communication services
3. Guidelines for implementation (teachers' training)
4. Learning materials
5. On-line support (technical helpdesk, pedagogical and organisational consulting services)

This main goal of providing e-COMODE services to the society, in particular to schools and educational institutions, teachers, students and parents, has to be validated by a market sample, following the methodology described in the next section, in order to elaborate plans

for the future deployment and exploitation of the services. Therefore the objective of the market validation is to investigate the potential market that would be commercially interested in a service providing a digital open collaborative environment for modelling, creative problem solving and expression including guidelines for teachers and school managers as well as appropriate teaching materials in the context of Secondary Schools.

3. Methodology

Three main activities have been combined in order to ensure the validation of the services. (1) The localisation of the application has adapted the environment to a new market (the Spanish market) giving figures for the elaboration of a market entry strategy, and preparing the environment for the validation phase; (2) the training sessions and the dissemination campaign have been crucial in order to make the teachers able to use the application, and to start with the validation phase; (3) finally, the market validation has included several activities like the creation of feedback-questionnaires for students, teachers, ICT coordinators and Schools directors, as well as personal interviews in order to identify:
1. The market acceptance of the services
2. The key actors in the commercialisation process
3. Critical issues in the commercialisation process

To assess the adequacy of e-COMODE services to the market, a market validation has been performed in five different environments, covering 3 countries (Spain, Greece and Northern Ireland in the UK) and two different school structures (private and networks of state schools). Mainly teachers (and their students) have participated in the validation of the services. However, also potential buyers and decision makers have been involved, by means of personal interviews and services demonstrations.

The results of the services validation are then compared to a general market analysis of the potential market for the e-COMODE services. The combination of those two studies serve as the bases for the elaboration of the final deployment plan describing what are the next steps towards the exploitation of the services in the future.
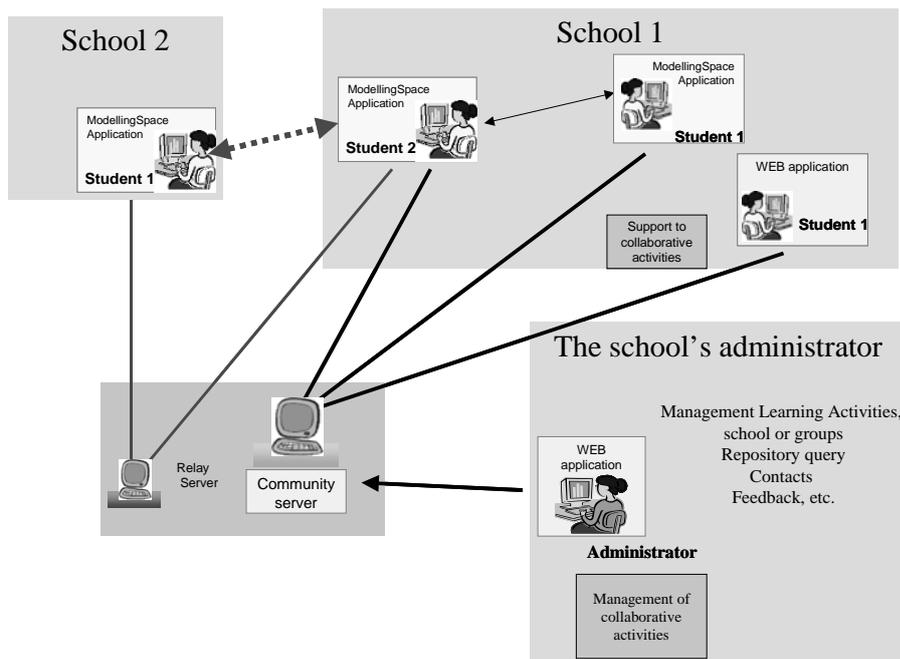
4. Technology Description

Figure 1: e-COMODE system architecture

The system can be adapted to several educational situations:

1. to support inter-school collaboration activities.
2. to be used in the frame of schools activities in a single classroom.
3. to be used in the frame of intra-school activities in a several classroom, at different time.

   e-COMODE application is constituted by seven elements:

1. The Modelling Environment, built in Java, is the main tool. It is a direct manipulation space, which is used mostly by students for building and exploring models made out of primitive modelling entities, inherent in the environment, or built by the users using the Entities Editor (component 2). Models can be presented through alternative views.
2. The Entities Editor is the tool provided to create primitive entities. This is an independent tool, built in Delphi, which can be accessed from the Modelling Environment. The entities are the building blocks of the models. Each entity is representing an object or a concept of the real world. A number of properties can be associated to entities through this tool. A visual representation of the entity is associated to each of these states. The option of directly inserting video has been recently added.
3. Supervision Environment. This tool built in Java, is integrated within the Modelling Environment, or can be used as an independent tool. Its main functionality is the presentation and processing of history log files produced by the Modelling environment, recording actions and exchanged messages of partners engaged in the modelling. This environment allows playing back the modelling activity, using the history log file in a step-by-step or continuous way.
4. Collaboration Analysis Tool. This is a tool for analysis of video and audio recordings and synchronisation of behavioural data files with activity log files. This is an independent tool, built in Visual Basic, which can be used for viewing, annotation and analysis of the collaborative environment history log files.
5. The Common Repository, which is found in the collaborative environment server. It is developed in Java, JSP and XML. It contains the study themes, entities, libraries of entities, and models. The repository is web-accessible and provides the possibility of downloading and uploading material by its distant users (teachers and students).
6. The Community Support Tools, which are found in the collaborative environment server. They are developed in Java, JSP and XML. They provide services like group management, session management, registration and login of users, facilitating synchronous interaction of the modelling environments. This is a component that also facilitates interaction between Modelling Environments (component 1), with no direct user interface.
7. The Communication Relay Server is a stand-alone application built in Java. It provides facilities for network communication among clients across firewalls.

The technological environment of e-COMODE consists of two main parts: a) the client applications and b) the community services. While the client applications are distributed on each user workstation, the community services follow a centralized architecture meaning that they are running on dedicated servers of the provider.

As a collaborative application, the collaborative environment has some network requirements such as the configuration of proxies from both the client as well as the relay server side. The minimum network requirements are of low bandwidth as communication between the peers through the relay server follows a message passing mechanism.

5. Developments

We have seen that the e-COMODE services allow the access to a software environment including training activities, pedagogical materials, use manuals, collaborative support via

ASP and helpdesk. In addition, e-COMODE provides associated services such as teachers' training and organisational versus pedagogical consultancy. Nevertheless, the core of e-COMODE solution is a software environment that provides the capability of applying modelling concepts at schools. This is complemented with tools used for collaborative modelling activities: entities editor, supervision environment, common repository, etc, and with a complete portfolio of consultancy and technological services.

The exploitation model of the e-COMODE services has been designed to be carried on at three complementary stages:

Stage 1 corresponds to the distribution of a basic version of the product, thus increasing the market share of the Modelling Space product.

- Some examples of accompanying educational material to familiarise the target users with the features of the product.
- Significant part of the user manuals, showing the benefits of usage of an advanced version of the product.
- Material to induce registration and license purchase.

Stage 2 corresponds to the licence + ASP. The main characteristics of this phase are:

- Users enjoy all functionalities of the product.
- Users operate in a web-based collaborative environment via ASP.
- Technical support (help-desk facilities).
- Pedagogical materials and guidelines
- Continuous upgrade of the product.

Stage 3 consists of the consultancy services. This level of service is superposed to the other ones in the sense that consultancy services may be requested either at the free demonstration stage or at the previous stage, or, the most obvious, in between both. The elements of this phase are:

- Teacher's and ICT coordinators training.
- In order to satisfy the demands and growing needs of the target users, organisational, technological, and pedagogical consultancy services, including teaching material adaptation.

Consequently, the development of the services validation consisted of three main phases. The first phase, called pre-pilot, during which activities have been performed to prepare the validation phase:

- Localisation and adaptation of the application and materials: it consists of the localisation of the application to the Spanish market, creation of entities creation tools (Video2Frame tool) and adaptation of material when necessary.
- Teachers and ICT training activities: the realisation of several training sessions in order to allow the users utilize the environment.
- Market analysis and pilot needs analysis: theses activities covered the deep analysis of the market with the objective to know the market situation, the competitors and to identify the real potential of the service and the existence of the market niche.

The second phase corresponds to the pilot implementation:

- Infrastructure adaptation and application installation. Each site had to create a minimum infrastructure, consisting of a personal computer and an Internet connexion for collaboration activities, to allow the students use the environment.
- Pedagogical adaptation: teachers and pedagogical coordinators had to incorporate the learning activities in the curricula activities. Each pilot has identified teaching subjects and created or adapted learning activities.
- Pilots roll out: each site has developed several activities using e-COMODE application.

Finally, the third phase concerns the post-pilot activities:

- Analysis of the information.
- Development of a complete deployment plan.

6. Results

At the moment of the conference, there will be a complete set of results based on the analysis of the validation phase. As interim results we can use (1) the teachers quality feedback got during a workshop organised to allow the teachers and ICT responsible of the schools to share experiences, (2) teleconference organised in the scope of the project to follow the project activities:

- teachers find the application easy to use
- teachers have easily incorporated modelling activities in the curricula
- students smoothly understand the application and follow the learning activities completing them
- pilots had had some technical problems during the installation phase that have been solved quickly with the helpdesk support
- successful collaboration activities have been performed inside classrooms

    In relation to market segments, we found out that there are two different approaches, one for state schools and the other one for private ones. The first market segment includes private schools:

- The market can be addressed directly through private schools directors, or key teachers in the school.
- Through content providers/pedagogical providers

    The second market segment considered include public schools and networks of public schools: there are different channels depending on the country but some key profiles are identified.

- ICT providers (C2K [8] in Northern Ireland, Red.es [9] in Spain)
- Educational institutions linked to public sector (Pedagogical institute in Greece)
    Learning Portals (LNI)

    In more general terms, the outcomes of the market analysis show that in most the European countries, there is a lack of sufficient and appropriate teachers' support to incorporate ICTs in their teaching practices. Besides the collaborative learning is a new direction in the educational systems, and the learning via computer based modelling is also a new or almost new activity. In most of the European countries, there are not existing established educational support mechanisms for those issues as well.

    It is interesting to note that although the e-COMODE services is highly rated among the teachers and the learners (during the validation excellent examples demonstrating how the students take over the teachers activity and start developing themselves "learning activities" have emerged), the barriers seem to be at the level of public administration. The outcomes of meetings and interviews with representatives of regional authorities demonstrate that, although there is a need of consultancy services for the implementation of new technologies for teaching and learning purposes, there is limited power of acquisition of educational products, not to mention services. It seems that services are anyway provided (in all of the three countries under study), however the arrangements and business models are diverse.

7. Business Benefits

Based on the preliminary results, it seems that e-COMODE services fulfil significant gaps detected in the European educational systems, such as the lack of offering together the variety of simulation and modelling tools in a collaborative environment. The business

benefits to be obtained through the commercialisation consider the licensing of a full e-COMODE environment, extra-fee coming from e-COMODE content reuse by the customers, and revenues from the technical, training and consultancy services.

Besides, the market validation has enabled us to discover that the target market of the e-COMODE services can be enlarged. For the market validation of the e-COMODE services, the students' ages considered were of 11-17 years old, however, after the analysis performed by the teachers while adapting activities, it happens that 10 years old students can also use the application. Furthermore, a large market at the University level, mainly in technical colleges, has also shown interest. The business benefits of this finding are that more and diverse users can be interested in the e-COMODE services, thus enlarging the market potential of the business.

Finally, although at the beginning the subjects considered were mainly technical; science, biology, math, etc, during the validation economics and geography have also been identified as disciplines that can benefit from the e-COMODE services. This also contributes to wider the possibilities of the application to convince schools directors to implement the environment.

At a higher level, e-COMODE services offer to European schools the only software that allows meta-analysis, multi-reasoning models: it is the only solution that combines all them: quantitative, qualitative and mixed, in a collaborative mode. This is a very important benefit when considering the importance of providing new categories of skills to students entering the new knowledge-based economy.

8. Conclusions

Besides identifying and classifying the market needs, a complete e-COMODE services' portfolio has been defined. Based on the validation feedback and the definition of market segmentation, an improved business model oriented to the licensing of an e-COMODE full solution for the commercialisation of e-COMODE services is being studied.

In all the cases, there is one or more services that e-COMODE could apply. For instance, teachers from UK are very interested by the concept of the software application and they find essential the support services and consultancy provided by e-COMODE.

Further work needed to progress towards a full exploitation of the e-COMODE services by the market is to adapt the service and the business approach in function of the results obtained during the pilot phase and produce a realistic business plan in view of a full market deployment of e-COMODE. Beside, the results of the market validation must still be widely disseminated, in order to invite new customers to know more about the service, to show the benefits of the use of the service to the market segment e-COMODE is targeting.

As indicated in the development section, to introduce and facilitate the market validation, training of teachers has been performed. Although this step (together with a consequent awareness campaign at all level of the school staff) seems to be obvious when conducting validation pilots, we observed that it was one of the most important part of the services delivered by e-COMODE and that appropriate teachers' training was generally lacking in schools.

Regarding the technology, as the technical status of the e-COMODE collaborative environment is stable and reliable, only few implementation problems have emerged. Besides a technical support service is part of the e-COMODE offer. Important issues are more related to cultural and organisational barriers, which hinder the take up of the use of e-COMODE in schools. At least there are difficulties in finding a win-win solution with the public sector and enter the state schools market.

Montandon L., Dimitracopoulou A., Avouris N., Casado E. (2006) e-COMODE Services for the Implementation of Collaborative Modelling Environments in Schools. In P. Cunningham (Eds) *e-Challenges conference 2006,* 25-27 October 2006, Barcelona, Spain

Finally, we would like to highlight that although the current organisation of the public administration in charge of school education in Europe is not flexible enough to be ready to adopt new teaching and learning methods and tools, the positive outcomes coming from the end-users (teachers, students) show clearly that e-COMODE is to become a valuable set of services in the near future.

References

[1] European Education Market Trends in ICT - presentation given by Peter J. Bates at an internal Cisco training seminar 5 October 2000 in Barcelona, Spain (www.pjb.co.uk/Ciscopjb/cisco2000/index.htm)

[2] Briefing paper on "Computer-supported Collaborative Learning Networks in Primary and Secondary Education", November 2000 (www.pjb.co.uk/npl/bp31.htm)

[3] DIMITRACOPOULOU A. (invited talk 2004). Modelling Activities in Schools with a collaborative technology-based learning environment: Scenarios of use in secondary education. In P. Massouras (Eds), "Information Technologies & Education", 13-14 December 2002, CCS, Cyprus, pp. 35-45.

[4] Understanding the Common Essential Learnings. A Handbook for Teachers", Saskatchewan Education (www.sasked.gov.sk.ca/docs/policy/cels/index.html)

[5] ORFANOS S. & DIMITRACOPOULOU A. (In press, 2005). Technology based modelling activities and the contribution in learning concepts' relations in kinimatics. In Research in Science and Technological education.

[6] ORFANOS S. & DIMITRACOPOULOU A. (2003).Technology based modelling activities in learning concepts relations in kinematics. In A. M. Vilas, J. A. M. Gonzalez, J. M. Gonzalez (Eds), Advances in Technology-Based Education:Toward a Knowledge-Based Society. II International conference on multimedia ICT's in Education, Badajoz, Spain, Dec 3-6 2003, Edition: Junta de Extremadura, Consejeria de Education,Volumes: I-III, Collection, pp. 1353-1357.

[7] SMYRNAIOU S. & WEIL-BARAIS A. (2003). The understanding of specific symbolic representations by students from 10 to 15 years old. In C. Constantinou (Eds), Computer Based Learning in Sciences, Proceedings of Sixth International Conference CBLIS, 5-10 July, 2003, Nicosia, Cyprus.

[8] C2K mission is to provide, for Northern Ireland's schools, a world class Learning Technology service and optimise its use throughout the Community (www.**c2k**ni.org.uk)

[9] Red.es (www.red.es)