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Quality Assurance Procedures for a Web-Based Degree

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INTRODUCTION

The growth of credit-bearing distance learning offerings and enrolments at accredited, degree-granting colleges and universities has been astonishing in the last few years. According to Eaton "during the academic year 1997–98, approximately 1.6 million students were enrolled in credit-bearing distance learning courses (whether electronic, television-based, or print- and-mail-based, and including both synchronous and asynchronous instruction) in degree-granting post-secondary colleges and universities in the United States. That year, 54,000 college-level credit-bearing distance-learning courses were offered in 1,680 institutions. Thirty-five states, currently operate virtual universities or participate in a regional virtual university, typically created by existing degree-granting colleges and universities"(Eaton, 2001).

This growth raises the demand for reliable information about quality.

Quality is defined in ISO 9000 as "The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs". According to the Higher Engineering Education for Europe working group, quality in higher education can be interpreted as "specifying worthwhile learning goals and enabling students to achieve them". Where "specifying worthwhile learning goals" involves paying attention to academic standards, to the expectations of society, to students' aspirations, to the demands of industry and other employers, to the requirements of professional institutions, to the fundamental principles of the subject, etc. Moreover, "enabling students to achieve" these goals involves making use of research into how students learn, adopting good course design procedures and building on successful teaching experience, all of which may require professional development for lecturers (H3E, 1999).

The previous definition of quality does not help very much in the evaluation of the quality of distance learning courses. In this paper, we discuss a case study on a possible approach in assuring both the quality of contents and the quality of the Internet based application of a web-based degree in Motor Disability Assessment.

In the next section a short outline of the degree will be provided, while in section 3 the quality assurance procedures enacted will be described.

AN OVERVIEW OF THE MODASPECTRA PROJECT

The MODASPECTRA (MOtor Disability Assessment SPEcialists' TRAining) project is a research and technology development project pertaining to the "Telematics Application Programme - Education and Training" sector of the fourth Framework Program for R&D of the European Union. The project is a joint activity of Department of Electronics and Automatics from the University of Ancona (Italy), the School of Physiotherapy of the University College Dublin (Ireland), the Medical Faculty of the University Montpellier - I (France), the Roessingh Research and Development (The Netherlands), the TSR consortium (Telematica per il Sistema Riabilitativo) in Italy.

The MODASPECTRA project was aimed at developing quality teaching and training of post-graduate specialists in Motor Disability Assessment (MDA), everywhere accessible on the Web. Thus, a degree that will provide strategic knowledge and skills aimed at enabling Physiatrists, Physical Therapists and Bioengineers to clinically apply movement analysis methods and tools in the clinical processes of patient assessment, treatment monitoring and communication has been developed. The aim of the program was to offer European professionals involved in Clinical Movement Analysis both a complete degree on clinical applications of Movement Analysis and a reduced number of courses in the perspective of Life Long Learning (Leo, 2000).

The project's goals included the definition of a Web Based Open and Distance Learning (WB-ODL) system usable by students, according to suitable tutoring pathways and schedules. The project also was aimed to implement multimedia databases of context-based experiences provided by recognised practitioners. Another key activity involved encouraging co-operation among academic and industrial actors for the production of course materials and for the exploitation and adaptation of remote-delivery systems involving, as appropriate, Internet, teleconference, videotape/CD-ROM and paper documents.

The results of the project and the MODASPECTRA system are available at the URL: http://www.modaspectra.org

The degree is composed by eight courses: three out of six Homogenisation Courses (table 1) which will be selected according to the previous academic career of the learners' and five Common Courses (table 2) that should be attended by all the students.

The Homogenisation Courses are meant to provide basic knowledge to professionals having different backgrounds in order to allow them to attend in a homogeneous manner the common courses.

The common courses are more specialistic and cover four main areas: Fundamentals of Measurement, Application of Measurement, Fundamentals of Movement and Telematics.

The content of the courses has been identified according to the processes and objectives involved in Clinical Measurement Analysis as defined in the functional specifications of the project

Table 1: Homogenisation courses of the MODASPECTRA degree

Career	Homogenisation Courses
Medical Doctors Physical Therapists Physiatrists	Basic Biomechanics Fundamentals of measurements and signal processing Basic Informatics
Bioengineers	Functional Anatomical Basis of Motor System Basic Physiology Fundamentals of Pathology and Procedures for Interaction with Patients

Table 2: Common courses of the MODASPECTRA degree

Area	Common Courses
Telematics	Telematics for Clinical Movement Analysis
Fundamentals of movement	Fundamentals of normal and pathological movement
Fundamentals of measurement	Instrumented measurement for clinical movement analysis Clinical measurement for clinical movement analysis
Applications of measurement	Clinical applications of clinical movement analysis

(MODASPECTRA, 1999) and will not further discussed since they appear to be outside the scope of this paper.

The minimum level of granularity selected for the content of the MODASPECTRA material is a Content Unit. According to the CEN/ISSS workshop (CEN, 2000) a Content Unit represents a piece of information not divisible anymore without losing its economic or didactic significance from the user's point of view (e.g. a number of HTML pages treating a specific and self-contained set of information).

Content Units are grouped in Composite Units through an index page. With the help of Composite Units, it is possible to provide a uniform navigation within the learning technology system on the one side, and on the other side to allow the usage of a Content Unit in more than one arrangement. Composite Units are similar to a table of contents in a book and may be dynamic in terms of adding or removing entries at any time. This allows high re-usability and modularity within a learning technology system and gives a clear added value for its users.

About Ten Composite Units compose a Course of the MODASPECTRA degree. Each course is meant as self-contained from the point of view of the instructional design, even if logically related to the others. A specific entry test for each course is devised to provide the learner with a personalised pathway within the degree. The entry test will explore the existing competence of the learner on the topics addressed by the Composite Units of the course.

A personal interaction with the tutor/teacher is planned for the final examination of each course.

In the case of learners attending the whole degree, a further workload was considered for the final dissertation needed to obtain the award granted by the degree.

The number of credits for each course is defined according to ECTS criteria (ECTS, 1998). Thus, the courses constitute a workload and provide a number of credits corresponding to the one of a post-degree master course in the context of ECTS.

In order to guarantee the reuse and the maintenance of the learning material a proper system for its storage and indexing has been designed and implemented. Every Content Unit, Composite Unit and Course has been indexed by Metadata. The structure of Metadata has been chosen coincident with the one proposed by the IEEE Learning Technology Standards Committee (LOM, 1999). Metadata contain, beside other information, all the instructional characters of every Content Unit, Composite Unit and Course and the complete information on their physical location.

QUALITY ASSURANCE PROCEDURES

Quality of Contents

Three main classes of procedures have been defined and followed in the implementation of the educational system: authoring procedures, to be followed for Content Creation and/or Learning Material construction; teaching procedures to be followed in order to guarantee proper monitoring and support/assistance to the learning process; and the didactic/administrative procedures to be followed by Back Office and Faculty. Every procedure is meant to be implemented by one or more actors, whose operation is inserted in a proper organisation framework. It appears that the most effective way of describing the whole operation is by the UML tools, as shown in fig. 1. In the present section, the authoring procedures adopted will shortly be discussed to provide a better understanding of the quality assurance approach.

Authoring Procedures

The Editor, appointed by the Faculty, has the responsibility of organising a Course. It defines the instructional design of the course and of its composite units and appoints one or more authors to produce the composite units. The Editor verifies the learning material produced by the authors and manages its storage in the databases.

The Editor in chief manages the validation of the learning material and takes care of the relationships with the Faculty in order to decide the acceptance of a Course and its activation in the Degree.

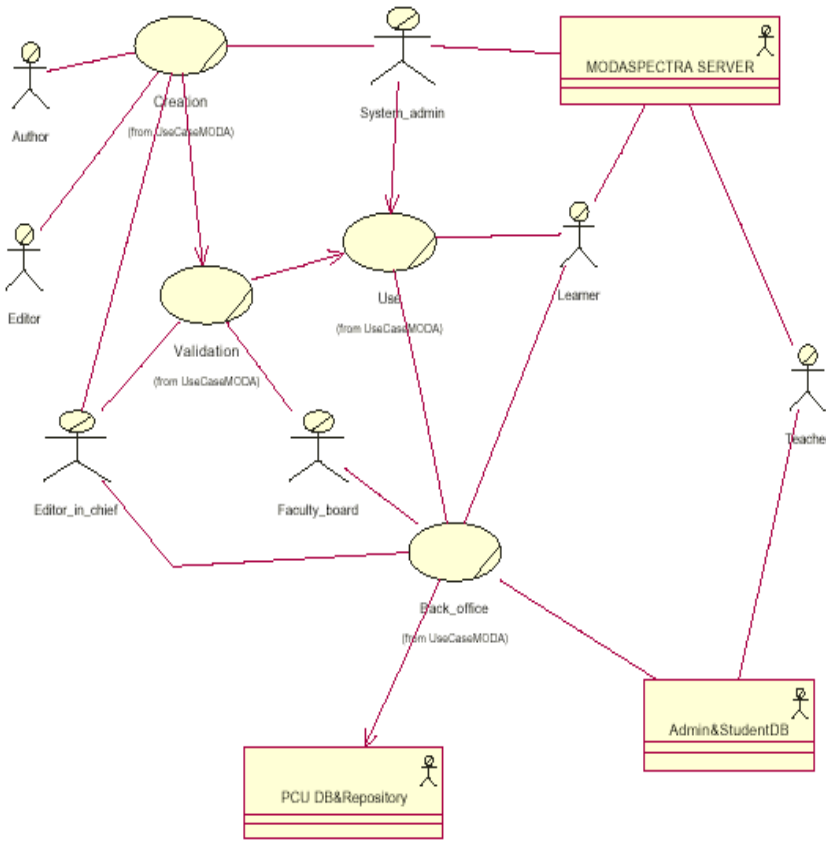
The author is the subject receiving the commitment to produce the contents of one or more Composite Units of a Course together with the relative Assessment, Remedial teaching, Glossary and Metadata. The author is subjected to constraints of time and formats in producing the material. He/she interacts with the editor in the phase of verification of the produced material. The instructional design of the learning material has to be defined, as discussed in section 3 of this paper, in terms of learning objectives, level of content, pedagogic approach, self assessment & feedback and remedial teaching.

The instructional design of the Composite Units and of the CU is in charge of the Authors. They have to be coherent with the learning objective of the Course and with the Composite Units defined by the Editor.

The quality of the procedure is guaranteed by the traceability of the decisions taken in this respect by the Faculty and communicated to the Editor in Chief. The communication is actually performed by e-mail. The trace mechanism is based on the daily back up of the incoming messages. Possible improvement of the communication traceability, if needed, will be implemented by means of a specific telematic procedure.

The consortium has chosen an iterative approach in the development of the MODASPECTRA course. This means that this development is a continuous cycle of specifying improvements over the present edition of the course, making the appropriate changes to courseware, and evaluating this improved course. In the first and the third step of

Figure 1: The MODASPECTRA scenario of operation



this development cycle, good contacts with both the scientific and user community are crucial.

Therefore, an evaluation system has been implemented using selected questionnaires and structured interviews that provide feedback from the users that allow improvement of the MODASPECTRA course. This feedback will be obtained from students, but also from the professional organisations that are interested in using the course to fulfil their education role.

A second goal in this iterative development is to keep track of the scientific and clinical state of the art. Worldwide there is a considerable ongoing research and development activity both in the technical and clinical areas. For a quality course, it is important that the consortium is continuously aware of new relevant developments that could have implications for the course. To achieve this, the consortium will frequently discuss the Learning Material of the course with members of the scientific community in the application area.

The basic mechanism in assuring quality of the contents is independent peer review. Three experts are involved in the review of each module: two domain experts, variable from module to module, and one MDA expert, to be involved in all the modules review to guarantee the needed homogeneity.

The frequency of consultation will be once every two years.

The comments and recommendations related to the course content will be processed by the editors of the individual modules. It is the responsibility of these editors to find the most appropriate measures for modifying the course content according to these comments.

The procedure for contents updating implies the traceability of the various successive versions by means of the explicit indication of the version in the Metadata.

Moreover, internal and external procedures have been defined at a preliminary level.

Accreditation of the Learning Material

The learning material has to be accredited by third parties active the educational field as, for instance, Academic Institutions. The procedures for the accreditation follow the ones defined by such Institutions; consequently, no QA specifications have been defined in this respect.

The Consortium has established contacts with the University of Dublin for the validation of Higher Diploma/Master degree course in Motor Disability Testing developed by MODASPECTRA. At present, the agreement of the Registrar of University College of Dublin has been obtained and the Consortium is requiring the approval of the Faculty of Medicine and the Academic Council.

Quality Assurance of the Web Based Implementation

As a general reference, QA procedures for software development are based on the relevant IEEE standards (IEEE, 1997).

The quality policy of the project with respect to Web Based software implementation (computer programs, procedures, information, data, records) is to satisfy quality requirements suitable for the establishment of a running Life Long Learning system at the completion of the project. In particular, the prototype of the MODASPECTRA Course focussed the attention to the key-elements of the quality plan: quality of the software tools and of their documentation, security services and security networks. Each of these issues will be discussed in the following sub-sections.

Quality of Software Tools and Their Documentation

The software quality characteristics to be attained are Functionality, Reliability, Usability, Efficiency, Maintainability and Portability, as defined by the ISO/IEC 9126 (ISO, 1998).

The software implementation has been performed taking into account the satisfaction of quality requirements at each phase of the software development cycle and in particular IEEE-1061 (IEEE, 1997). The QUINT - QUality in INformation Technology model (van Zeist et al., 1996) has been adopted for the software development process.

In this paper, the software documentation is meant as the description of the design solutions and of the implementation of the Metadata dB and Communication Tools.

The information is organised in:

- A section introducing the reader to the scenarios of the MODASPECTRA Teaching and Training System reported in UML code;
- A section describing the design and implementation of the knowledge pool of the system with particular reference to Metadata dB and the tools devoted t its management.
- A section describing the design and the implementation of the MODASPECTRA course delivery with particular reference to the chosen SW environment adopted.
- An annexed volume containing the "Editor Manual" and the "Learner User Manual" sections constituting a 'help' for the users.

The format of documentation is the standard requested by the CEC for the production of the project deliverables.

The quality of documentation is based on the application of ISO-9000-3 "Guidelines for the application of ISO-9001: 1994 to the Development, Supply, Installation and Maintenance of Computer Software", section 4.5. It has been assured by the supervision of the work package responsible and by the peer review process of the related deliverable (MODASPECTRA, 2001).

Security Issues

The problem of security has been faced taking into account the indications provided by the Information Technology Security Evaluation Criteria the European standard for the evaluation of security. According to such standard, the MODASPECTRA degree has been classified in the E2 category: "An informal detailed design, and test documentation must be produced. Architecture shows the separation of the Target of Evaluation into security enforcing and other components. Penetration testing searches for errors. Configuration control and developer's security is assessed. Audit trail output is required during start up and operation"(ITSEC, 2001).

The Security aspects implemented in the demonstrator are relative to availability, confidentiality and data/information integrity: A proper Access Control policy, based on the definition of different levels of passwords with the relative privileges for the access to the data, has been defined and implemented according to the scenarios. The following classes of users, having different (decreasing) privileges of accessibility to the stored data, have been implemented:

Table 3: Class of users that have been implemented

Content creation side	Course delivery side
Web administrator	Web administrator
Editor in chief	Teacher
Editors	Student
Authors	

Such Access Control policy assures also the confidentiality of the System with respect to the protection of the information relative to the students performing the Life Long Learning course.

As second aspect of the confidentiality, not yet implemented, is security of the transactions possibly needed for the on-line payment of the course fee. This aspect will be considered in the final version of the demonstrator when the enrolment procedures will be completely implemented.

A proper Data Management policy has been defined and implemented. A specific identifier of each version of CU and Metadata allows the traceability of the development of the content material. Taking standard back up (every week) and maintenance procedures for re-creating data lost or disrupted.

The two main issues to be considered at the networking level are the protection of the integrity of the data stored in the

MODASPECTRA repositories and the protection of data and system availability.

At present, QA procedures to guarantee Integrity of data stored have been implemented by means of a proper Access Control policy, adequate anti-virus, and weekly back up procedures.

Moreover, a back-up server is permanently available in order to substitute the main one in the case of its serious malfunction. Data and software of the back-up system are aligned to the last back up of the main system.

To protect against attacks from the outside world a security policy has been adopted at the TCP/IP and application levels so that: only the HTTP and S-HTTP traffics are authorised from the Internet to the WEB server; no traffic is authorised from the Internet to the RDBMS and vice -versa; only the HTTP server can perform requests to the RDBMS. IP spooling and denial of service attacks are not possible.

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