

Teaching Motor Disability Assessment over the Web: MODASPECTRA

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ABSTRACT

MODASPECTRA (MOTOR Disability Assessment SPECIALISTS' TRAINING) was a research and technology development project aimed at developing quality teaching and training of post-graduate specialists in Motor Disability Assessment. The specialists targeted come from a background of physiatry, physical therapy and bioengineering. The aim is to offer to the European professionals involved in Motor Disability Assessment both a complete degree and a number of courses on Clinical Applications of Movement Analysis in a Life Long Learning context as a mean for upgrading their skills in the line of good practice dissemination and standardisation. The outcome of the project is a Web-based Open and Distance Learning system usable by students, according to suitable tutoring pathways and schedules. The project also implemented multimedia databases of context-based experiences provided by recognised practitioners. These results have been obtained through co-operation among academic and industrial actors for the production of course materials and for the exploitation and adaptation of the remote delivery system. The results of the project and the MODASPECTRA system are available at <http://www.modaspectra.org>.

Keywords

Web-based Open and Distance Learning, Life-Long Learning, Instructional Design, Metadata, Knowledge Pool

Introduction

Demographic trends suggest for the next years a scenario characterised by a dramatically increasing demand of rehabilitation services, due to the explosive growth of the elderly/disabled incidence and by a dual decrease of the active population.

This implies that the relative number of rehabilitation professionals will diminish. It is therefore imperative to increase effectiveness of rehabilitation, in particular with the purpose of improving and/or extending in time the independence of the elderly persons.

This asks for more effective treatments, which can be planned only on the basis of a more effective Disability Assessment, i.e. the evaluation of the functional status of the patient, aimed at recognising and monitoring the present level of disability and forecasting its evolution (prognosis).

With respect to motor disorders the assessment has to be considered as the functional evaluation of motor disability. Functional evaluation can be defined as “the process by which the current functional status of the patient is assessed by the clinician”. It is aimed at evaluating the loss or reduction of the relevant functions. Like every clinical procedure, functional evaluation implies protocols and procedures: in the case under discussion four categories of procedures have been identified: clinical, measurement, data storage and retrieval. These two latter have been induced by the need of monitoring the efficacy of the rehabilitation treatment.

Functional evaluation is (or it should be) performed by a multidisciplinary assessment team involving physiotherapists, kinesiologists, bioengineers, rehabilitation doctors, rheumatologists, orthopaedic surgeons and possibly, geriatrists.

The main limitation of current functional evaluation is the lack of a uniform quantitative approach and the need of a scientific approach towards functional assessment aimed at the proper planning of the rehabilitation treatment. There is the need of assessment teams able to operate both clinical and measurement tools in a uniform manner, independently from the Country and/or the region in which they are located. It can be foreseen that although the rehabilitation services will be needed everywhere, and probably the relevant equipment will be available everywhere needed, the availability of the proper assessment team will be restricted only at the large rehabilitation institutions and departments. In other words it seems realistic to draw a scenario where only part of the Motor Disability Assessment (MDA) laboratories will be served by the proper personnel and the rest will operate under-served. This allows to foresee some form of teleconsulting or second opinion scenarios among the activities of motor rehabilitation centres exerted by the largest ones on request of those not endowed with the proper professional skills necessary to interpret their resulting measures.

The National regulations and laws in European countries ask for clinician registration and for continuing education for them. The current situation of the professionals involved in MDA is rather non-homogeneous both among the different European Countries and within each region of the same Country, according to the individual history of the centre and/or lab. This is mainly due to the recent Academic recognition of Rehabilitation, and to the existence of different Schools and approaches. Only recently emerged the need of harmonised MDA protocols, and standardisation efforts have been undertaken in this direction by the scientific and professional associations. The results attained are entering step by step in the common knowledge of the relevant professional communities.

Although a large number of excellent textbooks on MDA is available, they are limited to a “single discipline approach”, with very few relevant exceptions (Basmajian, 1996). On the other hand, scientific and professional associations offer a number of courses every year. The main novelty in the last ten years is that most of such courses involve specialist of the other relevant disciplines. They are appointed for a limited number of lectures aimed at making the audience acquainted with the “language” characterising the parent disciplines. However, it is rare to find courses fully embedding the multidisciplinary way of working which is currently followed in high level rehabilitation institutions and asking the students to practice such way of working. Currently available courses on MDA are characterised by the following drawbacks: they are of limited scope, often covering single arguments only; they provide polarised education, according to the views of the Schools driving the delivery of the material; they are mainly of residential nature, thus occupying some consecutive working days and implying costs for travel, for accommodation and for attending the course itself. Furthermore, a Country-based educational initiative would have the risk of missing the primary objective of disseminating uniform skills throughout Europe, which is on the contrary important in the interest of the final users of the rehabilitation system, i.e. disabled and elderly. Therefore, it seems important to prepare specialists in MDA and in particular specialists able to exploit information technology and telematics for enhancing their own efficacy and effectiveness and for improving the rehabilitation system efficiency.

The above considerations led a group of European Academic and Research Institutions to develop a web-based open-distance-learning system for specialists in Motor Disability Assessment. This system has been produced in the context of an EU funded project named MODASPECTRA - MOrtor Disability Assessment SPEcialists’ TRaining: a research and technology development project pertaining to the “Telematics Application Programme - Education and Training” sector of the 4th 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 aim of the developed system is to offer European professionals involved in Clinical Movement Analysis both a complete degree and a number of courses, in the perspective of Life-Long Learning (LLL), on clinical applications of Movement Analysis. This will reflect on the employment possibilities of the students.

Purpose of this paper is to provide an overview of the MODASPECTRA system.

Organisation of the Learning Material

Mason proposed a rather simple framework for classifying “the very wide range of exiting online courses” (Mason, 1998). According to such a framework, there exist three basic models:

- Content + Support Model. Here a relatively static body of content (e.g. a web package) provides the core of the course and is supplemented by tutorial support. The level of on-line interaction is low (typically no more than 20% of the students’ time). This model is most akin to traditional teaching and is, currently, the most prevalent in use.
- Wrap-around Model. Here the course materials are wrapped by activities, online discussions etc. Mason refers to this as 50/50 model as online interactions and discussions occupy roughly half of the students’ time, while the predetermined content occupies the other half. In Mason’s words, “this model tends to favour a resource-based approach to learning, giving more freedom and responsibility to the students to interpret the course for themselves. The tutor’s or teacher’s role is also more extensive than that in the first model, because less of the course is pre-determined and more is created each time the course is delivered, through the discussions and activities”.
- Integrated Model. This is a resource-based model where the course is defined by collaborative activities, discussions and joint assignments. The course contents are dynamic and are determined largely by individual needs and group activities. Resources are contributed by participants or tutors as the course develops.

The general pedagogic philosophy followed by MODASPECTRA with respect to the use and development of its Virtual Learning Environment (or Electronic Learning Environment) refers both to the Content + Support Model and to the Wrap-around Model defined in the Mason’s taxonomy. The pedagogic philosophy has been instantiated in the "Toolkit Paradigm" representing the basic model of the knowledge and skills needed to perform effective MDA (MODASPECTRA, 1999). Thus the MODASPECTRA system provides the clinician with a toolkit for movement analysis and clinical measurement. Depending on the problems he/she encounters, he/she chooses the most appropriate tools needed to solve them. The "toolkit paradigm" has profound implications on the content and on the instructional design, as well as on the organisation of the courses within the degree. The content design was intended to provide strategic knowledge and skills aimed at enabling Physiatrists, Physical Therapists and Bioengineers to apply Movement Analysis methods and tools in the clinical processes of patient assessment, treatment monitoring and communication. This led to classify the courses as Homogenisation Courses (HC) and Common Courses (CC). 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. Common Courses are more specialistic and cover four main areas: Fundamentals of Measurement, Application of Measurement, Fundamentals of Movement, and Telematics.

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

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

Table 1. Common Courses of the MODASPECTRA degree

Career	Homogenisation Courses
Medical Doctors Physical Therapists	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. Homogenisation Courses of the MODASPECTRA degree

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

According to emerging standards (CEN/ISSS, 2000) the organisation of content within a learning technology system may be described using four levels, as shown in table 3.

Level 0 <i>Atoms</i>	Atoms representing raw media data, e.g. text, video, audio or images.
Level 1 <i>Content Units</i>	Self contained learning resources not sensibly divisible.
Level 2 <i>Composite Units</i>	Groupings of content units augmented with uniform navigation aids within the Learning Technology System
Level 3 <i>Courses</i>	They are the largest level of granularity and represent composite learning experiences with a wider temporal horizon often connected with accreditation.

Table 3. Organisation of learning material as proposed by CEN/ISSS

Thus, courses can be decomposed in different ways depending on the minimum level of granularity adopted. The minimum level of granularity selected for the content of the MODASPECTRA material is the content unit. 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.

Composite units are the means to group content units together by 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 to allow the use of a content unit in more than one arrangement on the other side. 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 (CEN/ISSS, 2000).

The workload of each course, composed by an average of ten composite units, is subdivided in 20 hours of direct exposure to the system and in 80 hours of homework.

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.

Links to other courses are indicated in an explicit manner even if no direct access is allowed, according to the administrative and economic requirements.

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 involving a 200-250 hours was considered for the final dissertation needed to obtain the award granted by the degree. The number of credits for each course has been defined according to the European Credit Transfer System (ECTS, 1998). Thus, the MODASPECTRA degree constitutes a workload and provides a number of credits corresponding to a post-degree master course in the context of ECTS.

Instructional design

According to Norman (1993), learning occurs through the phases of Accretion, Tuning, and Restructuring.

In accretion, learning takes place by means of accumulation of new information. Real world situations are evaluated, matched with some appropriate set of schemata, representations for the current situation are formed and the newly acquired knowledge is stored into long-term memory. The newly created schema of knowledge is an instantiation of the previously existing one, changed only in the values of the variables that are stored in the schema (the relationships between such variables still holding the same).

In tuning, learning occurs when an existing schema is served as the base for the development of new ones by minor changes. This mode of learning is restricted to the cases where the basic relational structure of the schema remains unchanged. Through practice or consistent use of schemata, they are tuned or finely adjusted to meet specific task demands or adapted to particular knowledge domains or contexts. However, if the only learning processes were memory accretion and tuning, one could never increase the number of conceptual categories over those initially given. Thus, it is essential that new schemata be created.

In restructuring, learning occurs when existing memory structures (networks of schemata) are not adequate to account for new knowledge and new structures are created. New structures are generated either by creating new schemata specifically designed for the troublesome information or by modifying (tuning) old ones.

These phases correspond, on the whole, to the three phases of Conceptualisation, Construction and Dialogue of the Open University Model; in particular Accretion corresponds to Conceptualisation, Tuning together with self-assessment and homework corresponds to Construction, and Restructuring corresponds to Discussion.

The learning objectives that ensure a direct matching with each of the learning phases discussed above are static knowledge, skills and strategic knowledge. Concepts, facts, principles and relations are usually labelled as static knowledge. According to Ryle (1949) static knowledge is knowing that something exists. There is little, if any, understanding associated with static knowledge. Knowing how to apply the static knowledge is generally named "skill". Many researchers use this term as a synonym for procedural knowledge. As opposed to knowing "what", procedural knowledge is knowing "how". Finally strategic knowledge consists of the knowledge of learning strategies and activities to invoke in order to perform a task. Thus, strategic knowledge is the knowledge needed to apply concepts, facts, principles, relations and skills and to reason and elaborate on the knowledge involved. (Jonassen, 2000).

Table 4 lists the learning objectives of the Common Courses.

Course	Learning objective
Telematics	Static knowledge: Basic and generic concepts of the technology Strategic knowledge: The recent applications of telematics in rehabilitation of motor disability. The (potential) role of movement analysis techniques. The relevant Internet resources that the student can keep up with current developments. Skills needed by the student to remain up-to-date. To assess "quality" and reliability of Internet information.
Fundamentals of normal and pathological movement	Strategic knowledge: obtain necessary generic and specific knowledge of normal movement process to understand applications of clinical movement analysis that are presented in the degree. Skills: Ability to recognise different types of pathology.
Instrumented measurement for clinical movement analysis	Strategic knowledge: Introduction to movement analysis tools that are needed in the protocols in the course "Clinical applications of clinical movement analysis". Principles of measurement and data reduction. Ability to use the tools independently. Awareness of "golden cases" measurement results. Sources of error and artefacts. Validity and reliability. To tap Internet resources where methodological properties of these measurement tools are being discussed.
Clinical measurement for clinical movement analysis	Strategic knowledge: Introduction to some of the reliable measurement techniques, which are available to assess outcome following contact with health service.
Clinical applications of clinical movement analysis	Strategic knowledge: To be able to relate tools of the toolkit in clinical movement analysis. Discriminate between different aspects of described protocols.

Table 4. Learning objectives of the Common Courses

Accretion allows creating static knowledge that can be accumulated via learning by being told. Tuning allows creating skills and occurs via learning by doing, while Restructuring, that fosters the creation of strategic knowledge, can be obtained by learning via communication.

Learning by being told can be obtained via expository text, graphics and video-material; learning by doing can be obtained through self-assessment, homework assignments and exercises; and learning by communicating with the tutors and the other students occurs by means of discussion groups, groupwork and collaborative assignment.

Traditional university teaching methods have been followed, at a first glance, with respect to the information content of the largest part of the courses. Innovation relies mainly in the training part of the courses where "learning by doing" has been largely substituted by "learning by seeing and remotely doing" under the direction of experienced professionals discussing in a remote site a number of real cases and working situations. The consequences of using telematics tools on the information content and on the way of delivery of the different modules will thus be explored.

In principle every Composite Unit refers to all the three phases and types of learning products established: static knowledge, skills and strategic knowledge. This means that the Composite Units not only consist of the expository texts, but also consist of the exercises (tuning phase) the students have to perform outside the system environment as well as the on-line discussions that are to take place in the restructuring phase.

The level of content of each Composite Unit has been defined according to the Bloom's taxonomy (Bloom, 1956). For the Composite Units belonging to the Common Courses the level of content was deemed to be "evaluation" (i.e. the learner should be able to make judgements about the value of material or methods for a given purpose). On the other hand, the "synthesis" level (i.e.; the learner should be able to put together elements or parts to form a whole) was deemed quite universally appropriate for the Composite Units belonging to the Homogenisation Courses except for those involving basic skills learning where the "evaluation" level was assigned.

At the Content Unit level, not necessarily every phase is addressed: thus, it may solely aim at the transfer of static knowledge. Each Composite Unit has been designed keeping in mind the following distribution of workload: no less than two hours should be spent on line, in activities of Accretion and Restructuring (half an hour is for Accretion). In such a context the simplicity of the language and the effectiveness in exploiting the multimedia potential is essential. Residual time must be spent on tuning activities. Self-Assessment must be accomplished during this slice of time too. Self assessment and feedback are meant to be done via tests to be answered on line, via homework composed by practice and/or exercises according to the topics discussed by each Composite Unit and via communication with the teacher through managed discussion lists. For such a purpose the teacher will extract from the learning material a certain number of key topics organised in "Questions of the week" and will ask the students to discuss them within a prescribed time interval.

The interaction of the teacher with the students is pursued through personal questions & answers via e-mail, by discussion lists and via videoconferences at agreed meeting times. Furthermore, a directory of experts that may be consulted by the student with a pre-set schedule of availability has been defined. This provides the learners with the unique opportunity of exploiting the advice of leading experts "everywhere" resident. It has to be underlined that without a web-based approach such experts would be either inaccessible or reachable by travelling to their premises at unaffordable time and money costs.

It is worth mentioning that according to the particular nature of strategic knowledge and skills to be learnt in the degree, practice and exercises have been mostly planned and organised according to a minimum threshold criterion. Thus, for instance, there is a general agreement on the impossibility of learning how to administer the whole "Fugl Mayer" test for Stroke Assessment by learning how to apply its individual parts. On the contrary, the learner must gain ability in administering the whole test at an acceptable level of correctness or fails in learning it.

Remedial teaching has been planned at the level of Content Unit. At this point, remedial teaching occurs mainly through both repetition of specific parts of the learning material and interaction with the tutor. This is a rather primitive way of providing remedial teaching. It is meant to be updated as the experience of the authors in the distance learning field increases, during the operation phase of the project.

Table 5 summarises the instructional tasks associated to the Composite Units of each Course and to the Content Units of each Composite Unit.

Label	Value	Data Type	Multiplicity
Learning objective in terms of	Static knowledge	Controlled vocabulary	1 of the three values is allowed
	Skills		
	Strategic knowledge		
Level of content	Bloom's taxonomy	Predefined Labels	1 of the 6 levels is allowed
Pedagogic approach	Expository text, graphics, video (accretion)	Controlled vocabulary	1 or more values may be used for this slot
	Practice, homework, exercise (tuning)		
	Discussion, group work, collaborative assignments (restructuring)		
Self-assessment & feedback	Open questions	Controlled vocabulary	1 or more values may be used for this slot
	Yes-no questions		
	Multiple choice questions, etc (quizzes)		
	Practice, Homework, Exercises		
Remedial teaching	Interaction with tutor (discussion, groupwork, collaborative assignments)	Controlled vocabulary	1 or more values may be used for this slot
	Reference to existing learning material		
	Interaction with tutor	Free format	

Table 5. Instructional tasks of a Content Unit

The Knowledge Pool of MODASPECTRA

Metadata is the key to resource discovery, to effective use of resources and to interoperability across protocol domains. According to the IEEE Learning Technology Standards Committee (IEEE-LOM, 1999), metadata is information about an object, be it physical or digital. In the case of MODASPECTRA the object is a Learning Resource. Thus, metadata contain all the instructional characters of every content unit, composite unit and course along with the complete information on their physical location. The structure of Metadata has been chosen coincident with that proposed by IEEE. It should be noted that other standardisation initiatives are converging on it as for instance the recent developments in ARIADNE (<http://www.ariadne-eu.org>) and PROMETEUS activities (<http://www.prometeus.org/>). Table 6 lists a short fragment of the metadata associated to a Content Unit of the Course "Fundamentals of Measurement and Signal processing".

Nr	Name (LOM)	Value	Comments
	Identifier:	Moda_H3	
	Title:	Fundamentals of Measurement and Signal processing	
	CatalogEntry		
	Language	En	
	Description	To learn why and how measurements of physical quantities should be done and how measures should be handled to obtain the desired information. Special attention is paid to examples relative to the assessment of the present motor function of a person under examination.	
	Keywords	measure measurement pre-processing processing incertitude signal estimation	
	Coverage	20 th Century	
	Structure	8	8=branched
	Aggregation	3	3=course

Table 6. Metadata of a MODASPECTRA course (fragment)

According to IMS (2001), “digital repositories may hold actual assets or the metadata that describe assets – although, strictly speaking, metadata can be viewed as an asset particularly as new value chains are developed in the information economy”. In our design approach, assets are represented by Physical Content Units that are stored in a repository whose location is addressed by the Metadata. A content unit augmented with metadata and with the set of related documents as quizzes, remedial teaching and glossary constitutes the Physical Content Unit (PCU). It is worth mentioning that in coherence with the already discussed requirements for the authors, the self-evaluation active documents relative to each content unit are integral part of it, together with the keyword glossary. Because of the chosen level of granularity and of the design of the content units, the Metadata database represents the Knowledge Pool (KP) of the MODASPECTRA system. In fact the description of the content units contained in its Metadata covers all its instructional characters and provides the complete localisation information. Therefore the content units can be downloaded and exploited by every body authorised to do it. The metadata database is easily accessible by the different potential users in the way corresponding to the privileges they have. Users of the KP are Authors, Editors, Editor in chief and Administrator.

The KP server has been implemented separated by the delivery server, and will be mirrored in different physical locations if useful and appropriate in the operative phase of the project. The access to the KP is provided through a suitable “middle layer” providing both the appropriate view to each class of its users and the highest possible level of automatic completion of the metadata.

The "middle-layer" between the WebCT interface and the KP is the only software produced by the project. It constitutes the glue, assembling the previous heterogeneous environments in a running system able to fulfil the requirements of a usable instructional system (fig. 1).

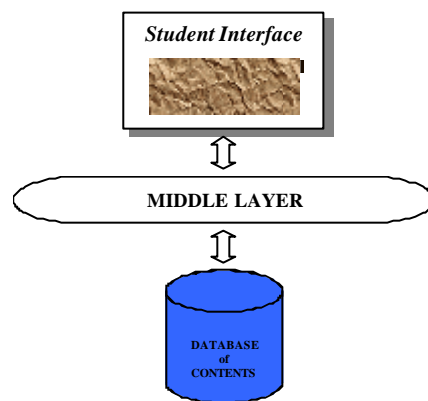


Figure 1. Architecture of the Middle-layer

The middle layer is composed by the following main components:

1. A GUI providing differentiated Internet access to the metadata database.
2. A tool for the automatic insertion of metadata in the relative database directly from MS-Word files. This is a utility developed to avoid duplication while producing metadata.
3. A tool for the automatic integration of the learning material in the delivery environment.

The functions of the "middle-layer" are:

- Automatic management of content units stored in the database and of their integration in the student interface (WebCT).
- Dynamic creation of links to automatically selected content units. Thus, a user can make queries to the database on specific topics, and the system allows him/her to find and/or visualise the proper content units among the whole set of contents, i.e. pertaining to all the modules of the MODASPECTRA course. To this purpose Metadata are essential.

The interface used to manage the metadata database is web-based, so users can access their data using a normal browser and connecting to “MODASPECTRA: Metadata Management” site. A user has to log into the system with his password and then is allowed to perform the tasks of inserting, modifying and viewing Metadata.

For the development of the interface the following technologies have been used:

- on server side Java servlets and JSP (Java Server Pages), which guarantee portability among different platforms.
- on client side XML (eXtensible Markup Language) is used for the visualisation of data. XML requires on client side the Internet Explorer 5 browser, which provides a native parser for viewing data.

The Metadata database has been made easily accessible to the different potential users according to their privileges. This has been joined with the possibility of adding new PCU (storing the metadata into their database, and the actual multimedia learning material into the repository) built either starting from scratch or by modifying already existing material. In particular, it has to be noticed that the contents have been constructed by authors seldom able to master sophisticated authoring tools, yet having the need of directly constructing the whole multimedia material. This is due to the interdisciplinary nature of the material involving a strict interdependence between text and visual contents (pictures, animations, movies, and videos with and without voice comment). This reflects on the need that authors manage not only the expositive material but also the on-line self-assessment tools (quizzes). Moreover, the fragmented nature of most of the domain knowledge is presumed to imply frequent maintenance (meant as limited and partial updating) of the contents. Finally, the iterative approach strictly followed in the operation of the project enhanced this latter requirement according to the feedback provided by the people reviewing, verifying and validating the Demonstrator.

All the above converged in suggesting to use Metadata not only as the appropriate indexing tool, but also as a tool for driving the design and implementation of the MODASPECTRA Contents.

As far as the development environment is concerned, it is universally agreed that no constraints should be placed on it in order to guarantee a real openness of the Learning Technology System. This specification has been strictly respected in MODASPECTRA, so that the authors had no specification on the authoring tools to use. This had the limiting side-effect that most of the material developed is not particularly sophisticated from the point of view of its attractiveness, but eliminated any kind of organisation and economic constraint for the authors (appointment of MM professional developers, purchase of smart authoring tools).

Content Delivery and procedures for Content Creation and Administration

The delivery of the material is web-based, except for the final examination that will be performed via face-to-face interaction with the people in charge of the examination, according to the regulations to be followed for satisfying the requirements for accreditation and the National legislation.

The delivery environment is WebCT (WebCT, 1999). This choice has been based on the technical and managerial motivations performed by the Centre for Curriculum, Transfer and Technology (<http://www.c2t2.ca>). In synthesis the technical arguments supporting the choice of WebCT are: the environment has all the relevant features needed for the delivery of the MODASPECTRA material, it is extensively tested according to its large adoption, has a good level of reliability and it is friendly and easy to use. The managerial arguments have been particularly important in such a choice. First of all it appeared not appropriate to design and implement a specific delivery environment in the case of MODASPECTRA. In fact it was a two years project focussed on producing quality learning material in a domain having multi-disciplinary requirements and a rather fragmented knowledge available. The main scientific objective was to produce "quality teaching" in the domain. The target of not wasting resources could have been nullified by the choice of a commercial delivery environment if the costs for obtaining the licenses had been high. In the case of WebCT the costs are linked to the number of actually enrolled students: this means that the whole prototyping operation of the project has been free of costs. The architecture adopted is shown in figure 2.

The WebCT interface is used by the students for the visualisation of the content units and by back-office operations for managing the student career information. Three main classes of procedures have been defined and followed in the implementation of the system: authoring procedures, dealing with Content Creation and Learning Material construction; teaching procedures, to guarantee proper monitoring and support/assistance to the learning process; and didactic/administrative procedures. Every procedure is meant to be implemented by one or more actors, whose operation is placed in a proper organisation framework, as shown in figure 3.

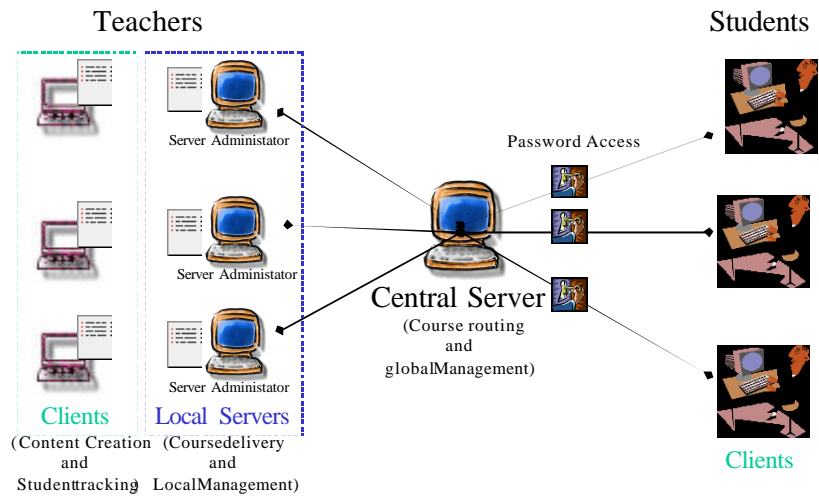


Figure 2. Architecture of the MODASPECTRA System

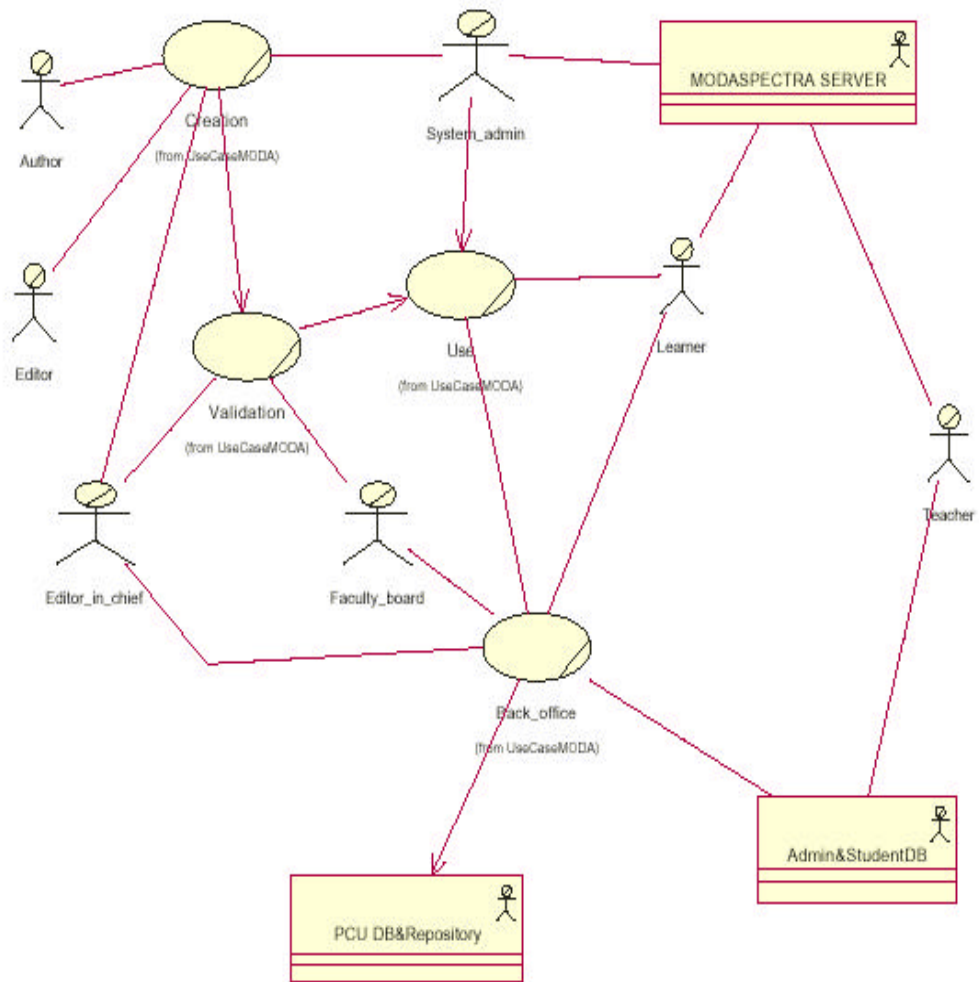


Figure 3. UML model of MODASPECTRA scenario

Authoring procedures

Editor procedure

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.

Author procedure

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 Composite Units and of the Content Units is in charge of the Authors. They have to be coherent with the learning objective of the Course as defined by the Editor.

Teaching procedures

Discussion management

The teacher/tutor activates specific discussion lists (bulletin board) in order to allow discussion with the students on particular topics ("Questions of the week"). The discussion lists are open for contributions during a limited time interval. The teacher interacts with the students at a predefined frequency by answering their questions and/or by suggesting some correction on the discussion items. The schedule of the discussions can be communicated to the students by means of the "Calendar of Course Events" provided by WebCT. At the end of the period the teacher summarises the results of the discussion and includes the summary in an addendum to be used at a suitable time for upgrading the learning material.

Personal communication between teachers and students is performed using the internal e-mail system. Both the discussion tools used in the Restructuring phase of learning provide to the student with a significant feedback on the learned concepts.

Assessment and assessment policy

The assessment occurs by means of a discussion with the teacher performed face-to-face or by videoconference. In this latter case the presence of the tutor at the student site is needed in order to guarantee the transparency of the assessment. The assessment policy foresees the verification of the achievement of the learning objective at the desired level of competence.

In the perspective of the whole degree attended by the student, a final dissertation has to be produced in order to demonstrate the capability to face a specific MDA issue at the evaluation level of Bloom's taxonomy. Students should also be able to demonstrate the awareness of the multi-disciplinary character of MDA.

Tutoring procedure

Tutors have the responsibility of the effectiveness of the learning path of a set of students. They are committed in monitoring such paths and assisting the students in overcoming educational and/or technical difficulties. The tutors interact with the students face-to-face, by e-mail and by videoconference.

Didactic/administrative procedures

Students enrollment

Students intending to enroll either to the whole degree or to the course(s) in a LLL perspective, have to contact the Back Office via Web and provide their curriculum vitae. A section containing explanatory pages and a form, compliant with the administrative office specifications, to be filled up on-line by the applicant learner has been included into the MODASPECTRA server. The form will be submitted, resent to the applicant for verification, modified if needed and finally confirmed. At this point the learner will be inserted in a student database and will be recognised by the administrative office and by the teacher. Once the enrolment has been confirmed, the learner will be allowed to interact with the teacher for performing the entry test and for receiving the assignment of Composite Units corresponding to his/her entry level. This initial phase will be done in two steps. During the former the teacher will invite by e-mail the learner to enter the entry-level test; during the latter the interactions among student and teacher will occur within the delivery environment, using its own facilities.

Faculty operation

The Faculty states the award policies both from the didactic and managerial point of view. It appoints the Editor-in-chief and provides her with the specifications for the quality of the Courses/Composite Units. On the basis of the results of the validation provided by the Editor-in-chief, the Faculty authorises the activation of the Courses. The Faculty appoints the Editors, the Teachers and the Tutors, too.

Back Office Operation

Among the operations performed by the Back-Office it is worth mentioning: a) the communication of the appointments to the Editors, to the Teachers and to the Tutors; b) the processing of the registration requests from the learners and the evaluation of the adequacy of the curriculum for the requested courses; c) the communication of the acceptance to the Course(s) and of their plan and scheduling to the learners, and the verification of the payment of the fees. Furthermore, the Back-Office is in charge of communicating the list of the Students attending a Course to the Teachers/Tutors and of managing the storage of the final results attained by the students.

Quality Assurance procedures

This section discusses the quality assurance procedures enacted with respect to the following main issues: Quality of contents and Quality Assurance (QA) of the Internet based implementation. The main mechanism in assuring quality of the contents is independent peer review. For each module one domain expert has been appointed among the scientific community on the basis of his/her recognised competence and interdisciplinary work experience. The editors of the individual modules processed the comments and recommendations related to the course content. It was the responsibility of these editors to find the most appropriate measures for modifying the course content according to these comments. The procedure for updating the contents implies also the traceability of the various successive versions by means of the explicit indication of the version in the Metadata.

The consortium has chosen an iterative approach in the development of the MODASPECTRA degree. Thus, development was obtained through a continuous cycle of specifying improvements over the successive editions of the degree, making the appropriate changes to courseware, and evaluating the improved material. Good contacts with the scientific and user communities were crucial. An evaluation system has been implemented using selected questionnaires and structured interviews that provided feedback from the users that allowed improvement of the degree. This feedback has been obtained from students, but also from the professional organisations interested in using the degree to fulfil their educational role. In particular the ENPHE (European Network for Physical Therapist Education) and INAIL (Italian National Institute for Insurance against Job related accidents and vocational diseases) must be cited.

A second goal in this iterative development was to keep track of the scientific and clinical state of the art. A considerable ongoing research and development activity both in the technical and clinical areas is available worldwide. To insure quality of content, it is important that the consortium is continuously aware of new

relevant developments that could have implications for the degree. To achieve this result, the consortium planned to discuss frequently the learning material with members of the scientific community in the application area.

Authorisation to release the learning material

The quality of the procedure for the authorisation to release the learning material 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 email. The trace mechanism is based on the daily back up of the incoming messages. Possible improvements of the communication traceability depend by the specific implementation needed by the Faculty that will exploit the results of the project.

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 those defined by such Institutions. Consequently, no Quality Assurance specifications have been defined in this respect. Moreover, an Academic Board has been constituted within the Project to face such an issue and to monitor the processes of the project in this respect.

Presently, MODASPECTRA has received the approval from University College Dublin to offer the course “Clinical measurement for clinical movement analysis” as a distance learning certificate course starting from the coming academic year. The Course has been renamed as “Outcome Assessment in Motor Disability”. Directed mainly at physiotherapists throughout Ireland and Europe the course consists of standardised and validated measures to be used before and after treatment to evaluate the effectiveness of the intervention. It could also be relevant to the practice of other health professionals.

Quality assurance of the Web based implementation

As a general reference, the quality assurance procedures for software development have been based on the relevant IEEE standards (IEEE, 1997). The policy of the project with respect to web-based software implementation (computer programs, procedures, information, data, and records) has been to satisfy quality requirements suitable for the establishment of a running LLL system at the completion of the project. In particular the prototype of the MODASPECTRA degree has been devised paying attention to the key-elements of the quality plan: quality of the software tools and of their documentation, of the security services and of the security networks.

The software quality characteristics to be attained are Functionality, Reliability, Usability, Efficiency, Maintainability and Portability, as defined by the ISO/IEC 9126 (ISO-9126, 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 - QQuality in INformation Technology model (van Zeist et al., 1996) has been adopted for the software development process. The quality of documentation is based on the application of ISO-9001 (ISO-9001, 1994). It has been assured by the supervision of the responsible of each work package and by the peer review process of the project's deliverables.

Security issues and services

The problem of security has been faced taking into account the indications provided by the Information Technology Security Evaluation Criteria (ITSEC, 2001), 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”.

The Security aspects implemented 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. Furthermore, the access control policy assures also the confidentiality of the system with respect to the protection of the information relative to the students enrolled. Another 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 very last version of the demonstrator when the enrolment procedures will be completely implemented.

The two main issues to be considered at the networking level are the protection of the integrity of the data stored in the 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 protection 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 spoofing and denial of service attacks are not possible.

Final Remarks

MODASPECTRA was a European project aimed at teaching and training Motor Disability Assessment to post graduates. The project addresses a domain that can be considered critical for the Quality of Life of the citizens and for the Quality of Health in the near future. The knowledge in the domain is multi-disciplinary and involves static, procedural and a large amount of strategic competence. Moreover, the knowledge is rather fragmented and fully satisfactory instructional designs do not appear to have been already implemented. This implied that the knowledge owners committed to produce the learning material had to manage personally the content creation. Therefore, the technical aspects of production of the learning material had to be prescribed at a basic level, to allow the fulfilment of the instructional design, since the experts in the domain are seldom acquainted with sophisticated authoring tools.

During the validation phase of the project, a number of issues for possible improvements have been pointed out. First of all, the difficulties with the English language evidenced mainly by Italian and French learners suggested to consider the translation of the learning material as a priority for the improvement of the Course. A wider exploitation of the project products calls for the translation in three other European languages: Spanish, Portuguese and Greek. The economic cost of this task will be faced as soon as the exploitation activities will be positively concluded.

A further aspect put into evidence by the verification and validation activities of the project, aimed at assessing the effectiveness of the learning material, was the importance of the communication among learners and tutors/teachers. In fact, contacts between learners and tutors/teachers have appeared of primary importance for the management of the various communication and self-assessment tools as well as for the understanding of the learning material, even if "virtual" or "remote".

MODASPECTRA was perceived by all the evaluators as a very original and attractive educational tool in the MDA domain, for distance learning and especially tailored for LLL, indicating that the main objectives of the project were attained. Nevertheless, it remains to demonstrate that MODASPECTRA is capable of bringing the learners to the level of competence sufficient to master high-tech tools and procedures for MDA.

Improvement of the multimedia character of the courses could be based on the use of virtual reality elements simulating situations that learners could have to face during their activities as MDA specialists. The problems relative to such situations are generally solved adopting solutions at different level of satisfaction. The virtual reality exercise should provide to the learners the evidence of these different levels allowing the improvement of their skills and strategic knowledge. The virtual reality elements should be adopted mainly in the tuning phase of the learning, as part of the homework and self-evaluation, when the static knowledge and skills have been already gained.

One further possible field of improvement implies the modification of the didactic strategy for taking in account the differences among learners. This means personalised pathways among the course material, tailored feedback provided by questions according to performance and active remedial teaching. Possible approaches to provide

such improvements lie in the field of Advanced Training Systems. In this light, the MODASPECTRA project has been involved in a cluster on "Learning Modelling" formed during a Concertation Meeting of current on going EU-funded projects in the Education and Training sector (Proacte, 2000). The purpose of such a cluster was to exchange information and experiences to foster a common approach that will, in turn, contribute toward greater inter-operability and re-usability of technologies. Though the results obtained were very interesting, this activity does not seem to be feasible in the short term.

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