QTI for self-assessment and embedded-assessment in competence oriented scenarios: The Agora Case

Patricia Santos, Wenceslao Llobet, Davinia Hernández-Leo and Josep Blat

Department of ICT, Universitat Pompeu Fabra, Barcelona, Spain

{patricia.santos, wenceslao.llobet01@campus., davinia.hernandez, josep.blat}@upf.edu

Abstract— **This paper describes a computer assisted assessment (CAA) case study within the context of an adult school for lifelong learners. The case study shows how to apply eQuestionnaires in competence oriented scenarios, especially for self-assessment activities (where learners have to know their proficiency level in order to further develop a competence) and for embedded-assessment activities (where an eQuestionnaire is contained in the flow of learning activities and is used to promote formative assessment). The assessment specification IMS Question & Test Interoperability (QTI) v2.1 has been used to create the eQuestionnaires. Thanks to the characteristics of the QTI v2.1 compliant tools used during the experience, a competence oriented assessment scenario has been successfully carried out.**

Index Terms— **Competence, Computer Assisted Assessment, embedded-assessment, eQuestionnaire, feedback, formative assessment, IMS Question & Test Interoperability, self-assessment.**

I. INTRODUCTION

COMPUTER Assisted Assessment (CAA) is based on the use of computers to evaluate the students' learning. In an educational scenario, the most common assessment instrument is an objective test. This type of test basically has a set of questions (multiple choice, multiple responses, true/false…) with a pre-determined correct answer. And these tests offer feedback mechanisms (automatic feedback for each question, and final report results) [1]. This type of eQuestionnaires is very useful when learners want to improve their competences with autonomy (creating their personal competence development plan).

A current research line, in the CAA field, works on the creation of tools compliant with assessment specifications or standards [2]. The IMS consortium [3] has an assessment specification, called IMS Question & Test Interoperability (QTI) [4]. Interoperability specifications, like QTI, are having an ever growing impact on the e-learning community in order to prevent the effect vendor lock-in [1]-[5]. This effect occurs when a system does not follow an interoperable assessment specification. For instance, if a teacher creates 200 questions using an assessment authoring tool, and after some years s/he has to change the system then s/he has to create again all the questions.

The aim of this paper is to describe a case study where QTI v2.1 was used successfully for self-assessment (with diagnostic objectives) and for embedded-assessment activities, in a competence oriented scenario. This scenario was carried out in an adult school in the framework of the TENCompetence project [6]. The requirements of the assessment questionnaires were chosen after some meetings with the experts of the school. In order to create the assessment activities a group of tools compliant with QTI v2.1 were used.

The rest of the paper is organized as follows. Section II describes the educational context and the design process carried out in order to indentify the requirements of the presented case study. Section III highlights the integration of QTI with LD and the role of the newAPIS engine. Section IV exposes the description of the methodology employed for evaluating the case study and for presenting and discussing the main results. Finally, conclusions and future work can be found in Section V.

II. THE PROBLEM OF SELF-ASSESSMENT AND EMBEDDED ASSESSMENT IN THE CONTEXT OF AGORA

A. The Agora educational context

This case study was performed in an adult education school situated in the district "La Verneda- San Martí" [7] of Barcelona, Spain. This school is carried out by an association called Agora which is devoted to support non-formal training using a methodology based on the dialogic learning [8]. The school has an average of 1600 participants, 100 volunteers and

10 staff. Agora offers free-of-charge courses about languages, music, arts and training of information and communication technologies (ICT). The majority of the participants are adults, women and men with an average of 55 years, who did not have access to formal education, immigrants, unemployed, and people with special needs. People who want to acquire new competences for a job, or for their personal learning, in order to promote their social and education inclusion in the society.

This case study is framed in the context of the TENCompetence project. In this project an eLearning environment has been developed with the aim of supporting individual learners, teams and organizations in their pursuit of competence development and competence practice. This is a four-year project in the European Commission's 6th Framework Programme, priority IST/Technology Enhanced Learning. The Agora association has participated in this project, with a pilot. The participants accessed to the TENCompetence tools from March to June of 2009. During these months the learners practiced a set of competences, uploaded by the experts as self-formation activities. The school offered a classroom, the OMNIA computer room (a room with 9 computers and internet access, created with the support of the local government of Catalonia) [9] (see Fig 1). The learners also had the possibility of using their own computers and practice the competences out of the school.

Fig 1.Participants in the OMNIA room using the TENCompetence tools

In the Agora pilot the competences profiles that the learners could practice were: basic and advanced English and training in ICTs. The profiles contained a set of similar competences. Each competence had a large variety of materials and learning activities created by the experts.

In this case study we focus our attention on the design, creation and use of assessment activities in the Agora pilot. A total of 10 self-assessment tests were created for the English competence profile. And 10 self-assessment tests and 4 Units of Learning (UoL) with embedded assessment activities were created for the ICT profile. A number of 97 learners have been registered to do the self-formation activities.

B. The assessment requirements of the Agora pilot

Before starting the experience with the participants of the school, it was first necessary to understand the assessment requirements of the pilot. For this reason some meetings took place between QTI experts (some authors of this paper) and experts from Agora.

The Personal Development Plan (PDP) [10]-[11] was the tool used to manage and practice the competences created by the experts. The participants had to use this tool to create their own personal competence development plans. They had to choose a competence profile (English or ICT) and then select the competences that they wanted to practice. To begin with a competence, the learners had to select their proficiency level. They had to indicate this level in the PDP self-assessment bar. This is a likert scale that enables learners to indicate a proficiency level for each competence. In figure 2 the user was indicating that s/he had a level of 3 out of 8. When an author uploads a competence to the PDP tool, s/he has to assign the required level necessary to acquire the competence. Learners had to achieve the goals of the competence in order to acquire the required level.
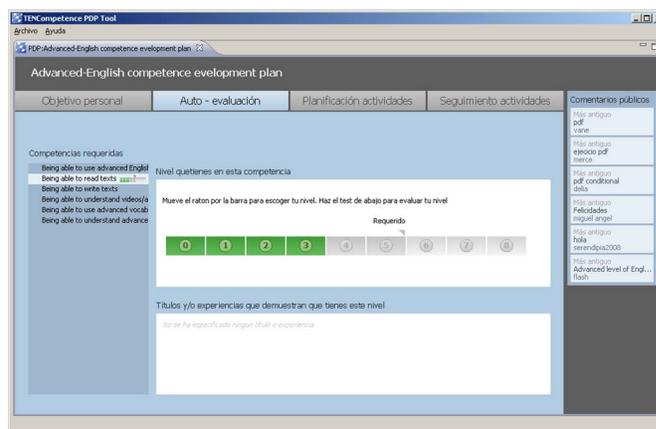

Fig 2. PDP self-assessment proficiency level bar

According with the previously detailed characteristics of the PDP tool, the Agora experts explained that taking into account previous experiences [12], the step of selecting the proficiency level could be a bit confusing for some participants. The learners did not have the self-confidence to know which specific proficiency of level in a competence they had. To solve this problem, the QTI experts proposed to add self-assessment questionnaires. These tests would offer a diagnosis feedback about the learners' proficiency, taking into account their results in the questionnaire. The structure of these QTI questionnaires were: a group of questions (questions to assess knowledge and questions to know if learners had practiced the competence before); a message for each question (modal feedback) which showed a text that explains if the answer was correct or not; a report result with a message (test feedback) suggesting the level of proficiency for this learner (by looking at the final score of the test). The report result also shows: the final grade, number of correct and incorrect responses, number of presented, answered and selected questions and finally the percentage of correct answers.

The Agora experts explained the need of designing embedded-assessment activities where learners had to perform guided activities with a final test. Each competence contained a set of activities; the learner had to practice those in order to acquire the competence. The experts wanted to create guided activities with the following requirements:

(1) The learners should have the possibility to repeat the steps of the activity.

(2) The final step had to be a test.

(3) The learners should have the option of repeating the test ever they wanted.

The QTI experts decided to use UoLs (a combination between IMS LD and QTI) to create these type of embedded activities. In this case a message with the proficiency level was not necessary. But in order to promote formative assessment, the questionnaire had to show a message (taking into account the number of correct answers) suggesting if the learner had to repeat some step of the activity or on the contrary s/he had achieved the expected goals.

Before starting the pilot an experience with participants was performed. A small group of learners, of the school, interacted with the tests, and their suggestion was to add (in the modal feedback) the correct answer when they fail a question. This suggestion was introduced in the following designs of the questionnaires.

III. AN ASSESSMENT ENVIRONMENT WITH QTI V2.1 QUESTIONNAIRES FOR A COMPETENCE ORIENTED SCENARIO

The requirements collected during the meetings were analyzed in order to understand which tools were useful to fit the experts' and participants' needs.

QTI v2.1 has been used to create the assessment activities of this pilot. This specification is based on an assessment pedagogical model defining a group of elements which enables the creation of assessment scenarios using questions, tests and report results. This specification has different versions [13]. The v1.x was the first version published and it offers the possibility of creating tests with a group of questions (with different types of interactions such as: multiple choice, multiple response, slider, fill-in-the-blank…). These questions can be organized in sections, and can be related to feedback mechanisms and scores. After it, IMS published the v2.0 which is focused on simplifying the concept of individual question items, and it increases the interaction possibilities and the processing of questions responses. In this version the format of the specification changes and is based on XHTML. QTI v2.0 also introduces the use of templates (for feedback and hints). An important improvement of this version was the addition of the method which enables the interoperability between QTI and the specification IMS Learning Design (IMS LD) [3]. QTI v2.1 is the latest draft and it is currently under discussion in the IMS QTI community. This version completes the other previous versions (v1.x and v2.0) by adding new elements for grouping items in sections or tests, and creating a new results report. The QTI draft version 2.1 lacks of significant examples and cases of study. For this reason the IMS community is currently discussing the utility of this version. The QTI v2.1 was chosen because its interoperability and the easy management of its elements.

In the framework of the TENCompetence project a set of tools compliant with QTI v2.1 have been developed. The authoring tool ReCourse [14] was used to create UoLs with QTI questionnaires. The QTI v2.1 engine, NewAPIS [15], has been improved taking into account the requirements of this case study, and it was the engine used to interpret and to save the data of the QTI questionnaires. Finally, the TENCompetence LD runtime system [16] was used for visualizing and interacting with the UoLs.

A. Edition of the assessment activities

As we detected in the design process with the Agora experts, the creation of UoLs was selected as the better option to design the embedded-assessment activities. Both specifications use the eXtensible Markup Language (XML) to create the documents which contain the learning and the assessment activities. The QTI questionnaire is added as an assessment activity in the LD structure of activities. This combination is possible thanks to the interoperability of the QTI v2.1.

An analysis of the IMS LD and QTI v2.1 properties was carried out to combine them in a UoL. Once these properties were detected, the ReCourse tool was improved offering the possibility of creating UoLs with QTI embedded-activities automatically.

ReCourse (see Fig 3) has a QTI-editor. This support the creation of seven types of QTI v2.x questions: multiple-choice, multiple-response, yes/no (true/false), likert, open-question (essay), fill-in-the-blank, and online-choice. And also the edition of feedback messages (for some types of questions and for the whole test). The test designer had to introduce the score of each question (for the correct and the incorrect ones). Other requirement of this pilot was to take into account the number of correct responses answered by the learner in order to show a test feedback. For the self-assessment activities were necessary to indicate the level of proficiency of a learner in order they could start with a competence. In the embedded-assessment activities were necessary to show a message indicating if the learner had to repeat the activities of the UoL or on the contrary s/he had the enough level to finish it. Using the QTI-editor the designer of the test had to specify the minimum number of correct responses which were necessary to show a test feedback.
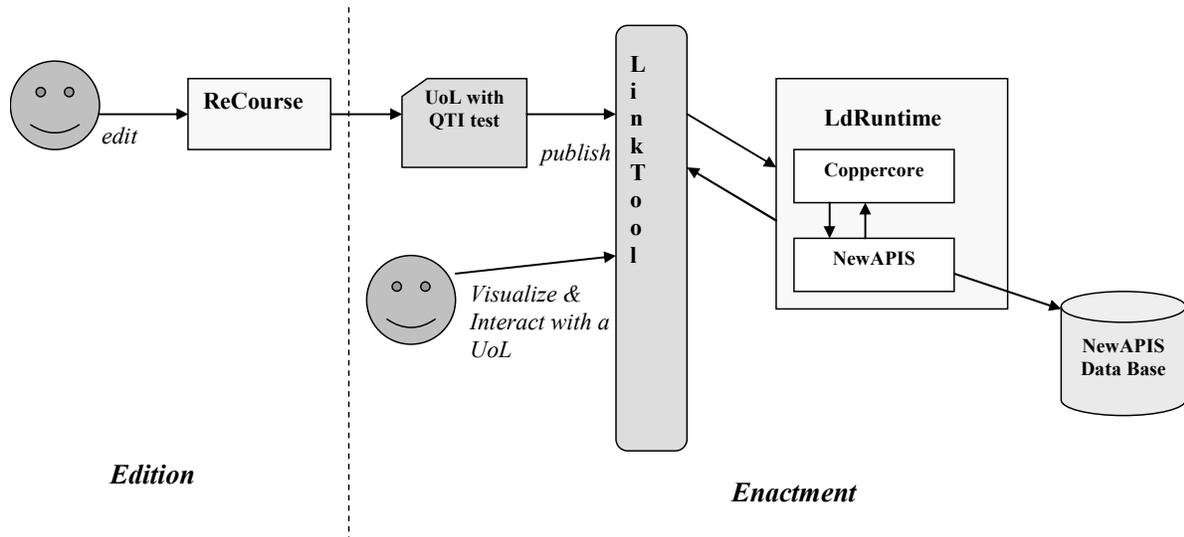
Fig 3. Edition and enactment of QTI assessment activities with QTI v2.1 compliant tools

B. Enactment of the assessment activities

The defined tests and questions created using ReCourse, are translated into the corresponding documents. To interpret the QTI questionnaires an engine is needed. We used the newAPIS engine [15], an engine which interprets the QTI versions 2.0 and 2.1. Taking into account the requirements of the Agora pilot, new issues were added to improve the engine.

The newAPIS engine interprets all the elements defined by the ReCourse QTI editor, this means that newAPIS interpret and renderizes seven different types of QTI questions. Also it computes the answers introduced by learners and shows the modal feedback of each question and computes the final report results of a QTI v2.1 test.

New persistence mechanisms and a data base (DB) were developed to save the data of the users who interacted with the QTI questionnaires. This data was useful to know the results and the progress of the learners and to evaluate the use of the assessment activities in the pilot. Currently, a HSQL database manager is used as a client to check the assessment data contained in the DB (see Fig 4).
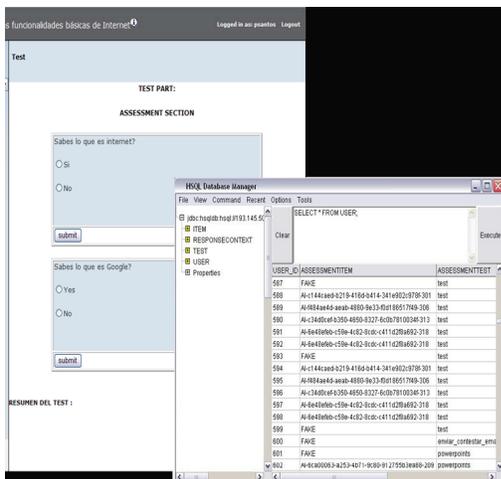

Fig 4. newAPIS persistence, and HSQL database manager

NewAPIS is integrated in the TENCompetence LD toolkit [16]. It is a package which contains the necessary tools to publish, visualize and interact with a UoL. When a UoL is published, the Coppercore IMS LD engine, contained in this package, interprets all the QTI information related to LD activities. When a UoL has a QTI activity test then newAPIS interprets all the information, maintaining a communication with the Coppercore engine (see Fig 3).

The UoLs were published using the LinkTool, also contained in this toolkit. It was used to visualize and interact with the UoLs and the assessment activities contained in them.

NewAPIS sends the information to the LinkTool to renderize the QTI information and enabling the interaction of the QTI questionnaires. A new interaction method was introduced in newAPIS. When users interact with a test, they can answer the questions in the order that they prefer. Once the learner has submitted all the questions of the test, newAPIS computes the answers and shows a test feedback with a report result. This diagnostic test feedback had been previously designed in the QTI editor of ReCourse. For instance, if the number of correct responses of the learner is larger than 0 but less than 2, s/he would visualize the following message: *"We suggest that you have to select the level 1 in the range of competence levels. You have to begin with the activities of this competence which have a level 1"*. Diagnostic feedback is commonly used in formative assessment to notify about the students' learning progress [17]. In the Agora questionnaires, feedback is used to help students to realize what their level of proficiency of a specific competence is.

IV. EVALUATION OF THE ASSESSMENT ACTIVITIES IN THE AGORA PILOT

A. Evaluation methodology

The Agora pilot was a learning experience of three months of duration, where participants had the opportunity of practicing competences to improve their English and/or ICT profile. These participants were adults (the majority older

people but also immigrants or unemployed people) who had the motivation of learning to be more integrated in the current society. Taking into account the range of backgrounds of these participants, the submission of a pre-test and a post-test to collect data about this experience was not enough to understand this case. As we have explained in section II.B it was necessary to maintain a direct contact with the experts and the learners involved in this pilot in order to understand their needs. Before, during and after the duration of this pilot we prepared discussion groups with the people involved in it. The authors of this paper applied an observational method [18] to collect comments, problems and ideas of the participants to design the assessment activities and understand the problems that learners have interacting with them. The performance of discussion groups with experts and learners was very important, especially before the pilot.

We considered various quantitative and qualitative data sources, adopting a mixed evaluation method, along the case study [19]. Quantitative data were collected with closed-questions in the pre-test and post-test (answered before and after the experience). We analyzed these results statistically to detect tendencies in occurrences of facts, possible problematic points, etc. Qualitative data (observations by 3 different researchers, discussion groups and experts' comments before, during and after the experience) served to understand the problematic of the context, to collect ideas to improve the assessment activities and to confirm or reject the tendencies detected in the quantitative analysis.

Thanks to the new persistence methods developed in newAPIS, the data generated when a learner interacts with a QTI questionnaire was saved in a DB. Using a HSQL manager this automatic data could be easily extracted. This has been analyzed in order to collect quantitative data for: verifying the number of people registered to the system, the number of learners in the English profile and in the ICT profile.

Table I summarizes the type of collected data used for designing, creating and analyzing the assessment activities of the Agora pilot.

TABLE 1.
DATA COLLECTED FOR THE ASSESSMENT ACTIVITIES OF THE AGORA PILOT

Data source	Type of data	Labels
Questionnaire	Quantitative and qualitative answers of the learners, before and after interacting with the system.	[pre-test] [post-test]
Discussion groups with participants	Wrotes taken during the discussion with participants	[Discussion participants]
Discussion groups with experts	Wrotes taken during the discussion with experts.	[Discussion experts]
Automatic Data	QTI data saved in the data base of NewAPIS.	[DB data]

B. Results and discussion

The analysis and interpretation of the data collected in the Agora Pilot followed the methodology described above. Table II shows the relation between the type of data source, the support data and the results extracted.

A total of 97 learners interacted with the questionnaires in more than one occasion. The English assessment activities were accomplished by 88 participants, and 27 participants practiced the ICT assessment activities [DB data].

Before starting with the pilot, the participants answered a pre-test [pre-test]. These answers were useful to know the profile of the learners of this pilot (see table II, result 1). The previous educational experiences of the learners was an important data to take into account in the designing the self-formation assessment activities. We had to ensure the autonomy of the user facilitating methods to support a proper working.

Other important step before starting with the pilot was to maintain some discussions with the experts [discussion-experts]. These discussions were necessary to take the requirements for designing the assessment scenario of the Agora pilot [Discussion-experts]. In the design process (explained previously in section II.b), we detected two types of assessment activities: (1) self-assessment and (2) embedded assessment.

Self-assessment activities were created for supporting learners who do not have knowledge of their proficiency level in a competence. Analyzing the comments of the learners after their participation in the pilot [post-test], we detected that this type of activity guided the participants who did not know their proficiency level (table II, result 2).

Experts wanted guided activities with a test. This type of embedded assessment activities was created using the UoL format. The combination between IMS LD and QTI enabled to create activities with steps, the steps could be repeated ever the learner wanted, and a QTI questionnaire was added as an activity. The feedback of this questionnaire was useful for a leaner to know if s/he had to repeat some of the steps (see table II, result 3). In both type of activities QTI questionnaires were used to check the learners' results and give a feedback. When a result of an individual question was checked a modal feedback appeared. This feedback showed the result and grade of the learner, but also the Agora participants indicated that it would be necessary that the feedback would contained the correct answer of the question if they failed it (see table II, result 4).

Finally we indentified that some learners were interested in doing self-assessment questionnaires, before, during and after they were performing a competence. Because then they could check their progress (see table II, result 5).

TABLE II. RESULTS, SUPPORT DATA AND DATA SOURCE COLLECTED IN THE AGORA PILOT

Results	Support data	Data source
1. Participants' background is very diverse but the majority of them have in common that they did not have evidences of their competences or qualification levels, and they are not able to select one.	93 participants of the Agora Pilot answered the Pre-test. The average of the learners was 55 years 36 participants were men and 57 women Primary incomplete (8/93) Primary (16/93) Secondary 1rst stage (8/93) Secondary 2nd stage (20/93) Occupational training course 1rst grade (13/93) Occupational training course 2nd grade (14/93)	[pre-test]
2. Self-assessment questionnaires with a feedback which suggest a proficiency level (taking into account the answers of the student) is a solution to support users who does not have evidences of their competences.	These learners can have difficulties selecting their personal proficiency level in a competence. In previous experiences teachers detects that some learners did not know their personal proficient level. 52/72 students rate the self-assessment test such as very useful or useful to know their proficiency level about a competence. Some of the participants that for some reason they did not perform any self-assessment test they also think that these type of test are useful to improve their learning.	[Discussion-experts] [Post-test]
3. Using a UoL (combining IMS LD activities and QTI questionnaires) the Agora expert can create guided activities, using the test-feedback to promote formative assessment.	Experts want to design guided activities where the participant have the possibility of: (1) Follow a set of steps. (2) Repeat the steps over and over again. (3) One step has to be a questionnaire. The questionnaire has to guide the learner indicating if s/he has to repeat (or not) the activity.	[Discussion-experts]
4. The feedback of each question of a test has to indicate the score of this question but also the correct answer (if the student has failed it).	The self-assessment questionnaires suggest the proficiency level of the participants and for each question shows if the answer of the user is correct or not. Participants want to know the correct answer of a question, to improve their knowledge.	[Discussion-participants]
5. Self-assessment questionnaires were designed to be answered by the students to know their proficiency level to perform a competence. According with the answers of the users, these self-assessment test can be used to evaluate the progress of the students before, during and after they perform the competence.To evaluate if their proficiency level change.	97 participants were registered and used the assessment questionnaires, 88 in the English activities and 29 in the ICT. 72 participants (of the 92 registered) of the Agora Pilot answered the Post-test: 45/72 participants perform self-assessment test in some moment during the pilot. Taking into account the profile of the participants and the fact that the tests were optional, the % of usage is significative. The majority of the participants 29/72 perform de self-assessment test when they had to select the proficiency level Some students 13/72 after they had completed all activities of one competence profiles they would wanted to perform the self-assessment test to know their improvements Only 5/72 perform a self-assessment test When they were half-way working on the activities of one competence profile	[DB data] [Post-test]

V. CONCLUSIONS AND FUTURE WORK

This paper presents a case study that investigates the benefits of using the QTI v2.1 assessment specification with the TENCompetence infrastructure for supporting competence development. We have used tests and tools, compliant with this version of QTI, offering the possibility of designing, creating, visualizing and interacting with assessment activities which support the competence development. The context of the case study was an adult school, a non-formal educational context, where the majority of the learners were older people. Around 100 participants (including Agora experts and learners) used the assessment activities to practice the competences contained in the TENCompetence PDP tool.

The assessment requirements of this context were collected after some discussion groups with the experts and the participants of the school. Two different types of assessment activities were identified: self-assessment and embedded-assessment. For each competence the PDP tool had a likert scale, where learners had to select their proficiency level. The self-assessment tests were created for helping those learners who did not know their proficiency level. These tests were designed to support the learner before they had to practice a competence. But according with the results of the evaluation phase, learners and Agora experts highlighted that these type of questionnaires would be useful before but also during and after practicing a competence. Learners suggested to use this type of questionnaires to know their progress. For helping users to know their progress we plan to improve the DB of newAPIS creating a mechanism for extracting the data contained in it. A possible solution is the creation of a tool which will shows the information of the progress of the learners using their assessment results.

The questionnaires of the two types of assessment activities used a modal feedback for each question. Taking into account the learners' comments, this feedback has to contain: the result of the answer but also the correct answer when the learner fails the question. Adding this information to the modal feedback these tests are promoting a formative assessment and not only a summative assessment. A future work could be to include suggestions in ReCourse, taking into account the different types of feedback in assessment, for guiding teachers in the creation of questionnaires.

We plan to improve the interaction and visualization issues of QTI v2.1 questionnaires, to make the resolution of the tests more fluent. Currently all the questions of a test appear in the same page. The problem becomes if a test has a lot of questions (for instance 40 questions). Future work includes improving the visualization of the questionnaires: with the possibility of choosing the number of questions which will appear in a page and adding the possibility of maintaining the answered questions (up to now, when a user answer a question this question disappears).

Finally, as we mentioned before, the interoperability of the QTI v2.1 is one of the most important characteristics of this version. We want to take advantage of it, and combine QTI with other specifications, languages and systems in order to support the evaluation of competences.

REFERENCES

[1]Bull, J., & McKenna, C. (2004). *Blueprint for computer-assisted assessment* . London: RoutledgeFalmer.

[2]Conole, G., & Warburton, B. (2005). A review of computer-assisted assessment. *ALT-J, 13*(1), 17-31.

[3]IMS. (2003). *IMS learning design specification.* Retrieved 23/06, 2009, from http://www.imsglobal.org/learningdesign/index.html

[4]IMS. (2006). *IMS question & test interoperability specification v2.0/v2.1.* Retrieved 23/06, 2009, from http://www.imsglobal.org/question/index.html

[5]Vogten, H., Martens, H., Nadolski, R., Tattersall, C., van Rosmalen, P., & Koper, R. (2006). CopperCore service integration, integrating IMS learning design and IMS question and test interoperability.

Proceedings of the 6th IEEE International Conference on Advanced Learning Technologies, Kerkrade, The Netherlands. 378-379.

[6]TENCompetence. (2009). *TENCompetence : Building the european network for lifelong competence development.* Retrieved 23/06, 2009, from http://www.tencompetence.org/

[7]edaVerneda. (2009). *La verneda school for adult education.*, Retrieved 23/06, 2009, from http://www.edaverneda.org/

[8]Flecha, R. (2000). *Sharing words: Theory and practice of dialogic learning*. Lanham, M.D. In Rowman & Littlefield (Ed.).

[9]Sánchez-Aroca, M. (1999). La vermeda-sant martí: A school where people dare to dream. *Harvard Educational Review, 69*(3), 320-335.

[10]Martens, H., & Vogten, H. (2008). *TENCompetence personal development planner 0.9.3. TENCompetence software and documentation.* Retrieved 06/17, 2009, from http://dspace.ou.nl/dspace/handle/1820/1545

[11]Koper, R., & Specht, M. (2006). Ten-competence: Life-long competence development and learning. In M-A. Cicilia (Ed.) (Ed.), (pp. 234-252) Hershey: IGI-Global.

[12]Louys, A., Hernández-Leo, D., Schoonenboom, J., Lemmers, R., & Pérez-Sanagustín, M. (in press). Self-development of competences for social inclusion using the TENCompetence Infrastructure**.** *Journal Educational Technology & Society,*

[13]Batlle, H., Navarrete, T., & Blat, J. (2007). *Defining new forms of eAssesment.* Unpublished Master Thesis, University Pompeu Fabra,

[14]ReCourse. (2009). *ReCourse: LdAuthor.* Retrieved 23/06, 2009, from http://www.tencompetence.org/ldauthor/

[15]Blat, J., Navarrete, T., Mognieh, A., & Batlle, H. (2007). *A QTI management system for service oriented architectures.* Paper presented at the *Proceedings of the TENCompetence Open Workshop on Service Oriented Approaches and Lifelong Competence Development Infrastructures,* Manchester. 175-181.

[16]CCRT 3.3. (2009). *TENCompetence learning design runtime update: CCRT 3.3.* Retrieved 06/17, 2009, from http://hdl.handle.net/1820/1778

[17] Green, S., Nacheva-Skopalik, L. & Pearson, E. (2008). *An adaptable personal learning environment for e-Learning and e-Assessment.* Proceedings of the 9th International Conference on Computer Systems and Technologies and Workshop for PhD Students in Computing. Gabrovo, Bulgaria.

[18]Zelkowitz, M. V., & Wallace, D. R. (1998). *Experimental models for validating technology. IEEE Computer, 31*(5), 23-31.

[19]Martinez, A., Dimitriadis, Y., Rubia, B., Gomez, E., & de la Fuente, P. (2003). Combining qualitative evaluation and social network analysis for the study of classroom social interactions. *41*(4), 353-368.

P. Santos received an Engineering degree in Computer Science from UPF (2007) and has a master degree in Technologies of Information and Communication (2008) at Universitat Pompeu Fabra (UPF).Since 2007, Patricia has been collaborating in the GTI research group (Interactive Technologies Group, UPF) where she is currently doing her PhD. Patricia's research interests are mainly focused on technologies to enhance education, especially for eAssessment (IMS Learning Design and IMS Question & Test Interoperability). (e-mail: patricia.santos@upf.edu).

W. LLobet received an Engineering degree in Computer Science from UPF (2009). Since 2008, he has been collaborating in the GTI research group (Interactive Technologies Group, UPF) as a programmer. His research interests are mainly focused on technologies to enhance education, especially IMS Question & Test Interoperability v2.1. (e-mail: wenceslao.llobet01@campus.upf.edu).

D. Hernández-Leo received the M.S. (2003) and the PhD. degrees in telecommunications engineering (2007) from University of Valladolid. She is currently a lecturer at the Department of Information and Communications Technologies of Pompeu Fabra University and member of the GTI research group. Her main research interests are Educational Telematics, Computer Supported Collaborative Learning, techniques for the design of educational situations, and learning technology standards and specifications. Davinia is an executive peer-reviewer of the Educational Technology & Society journal and has been honoured with several awards, such as 2006-2007 European CSCL Award for Excellence in the field of CSCL Technology and Best Paper Award of the International Conference In Advanced Learning Technologies 2004. (e-mail: davinia.hernandez@upf.edu)

J. Blat, professor of Computer Science, at Universitat Pompeu Fabra (Barcelona) since 1998 where he is currently director of the Technology department. He was previously at Universitat de les Illes Balears where he was head of its Dpt of Maths & Computer Science from 1988 till 1994. He graduated from Universitat de València in 1979, got his PhD (Mathematics) at Heriot-Watt University (Edinburgh) in 1985 and has developed post-doctoral work at Université Paris-Dauphine where he has been visiting professor. His current research interests include cooperative environments; intelligent web portals; educational telematics; multimedia and GIS; computational educational toys; advanced 3D graphics (human modelling and animation). He has developed research and development in the frame of the European programmes. He is currently co-director of two IDEC-UPF postgraduate programmes, in Computer Animation, and Videogames Design and Programming. He has been member of the Information Engineering research panel, of the Committee for the Applications of Mathematics of the European Mathematical Society, and in 1991-92 he was member of the Board of Administrators of CITE-UETP
 (e-mail: josep.blat@upf.edu)