

---

# THE IQTOOL PROJECT: DEVELOPING A QUALITY ASSURANCE TOOL FOR ELEARNING

*Nektarios Moumoutzis, Marios Christoulakis, Polyxeni Arapi, Manolis Mylonakis,  
and Stavros Christodoulakis*

*Technical University of Crete, Laboratory of Distributed Multimedia Information Systems and Applications*

---

## Abstract

In order to establish and maintain the credibility of national educational systems, institutions and programmes in higher education it is necessary to assure the high quality of education provision. Quality Assurance (QA) systems can help us prove that the quality of student learning achieved using eLearning systems is equivalent to face-to-face teaching methods. In this respect, Quality Assurance (QA) systems can provide valuable help. QA systems are designed to improve the quality of an institution's methods educational products and outcomes. In case of eLearning, this includes the production and development of learning material, academic programmes and services. It also includes developing standards of student learning. The good reputation of an institution can be established with a consistent and systematic QA system. This includes the definition of standards about documented procedures, standard ways of responding to issues and clear accountability for outcomes. All these lead to better and more efficient processes, greater public confidence, more satisfied students and employees who feel better and more confident about their jobs. Also students experience improved quality learning, learning material and better interaction with the stuff. This leads to enhanced learning outcomes and to satisfied students who are likely to choose the institution again or recommend it to other students.

The iQTool project (<http://www.iqtool.eu/>) targets VET institutions and professions with the aim to enable them develop a quality culture with respect to the eLearning services they offer. It develops a quality assurance methodology that they can follow to ensure high quality eLearning services and learning material. The methodology is the basis for the development of an open source quality assessment software tool that can be easily integrated with existing open source LMSs in order to facilitate the systematic evaluation of training material with respect to the proposed quality assurance methodology. The tool provides a standards-based approach to the creation of quality control questionnaires, the usage of these questionnaires for the evaluation of the quality of training materials as well as for the statistical processing of evaluation results to facilitate actions for quality improvement. Finally, the project develops appropriate training material to help its target group members learn about the quality assurance methodology used and how to use and take advantage of the software tool.

## Introduction

Quality assurance is a term that describes planned and systematic production processes that can ensure suitability of products for their intended purpose, in other words, to satisfy customer requirements in a systematic and reliable fashion. Although quality assurance cannot absolutely guarantee the quality of the final products, it certainly makes it more likely and this is why it is of high importance in all kinds of production environments. Quality assurance is closely related with quality control, a term that refers to testing and blocking the release of defective or non-quality products. Quality assurance does not eliminate the need for quality control. It rather helps in identifying the critical parameters of product testing as well as to identify important issues for quality improvement. A relevant term is *quality management* signifying methods for the systematic design and development of a product or services following well defined steps in order to ensure the quality. Note that quality management does not only focus on performance and quality of a system but also focuses on the specific means to achieve it and is an umbrella term that incorporates quality control, quality assurance and quality improvement. Learning in general and e-learning in particular can be considered as a special case of production process that needs to embrace quality management methodologies in order to meet the needs of learners. In this respect, learning services and corresponding learning materials can be considered as products and their quality should be systematically ensured and controlled. The institutions that produce and offer e-learning services and content are increasingly aware of this fact as various studies show.

In [EHLERS ET AL., 2005] it is stressed that in Europe, quality is significant in the e-learning context in two distinct perspectives: The first one (termed “quality through e-learning”) refers to the debate and the European policies aiming at increasing the quality of educational opportunities towards a successful shift to the information society. The second perspective (termed “quality for e-learning”) refers to ways of improving the quality of e-learning itself through political measures and specific quality management approaches. The two perspectives are closely related as it is evident that ensuring high quality for e-learning promotes the quality of educational opportunities in general. The study confirms that more quality competence is needed for e-learning in Europe and identifies that there is not sufficient experience in implementing quality strategies in institutions that provide e-learning. The study reveals that only a small percentage of institutions have implemented a quality strategy although quality is considered to have a great importance ('quality gap').

The iQTool project, that is presented in this paper, is a Leonard Da Vinci project that aims at bridging the above mentioned quality gap with respect to vocational education and training by elaborating an appropriate European-wide quality assurance methodology taking into account existing standards and approaches along with the necessary training material and software to apply this methodology efficiently. We will present more details in the rest of this paper that is structured as follows: Section 2 presents the iQTool project and gives its aim. Section 3 presents the functionality of the iQTool Evaluation Component in terms of use cases. This component is the software tool to assess the quality of training materials. It contains as a major subsystem, a repository that stores user profiles, assessment objects conforming to the METS and QTI standards and assessment responses. The high level architecture of the Evaluation Component is described in section 4. Section 5 concludes and presents the directions for future work.

## The iQTool project

The iQTool project (<http://www.iqtool.eu/>) is a 2-years Leonardo Da Vinci project that started on December 2008. The aim of the project is to develop an open source software tool integrated in LMS(s), which is suitable to assess the teaching quality management of eLearning training programs and training materials for supporting the application of the quality measurement tool for institutions dealing with vocational training and which therefore can promote the establishment and development of quality culture. The project implementation integrates testing of software and pilot training of the training material as well. Thus the aim of the project is to elaborate an eLearning quality tool which can be applied at European level and which enables the teaching of quality management. Also, the project aims to provide the management and quality assurance of vocational training with an effective tool.

The innovative aim of the project is to develop a software tool for the evaluation (quality control) of the training materials in LMS on the basis of research work result and quality assurance methodology will be formed in this project. The advantage of the integration of the evaluation system and LMS is that it can store the answers related to the quality simultaneously when the training material pages displayed on the screen. Furthermore, it offers for developers and teachers an opportunity to display statistically the quality control results in the LMS(s) which helps to evaluate them.

The innovative content means development an up-to-date and interactive eLearning tool which helps the quality assurance of eLearning training materials development in vocational training institutions can be carried out. In this context it is of major importance that European VET institutions can enter the competitive education market through a quality approach and guarantee that their eLearning services conform to an explicit quality standard. For academic and administrative staff it will be important to rely upon the quality of the eLearning services proposed by other institutions to validate courses followed there by their own students.

The iQTool consortium consists of the following organizations:

- SZÁMALK Education and Information Technology Ltd (Hungary), Coordinator - <http://www.szamalk.hu>
- TISIP Research Foundation (Norway) - <http://www.tisip.no>
- TUC/MUSIC Laboratory of Distributed Multimedia Information Systems and Applications of the Technical University of Crete (Greece) - <http://www.music.tuc.gr>
- MTA SZTAKI Computer and Automation Research Institute of the Hungarian Academy of Sciences (Hungary) - <http://www.sztaki.hu/elearning>

- F-BB Research Institute for Vocational Training (Germany) - <http://www.f-bb.de>
- CENFIM Vocational Training Centre for Metallurgy and Metalwork Industry (Portugal) - <http://www.cenfim.pt>

## Functionality of the iQTool Evaluation Component

The innovative aim of the iQTool project is to develop a software tool for the evaluation of the training materials in LMSs on the basis of research work results regarding a quality assurance methodology that will be formed in the project. The advantage of the integration of the evaluation system and LMS is that it can store the answers related to the quality simultaneously when the training material pages are displayed on the screen. Furthermore, it offers for developers and teachers an opportunity to display statistically the results in the LMS(s) which helps to evaluate them.

The identified user roles that capture the functionality of the software, which is given in detailed use cases, are the following:

- **Evaluator:** He is responsible for the evaluation of certain training materials. The evaluation is done through appropriate questionnaires that this actor should fill in after reviewing the corresponding training materials. Questionnaires contain questions organized in sections that contain navigation conditions.
- **Quality Assurance Manager:** He is responsible for the creation of questionnaires as well as for the creation of statistical indicators that can be used to process the evaluation results in order to facilitate decisions regarding the improvement of training materials or the training processes. Moreover, he is responsible for creating of 'profile' questions that are a special type of questions to be used to record additional profile information for Evaluators. He is also responsible for the definition of parameters for evaluations (questionnaires to be used, Evaluators to be engaged etc.).
- **Publisher:** He mediates between Quality Assurance Managers and Evaluators. His task is to review questionnaires that have been created by Quality Assurance Managers and publish them. Published questionnaires are then used by the authorized evaluators in order to evaluate the training materials.
- **Administrator:** He is responsible for the administration of the system and is able to import/export user profiles and create new user accounts, remove users and remove data (such as questionnaires and answers) that are not valid.

The following figure presents the UML use case diagram for iQTool Evaluation Component where the functionality that is offered to the various iQTool user roles is given through appropriate use cases.

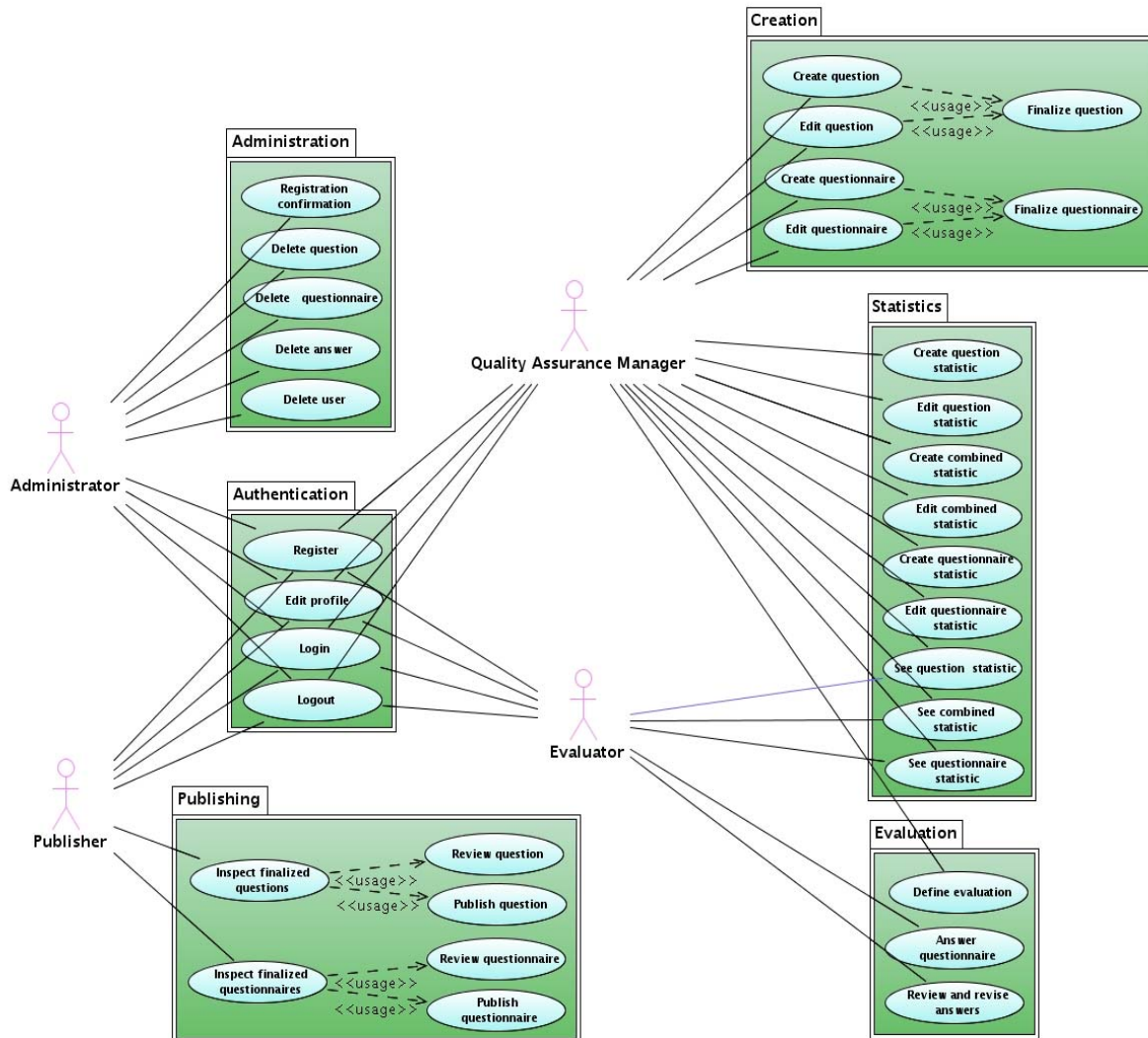


Figure 1 UML use case diagram showing the functionality of the iQTool Evaluation Component.

It is apparent from the previous figure that there is a set of use cases (those in the Authentication package) common to all user roles. These use cases refer to user registration, profile edition, login and logout.

Administrators are associated with administration use cases that refer to user registration confirmation (we assume that after user registration it may be necessary to confirm the creation of a new user account by a human – i.e. the administrator), deletion of non valid questionnaires and questions as well as deletion of user accounts.

Evaluators are associated with use cases that refer to the actual evaluation of the training materials according to the specific questionnaire(s). Evaluators may give answers to questionnaires and also review and revise the answers that they have already given, if this is allowed. They can also see statistical results computed for statistics defined in way that allows their usage from Evaluators.

Quality Assurance Managers are associated with use cases that refer to the creation of questionnaires and to the creation and usage of statistics.

- Creation of questionnaires involves creation of questions, edition of existing questions, finalization of questions (i.e. finishing of question editing and forwarding of questions to publishers for reviewing and publishing), creation of questionnaires by selecting appropriate (published) questions, edition of existing

questionnaires and finalization of questionnaires (i.e. finishing of questionnaire editing and forwarding of questionnaire to publishers for reviewing and publishing). Note that editing can be done only on non-finalized questions and questionnaires.

- Creation of statistics refers to creation and editing of simple statistics that refer to one question, combined statistics that refer to two or more questions (similar to pivot tables used in spreadsheet applications), and summary statistics for whole questionnaires. Usage of statistics refers to the functionality offered to see statistical results computed for statistics defined.
- Definition of evaluation parameters refers to the usage of certain questionnaires to evaluate specific training material from appropriate Evaluators.

Publishers are associated with publishing use cases. They can inspect finalized questions that have not been published yet, review them and publish them so that they can be further used for the creation of questionnaires. They can also inspect finalized questionnaires that have not been published yet, review them and publish them so that they can be further used for the evaluation of training materials by evaluators.

## High level architecture of iQTool Evaluation Component and its integration points with LMSs

The iQTool Evaluation Component, depicted in Figure 2, consists of the following parts:

- The iQTool Evaluation Component Repository offers persistent storage and retrieval capabilities for user profiles, assessment objects (classified in questionnaires and questions), and responses on assessment objects given by Evaluators in the context of quality control procedures. It also offers functionality to define and compute statistical indicators on top of Evaluators' responses that can be used in order to infer quality indicators of the materials that have been evaluated. The Repository and the corresponding services are based on the recommendations of IMS Digital Repositories Interoperability specification [IMS DRI, 2003]. The specific modules of the Evaluation Component Repository are the following:
  - A repository for the management of User Profiles according to the identified user roles (Administrators, Evaluators, Quality Assurance Managers and Publishers) based on an IMS LIP [IMS LIP, 2005] application profile.
  - The core part of the Evaluation Component Repository is the module that handles Assessment Objects. Assessment Objects (AOs) are represented using IMS QTI 2.1 [IMS QTI, 2006] specification and enriched with educational metadata based on LOM standard. The METS digital library standard [METS, 2005] is used in order to integrate IMS QTI descriptions with LOM metadata. Assessment Objects could be simple questions (Assessment Items) or complex questionnaires consisting of Assessment Items (Assessment Tests)<sup>1</sup>. The Assessment Object Repository was developed in the context of the IST LOGOS project (<http://www.logosproject.com>) [LOGOS PROJECT CONSORTIUM, 2008].
  - A User Answers repository based on IMS QTI 2.1 Results Reporting for the storage of the Evaluations answers to the above questionnaires/questions regarding the evaluation of the quality of the resources.
- An Evaluation Component Interface that exploits the Evaluation Component repositories services and implements the use cases for each user role mentioned earlier in this paper capturing the functionality of the software.

The typical architecture of a Learning Management System (LMS) consists of the following parts:

---

<sup>1</sup> Note that although both QTI and LOM adhere to requirements that have been drawn from the eLearning domain, we use them in iQTool to represent questionnaires and questions that are not addressed to learners in the context of a learning process in order to assess the skills/knowledge acquired but to assess the quality of the learning objects. This is possible given the general structure of the corresponding standards. Other approaches for building assessment object repositories to support learning assessments are those reported in [MIAO & KOPER, 2007], [BLAT ET AL., 2007] [COSTAGLIOLA ET AL., 2004], and [MARTINEZ-ORTIZ ET AL., 2006].

- Appropriate repositories and services for the storage of Learner Profiles, learning resources (Learning Objects, Content Aggregations, or complete courses) and their corresponding metadata. In the context of this project it is assumed that a SCORM compliant LMS (ILIAS has been selected in iQTool) is integrated with the Evaluation Component, therefore the following repositories are relevant:
  - A Learner Profile repository based on IMS LIP standard for the storage of Learner Profiles
  - A repository for the storage of learning resources (Learning Objects, Content Aggregations, or complete courses) in the form of IMS manifest files
  - A repository for the storage of learning resources' metadata based on LOM standard

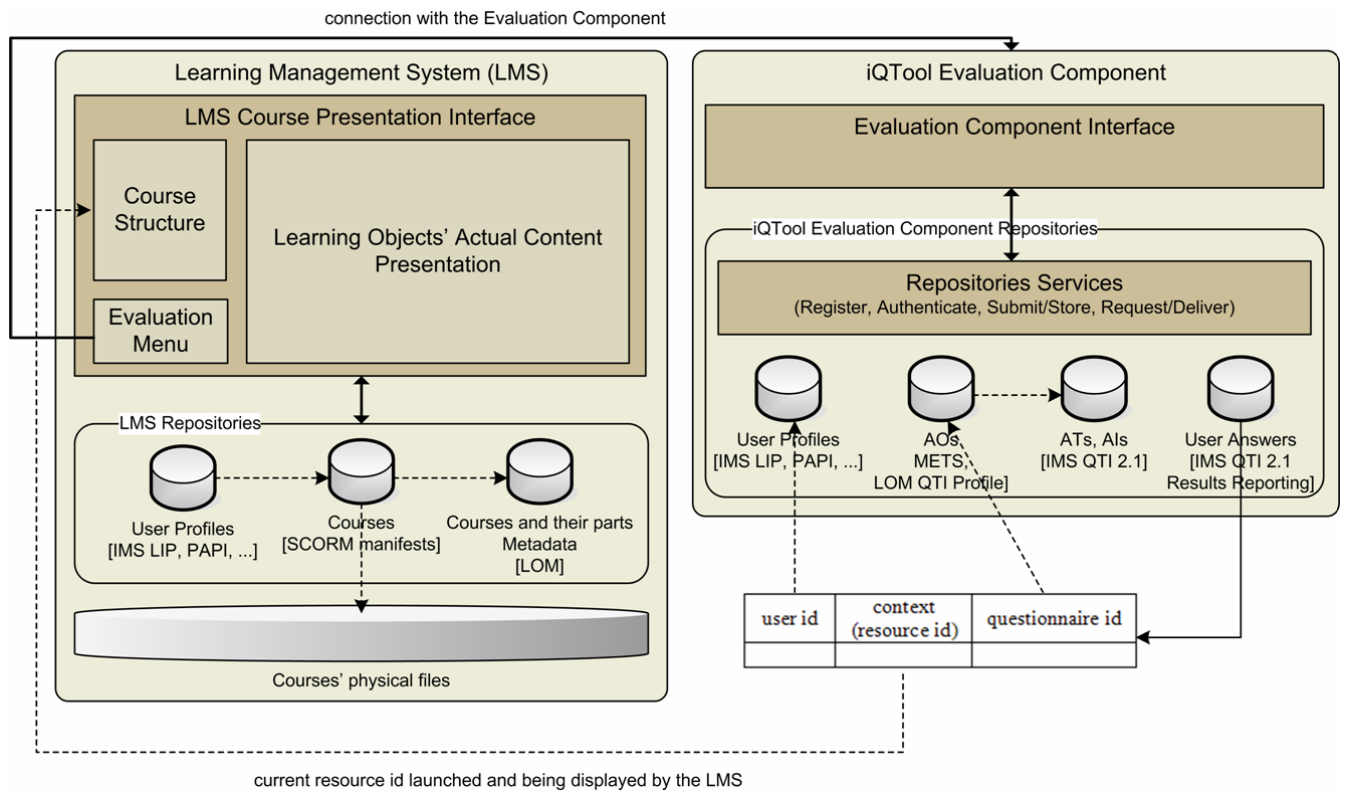


Figure 2 High level architecture of iQTool software.

Through an appropriate plugin the Evaluation Component Interface functions for each user role are integrated in the LMS. The functions related to the Evaluator user role are integrated in the LMS Course Presentation Interface from where the Evaluator is able to evaluate what (s)he actually experiences. This could be a simple learning object, a content aggregation or a complete course while it is being displayed (launched) by the LMS. The Evaluation Component plugin acts as a middleware between the LMS and the Evaluation Component allowing for the retrieval of appropriate questionnaires from the Assessment Objects Repository depending on what type of resource is each time being evaluated (e.g. a learning object, a content aggregation, a complete course) in order for the Evaluator to evaluate the corresponding resource. This is done by calling the appropriate repository service for the retrieval of appropriate questionnaires passing appropriate arguments. The results of each evaluation session are stored in the User Answers repository in the form of an IMS QTI Results Reporting document, along with info about the context of the evaluation formed by the user id, the resource id (the id of the resource in the manifest file) and the id of the questionnaire that has been used to evaluate the current resource. An advantage of the above approach is that the evaluation of the resources can be done simultaneously when the training material pages are displayed on the screen. Through the same plugin the other functions regarding the remaining user roles are also integrated in appropriate places within the LMS' interfaces.

## Conclusions and future work

We have presented in this paper the iQTool project approach for addressing the need for quality assurance in e-Learning. We emphasized on the design of the iQTool Evaluation Component which is an open source software facilitating quality assurance control of learning material. The presented software exploits the availability of open source LMS to provide an integrated environment for the systematic development of quality training materials. It also exploits previous development results from the LOGOS project and in particular a standards-based assessment objects repository based on the METS, QTI and LOM standards.

The iQTool project is currently in its second year of development and the software implementation is finishing while the development of the quality management training material is starting. After the development of the material a pilot phase will be implemented to test the validity of the approach.

## References

1. ARAPI P., MOUMOUTZIS N., MYLONAKIS M., THEODORAKIS G., STYLIANAKIS G. (2007): *Supporting Personalized Learning Experiences within the LOGOS Cross-Media Learning Platform*. Proceedings of the Workshop on Cross-Media and Personalized Learning Applications on top of Digital Libraries (LADL2007) in conj. with ECDL2007 Conference, September 2007, Budapest, Hungary.
2. BLAT, J., NAVARRETE, T., MOGHNIEH, A., BATTLE DELGADO, H. (2007): *A QTI Management System for Service Oriented Architectures*. TenCompetence Open Workshop, Manchester, 11th-12th January 2007
3. COSTAGLIOLA, G.; FERRUCCI, F.; FUCELLA, V.; GIOVIALE, V. (2004): *A Web based tool for assessment and self-assessment*. 2nd International Conference on Information Technology: Research and Education ITRE, 28 June-1 July 2004
4. EHLERS, U., GOERTZ, L., HILDEBRANDT, B., PAWLOWSKI, J.M. (2005): *Quality in E-Learning. Use and Distribution of Quality Approaches in European E-Learning*. A Study of the European Quality Observatory, CEDEFOP, Thessaloniki, 2005.
5. IMS DRI. (2003). IMS Digital Repositories specification V1.0. Available at: <http://www.imsglobal.org/digitalrepositories/>
6. IMS LIP. (2005). IMS Learner Information Package Specification V1.0.1 Available at: <http://www.imsglobal.org/profiles/>
7. IMS QTI. (2006). IMS Question and Test Interoperability Specification V2.1. Available at: <http://www.imsglobal.org/question/>
8. LOGOS PROJECT CONSORTIUM (2008): *D6 – report, Report on work package WP3: LOGOS subsystem for transforming digitised knowledge in courseware objects*. Technical Report, Editors: Moumoutzis N., Arapi P., Stockinger P., 21<sup>st</sup> January 2008.
9. MARTINEZ-ORTIZ, I., MORENO-GER, P., SIERRA, J.L., FERNANDEZ-MANJÓN, B. (2006): *<e-QTI>: a Reusable Assessment Engine*. In Proceedings of 5th International Conference on Web-based Learning, Penang, Malaysia, Lecture Notes in Computer Science, Springer.
10. METS. (2005). Metadata Encoding and Transmission Standard (METS) Official Website. Available at: <http://www.loc.gov/standards/mets/>
11. MIAO, Y. & KOPER, R. (2007): *An Efficient and Flexible Technical Approach to Develop and Deliver Online Peer Assessment*. In proceedings of CSCL 2007 conference, p. 502-511, July 2007.
12. SAMPSON, D., KARAGIANNIDIS, C., CARDINALI, F. (2002): *An Architecture for Web-based e-Learning Promoting Reusable Adaptive Educational e-Content*. Educational Technology & Society 5 (4) 2002, ISSN 1436-4522.