CANDLE: AN EUROPEAN E-EDUCATION PROJECT TO IMPROVE THE TEACHING ON THE INTERNET

Jodok Batlogg (UKA), Rolv Braek (NTNU), Chris Fowler (BT), Ivon Kermarreck (ENST-B), Lionel Sacks (UCL), Joachim Wetterling (UT) and

LLuís Gutierrez
Technical University of Catalonia (EUPVG – UPC)
Avda Victor Balaguer s/n
08800 Vilanova i la Geltrú – Spain
e-mail: luisg @ mat.upc.es
project URL: www.candle.eu.org

ABSTRACT

CANDLE (Cooperative And Network Distributed Learning Environment) is a new European project supported by European Telecommunications Schools members of EUNICE, and others partners as: BT, IOE, Siemens, . . . The project is supported by the EC within the IST Program.

The objective of this project is to use the Internet to improve the quality and reduce the cost of ICT teaching in Europe by using web and multimedia technology, and to enable co-operation between universities and industry in creating and reusing learning materials and improving the quality of delivery. However, the proposed system is not designed to constrain the freedom of academics and trainers to develop their own courseware. The use of component architectures, toolkits and pedagogical frameworks that allow individual teachers to combine course objects to create their own courses designed to meet their learners particular needs.

The results of the project will be course modules and complete courses on ICT topics, as well as tools to support the creation, delivery and organization of courses. The results will be available to all European universities, industry as well as small and medium enterprises under the "open courseware" license[1]

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1. INTRODUCTION

The new era is more and more called the Information Society, there are plenty of new services being offered to the citizens mostly based on the Internet technology. Among them the most important nowadays are e-commerce and e-education services.

It is needless to explain what e-education means today, we will rather focus on its main highlights. An e-education service must be a “smart” system very simple-to-use, with broad access for everybody, where any European citizen will be able not only to “know” or “access” information but *learn* where he wants, when he wants, what he wants and at its own pace according to his background and preferences, also known as lifelong (non-formal) learning. In other words the future society is moving towards what is being called the “Knowledge Based Society”.

The half-life of knowledge is being reduced dramatically so it is widely known that nearly any individual must continuously update himself. An “open courseware” system should be addressed to any kind of people: students, teachers, small and medium enterprises (SME’s), councils, and any other type of institution. It should be also easily configurable and adaptive so it can be modeled as a very specialized system in a particular area, as a

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post-graduate or master curricula, or be adapted to a more generalist discipline.

It is also important to note that new e-education services needs important investments and efforts in:

Technology: networks, operative systems, author's and navigation tools.

Pedagogy: a very rich, and collaborative user-friendly learning environment.

Assessment: any part and the whole system must be carefully evaluated and tested so that we can guarantee that the user reaches the highest quality possible in terms of the "pedagogical and technical" level.

E-education is a tremendous potential market, although the development of new systems is carried out mostly by public organizations such as Universities, with public funds.

The present article is devoted to present a new e-education project titled CANDLE (Collaborative And Network Distributed Learning Environment) focused on the teaching of ICT topics, as well as tools to support the creation, delivery and organization of courses. The results will be available to all European universities, industry as well as small and medium enterprises under the "open courseware" license.

The organizations of the paper is as follows: in section 2 we will take a quick look at some existing e-education systems, specially those supported in the past by the European Commission. In section 3 we will present CANDLE, its objectives, the Consortium and its innovative aspects with respect to similar products. In section 4 the work that should be done to develop CANDLE is described, and finally we will conclude at section 5 where not only the aims of the proposal are described but also the main difficulties we face when developing such a new system in the e-education area.

2. EC SUPPORT TO E-EDUCATION

The European Commission (EC) has been investing in e-education since 1988 when DELTA program was launched under the II Framework program [1]. The main aims of the EC work on e-education are expressed: "we must continue to act as a catalyst to stimulate a wide variety of models for the provision of education and training models that will work in the rich linguistic and cultural environment in Europe".

As a resume the final goal of the EC support to e-education is to improve the access to lifelong learning for all European citizens. When we consider the European Community the results of this extra education and training of its citizens will be more skilled people, with more technological strength, so that Europe will be able to maintain the capacity of competition against the rest of highly technically developed regions of the planet in the XXIth millennium.

2.1. The 4th Framework: achievements

The latest European program devoted to education and training was the 4th Framework Program, (1994-1998). In [2] you will find the most important considerations about the benefits obtained once this program is successfully finished. There were more than 700 organizations participating in different Consortium to carry out 86 projects. The EC allocated more than 100 million euros to support them all.

Among these projects some addressed particular areas and groups of people, e.g.: homes, meteorology, Aquarius, teachers, . . . while others addressed more general aspects conceived to develop a rich, powerful set of tools, multimedia contents and so on, in order to develop complete lifelong learning systems. In this category we may highlight projects such as ARIADNE [3] or REM [4].

There is a special project, TETRISS [5], aimed to facilitate and coordinate the dissemination, and to be a central control point for the Education and Training sector, where further information about those projects and also the future ones can be obtained.

2.2. The 5th Framework: trends

The 5th program [6] will run from 1998 to 2002 and covers four diverse themes of research. The one that interests us is the *Information Societies Technology (IST) Program* [7] devoted to the creation of the user-friendly Information Society which involves four main actions: *Systems and Services for the Citizen*, *New Methods of Work and Electronic Commerce*, *Essential Technologies and Infrastructures*, and *finally Multimedia content and Tools*, (see references for more information).

Developing an Open Platform for providing Cost-effective and individualized learning is one of the main priorities to reach the goals mentioned, that means to go towards new forms of multimedia-based telematics-supported teaching and learning systems.

The main features of such platforms are: to be an Adaptable Learning System, to provide tools for multi-user Collaboration and Interaction, to improve Authoring Learning Environments and

Learning Software architectures and finally to be helpful for the organization and management of learning resources, which means to research in developing learning resources metadata and to define an appropriate taxonomy and curricula structures in order to provide user-friendly access to the different users to the information stored.

Last but not least this program should also move forward to the convergence, integration and standardization (IMS) of Education and Training Technologies. The ongoing projects on the Internet will foster the improvement of the network infrastructures in Europe in the next years to come in order to meet the QoS (Quality of Service) the delivery of these new services require.

3. CANDLE: A NEW 5TH FRAMEWORK PROGRAM PROJECT

CANDLE is an ambitious project that is going to be developed in the 5th Framework Program. It was first presented in June 1999 to the EC and started on June 2000, it is expected to be finished at the end of the year 2002.

3.1. Objectives

The main objectives of CANDLE are:

- To develop a methodology and a set of guidelines for the development of network-based, multimedia ICT courses.
- To manage and deliver a framework of open courseware containing customizable ICT courses based on reusable learning components.
- To deploy a system for delivery and navigation, and a set of multimedia authoring tools for courses customization.
- To work out open distributed architecture, with distributed information and directories, and to develop the information brokering middleware elements.
- To study and evaluate pedagogical models for lifelong distance learning, and to evaluate the whole system technically and pedagogically.
- To foster co-operation between European academic and industrial organizations.
- To contribute to standardization efforts in this area.

3.2. The Consortium

The consortium is constituted by a group of institutions that are experts in ICT topics, as well as major industrial partners such as: BT or Siemens, SME's and educational and pedagogical institutions.

The core and the strength of the Consortium is EUNICE (European Network of Universities and Companies in Information and Communication Engineering) since some members belong to this organization, which includes many European (and some non-European) Universities and companies. Many of them have been working in the past developing systems for e-education for their own use, and have acquired a wide experience. Among them are the *Teletop* system from UT and the *Companion* system from UKA.

Expert partners such as IoE (Institute of Education) and UT assure a highly professional pedagogic assessment and thus guarantee the usability and the added value of CANDLE.

3.3. Innovative aspects and contribution to the EU policies

CANDLE aims to introduce innovative aspects with respect previous e-learning models, the key important features are:

- The re-usability of modules at different levels of granularity to create cost-effective courses.
- The open and distributed architecture of the platform and the whole system.
- The "open courseware" customization of courses that permit the adaptation of contents to the individual, companies or institutions.
- The collaborative learning environment created by such a system, helping the harmonization (standardization) of European diplomacy and the mobility of students and persons across Europe.
- The openness and flexibility of the new pedagogical model. Teachers will be able to create their own courses, while students will follow them strictly or build their own paths to meet their learning interests and to do it at their appropriate speed.
- The evaluation of results of the learning process and the system both globally and individually.

Such innovation matches extraordinary well to the objectives of the 5th Framework Program described before.

4. DESCRIPTION OF WORK

The project is divided into different Work Packages (WP's) as illustrated in Figure 1:

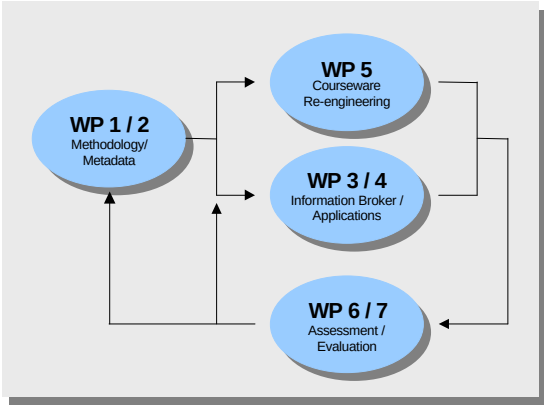

Figure 1. - Relations between Work packages

4.1. Methodology and Metadata

Workpackage 1 controls the methodological and pedagogical issues within CANDLE. The workpackage intends to provide coordination between scientific, business-oriented and practical perspectives in offering valid and reliable methods of working for both technological and educational components in the project.

The main objectives of this workpackage are:

- To develop and provide a theoretical reference framework for the reusability and re-engineering of web-based learning material in telematics in proven theories, methods and procedures.
- To design and develop guidelines and performance support for the re-engineering of web-based course material.
- To validate the guidelines and performance support with respect to usability, effectiveness and acceptance according to criteria from the theoretical reference framework.

The reference framework is to be built on findings from previous research as published in the literature. Findings from surveys to be conducted in the workpackage establish a target group profile with respect to personal expertise and attitudes, available technological infrastructure, institutional policies and economical conditions and an evaluation of existing systems and models for delivery and organization of web-based learning.

The guidelines and performance support are to be designed according to results from the literature survey, needs assessment results and the analysis of characteristics and functionalities of information systems and applications being used in CANDLE. The validation of guidelines and performance support is to be carried out concerning pilots with experienced and non-experienced users pilots in controlled as well as field settings.

Metadata and their use in the context of re-usability and standardization of web-based learning material are an important element of CANDLE. Metadata are the main object of study in workpackage 2. The objectives of the workpackage dedicated to metadata are:

- To generate an initial framework definition of the metadata required to suport the Candle objectives.
- To derive, from the Candle Telematics knowledge domain a complete ontology and metadata set.
- To synthesise guidelines and techniques for utilising the metadata for advanced navigation and searching tasks.

Activities in the metadata workpackage are to be carried out in close cooperation with the methodology workpackage as well as the workpackges concentrating on the construction and implementation of the information broker and the workpackages elaborating on course components in making them suitable for integration in the CANDLE learning approach.

4.2. Database Distribution. Brokering applications and Tools

An international team well known for their expertise in network technologies will produce teaching materials. Each of the partners has accumulated numerous pedagogical documents over the years: they may correspond to pieces of software describing protocols or algorithms, diagrams, animations, tutorials and lecture notes. All these resources will provide an extremely valuable base when all the partners will put them together. From all these documents, we need to build courseware for a large audience with various backgrounds, preferences and skills.

One part of this activity will then deal with infrastructure and the second part will deal with the user (teacher and student) level.

The infrastructure role is to provide an open distributed platform for collaborative courseware life cycle management. Various issues have to be considered to reach this aim: from distributed storage of numerous documents to their security through directories.

The user interface plays a key role since we need to rely on the effective contribution of the teachers and on the student approval. Both views complement each other even if major discrepancies do exist.

The teacher is mainly concerned with the production of courseware in a collaborative perspective. Two kinds of operations are concerned with sharing information and documents.

- Accessing the library of courseware documents: when a teacher inserts his document in the base, he needs to index it in a way so that information might be retrieved. The indexation process plays a key role and the teacher should be assisted to make proper use of metadata and other keywords.
- Authoring courseware. The CANDLE approach is based on components which are glued together. As mentioned earlier, our future product should take into account user's goals and current expertise so as to adapt the courseware. This requires specific actions by the teacher so that he can develop such materials and we should provide assistance for this step. In fact, the students should use the same courseware materials in numerous contexts.

The student module is mainly concerned with the interface to the materials produced by the teachers and with communication tools to interact with other students and the teaching staff. CANDLE will provide:

- Adaptive navigation modules: The adaptive navigation tools provide a powerful approach for learning since they make it possible to adapt both contents and structure for each specific user. User's profile (e.g.; preferences, background, level, expertise) can be used for this purpose.
- Assistance tools to get further information.
- Student communication tools.

Knowledge and expertise from different countries and different views will be made accessible. This will guarantee that the current trends and state-of-the-art information will be made available. CANDLE will provide a framework for dynamic and involving teaching domains where evolutions are fast paced and only collaboration will enable the community to keep track of changes. This effort will be done by actors from academia (the education partners) and industry.

The tools and the environment of CANDLE will also consist of modules to assist the student and to propose a personalized curriculum based on an analysis of the background of his/her knowledge. Adaptation, interactivity and customization will guarantee the benefits of the system. Additional tools will assist the teacher when evaluating the pedagogy and the progression of the course and to modify it if needed. Moreover, these tools will provide feedback that will be used by the student to determine his level and what needs to be achieved.

4.3. Courseware Re-engineering

The partners of the consortium will generate material according to their expertise, and the content will be inserted into the course database, where it will be available for other course developers using the metadata facilities provided. The course metadata and the guidelines for module construction are to be defined in workpackage 1 and workpackage 2. The core activity of this work package is to provide course material which:

- Covers a large part of the telematics and Communications 'syllabus'.
- Spans a large number of teaching institutes through Europe.
- Actually can be used by a large number of students throughout Europe.
- Is usable by both full- and part-time students pursuing higher academic qualifications at Masters or Diploma level; and members of the broader community (private citizens as well as employees) following specific courses to meet lifelong-learning objectives.

An initial activity is concerned with the development and definition of a base line set of modules that will be carried out after the first prototype of the platform should be delivered. As the courseware contributions are expected to be derived from material already developed, in a classical form, by participating partners, we term this activity **Courseware Re-engineering**.

An important goal is to ensure that course material is re-usable for the construction of new 'modules' or courses out of existing material. To evaluate this functionality, there is a specific phase of Course Customization with two assessments and milestone releases. Material for course customization should be available through out the consortium partners. Thus we should be able to produce custom courses not only as early as possible, but of high quality and suitability for the teaching and learning to hand.

Scheduling of this work package is guided by the requirements for material to be used in evaluation phases. This demands some early development of courses and course material for initial trials.

4.4. Assessment and Evaluation

The term *Evaluation* is used to refer to the measurement of the value of the *completed* system

to its targeted users. In contrast, the term *Assessment* refers to the value to the users of a *proposed* system. In essence they are both evaluation exercises, but one, Assessment, occurs *early* in the development process and the other, evaluation, occurs *late* in the development process. Assessment and Evaluation cover course construction as well as course usage. Thus feedback from initial course construction is given to the workpackages 3 and 4 to guide in applications development.

The Evaluation Framework must cover both early (formative) and late (summative) activities. This framework covers technological, educational, and organizational aspects both at the design stage, and implementation stages.

At the early stages, the framework will be used to evaluate design decision based on a selected pedagogical model for the educational evaluation, usability, performance, reliability and other related measurable criteria. At the later stage, a more traditional summative evaluation approach is proposed. This will center around three formal testbed settings: university settings, corporate settings and a number of SME's.

The figure 2 below summaries the Evaluation component of Workpackages Assessment and Evaluation.

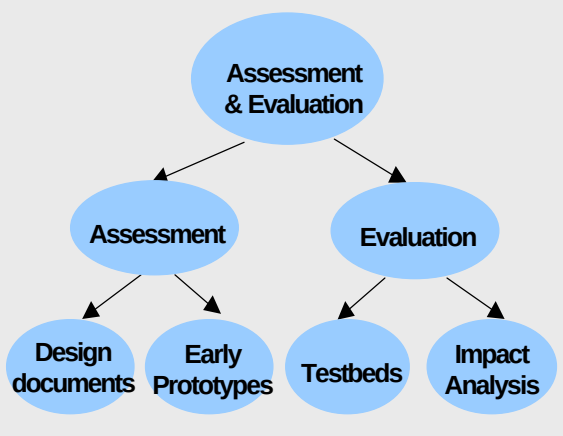

Figure 2. – Assessment and Evaluation components

The Assessment and Evaluation Framework will specify acceptance criteria against which the system will be tested, methods of collecting assessment and evaluation data, and the specification of both when and how evaluation decisions will be fed back and utilised by the system developers.

The Assessment package will specify the different evaluation elements required, namely: Technical, Pedagogical and Organizational. While the Evaluation package is concerned with the development of a number of testbeds where targeted users can extensively test a late prototype of the Candle system.

5. CONCLUSIONS AND THE WORK

A new E-Educational project, CANDLE, under the 5th Framework Program has been presented. The project Consortium conceives it as being innovative and in harmony with the most advanced pedagogical and technical current trends.

It is going to be performed by a Consortium constituted basically of Universities related to ICT disciplines. The final results will be an open collaborative learning environment, and a set of course modules and complete courses on ICT topics, as well as tools to support the creation, delivery and organization of courses.

The *openness* and *flexibility* of the new pedagogical model, which will be as general as possible, will be one step towards realization of the vision "*lifelong network-based distributed learning*".

The are still open questions to be fixed by the Consortium before this project becomes a reality as: the "harmonization" of topics and levels across Europe, the "open courseware" license, the copyright of authors modules, and so on. Some of these questions will be also discussed in other EC Forums.

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