Adaptive Integral Assessment Package for the A2UN@ Project

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***Abstract*— This paper presents a first approach of Evaluation Engine Architecture (EEA) as proposal to support adaptive integral assessment, in the context of a virtual learning environment. The goal of our research is design an evaluation engine tool to assist in the whole assessment process within the A2UN@ project, linking that tool with the other key elements of a learning design (learning task, learning resources and learning support). The teachers would define the relation between knowledge, competencies, activities, resources and type of assessment. Providing this relation is possible obtain more accurate estimations of student's knowledge for adaptive evaluations and future recommendations. The process is supported by usage of educational standards and specifications and for an integral user modelling.**

I. INTRODUCTION

Generally, assessment in e-learning environment is conducted independently from learning processes [1]. Learning designers are very focus in learning tasks, learning resources and learning support tools. Slightly forgetting, assessment issues are integrated at the end in e-learning process. This integration not necessarily is linked with the measurement of learning objectives during the student's learning process.

Recently, it is more and more emphasized to integrate assessment with the other key elements of learning design and to develop competence [1], [2]. Still, planning methods of assessing and evaluating learning implies answer many questions as [3], [4]: What learning activities will be graded? What types of evaluation methods are more appropriate for the educational objectives of a learning experience? How can these methods to be customized to a specific learning context and to the expected benefits of a particular learning experience? What are the strategies for monitoring, assessment and evaluation? What are the adaptive strategies to provide in assessment tools?

In order to integrate properly assessment within learning process, some proposals as [2] and [5] claim as main ideas: 1) Introduce assessment as another key element of leaning process and 2) Link each learning objective or competence with one or many kind of assessments. In this way, assessment becomes a way of spiral measuring for student's learning achievement. Additionally, assessment turns into a good source for feedback to learners, for generation of recommendations and for drive adaptations in the learning environment.

Our proposal is build an adaptive assessment tool, fully integrated with IMS dotLRN, with different methods of assessment, with which we can monitor the student's competencies knowledge evolution and we can show them feedback. In the context of A2UN@ Project [6] we need develop assessment required to attend the accessibility and adaptation needs for ALL in Higher Education, with special attention to the diversity of requirements of adult learners and whose have the so-called disabilities.

We have analysed some tools with certain grade of assessing that has been developed and then intergraded with e-learning environments [2], [7], [8], [9], and [10]. In this paper we present characterises comparison, which can help us to design our adaptive assessment tools within the Evaluation Engine Architecture (EEA) proposal.

This paper is structured as follows: First, we introduce the background of our proposal (section 2). Second, we present an analysis of some evaluation systems for education (section 3). Third, we introduce our proposal of an adaptive integral assessment package (section 4). Fourth, we present some results in our work (section 5). And finally, we outline some concluding remarks and future work (section 6).

II. CONTEXT

The principal ADAPTAPlan project [11] purpose was focused on alleviating the workload for designers of adaptive courses on the complexity task of authoring adaptive learning designs adjusted to different user characteristics as her learning style [12], collaborative competence [13] and individual competence [14], and also the user context (i.e. device capabilities and situation in the course) [15].

As a result of this effort the Adaptive Learning Framework Architecture (ALFA) was proposed. ALFA describe how the user modelling elements and adaptation mechanism should be combined in order to offer resources and services adjusted to users in a virtual learning environment.

ADAPTAPlan conceptual model define the competencies as complex processes that people put into play in order to solve problems and to carry out activities (both at everyday life and at the workplace) [16]. Two different types of

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competencies are considered: generic or transversal competencies and specific competencies [17]. Generic competencies affect various fields and are transferable to a multitude of functions or training programs. They are focused on the “to be". Special types of generic competencies are the collaborative competencies. They allow a group of individuals to carry out a job as the result of joint effort and cohesion towards achieving a common goal. In turn, specific competencies are directly related to a specific occupation and are focused on the "know" and "do”. The individual competencies are a particular type of specific competencies.

The process of evaluation is different for each type of competence.

Collaborative Competence Level [13] is defined by use some clustering techniques that allow grouping students in subsets (clusters) of them, according to their collaboration similarities. This grouping is based on user’s behaviour on different collaborative tools.

Specifics competence levels [14] are inferred for applying different assessment tools related previously with the evidences attribute in the competence definition. These elements permit to measure theoretical [18] and practical [9] performance of users in the system.

Levels of competence are monitored and they support the decision about what Learning Objects or services should be presented to each particular user.

In ADAPTAPlan project were used standards and specifications as IMS-LIP [19] for the information register, IMS-RDCEO [20] for the competencies definition, IMS-LD [21] for build instructional design , IEEE-LOM [22] for resources metadata annotation and IMS-QTI [18] for build tests. IMS-QTI describes a model for the representation of questions and tests, in addition to the generation of result’s reports. IMS-QTI uses ASI model (Assessment-Section-Item) to define reusable tests. The specification allows the exchange of items, tests and results between different e-learning systems.

As a continuation of the ADAPTAPlan project, A2UN@ project looking for achieve a conceptual design of an interoperable and layered-based infrastructure in order to facilitate the definition, development, deployment and evaluation of the services for supporting accessible and personalised learning in Higher Education.

In this context, it is neccesary consider the users covering the whole range of functional diversity issues existing at this educational level (i.e., hearing impairments, visual impairments and slight congnitive issues such as dyslexia and dyscalculia) for the design of an useful and strong evaluation service.

In this paper a first approach for an extended evaluation model in the context of the A2UN@ project is proposed. The Evaluation Engine Architecture (EEA) is proposal to support adaptive integral evaluation, in the context of a virtual learning environment.

III. Analysis of evaluation systems for education

Before to define our proposal we analysed some available evaluations tools used in e-learning context. Our objective is present a characteristics comparison table, which can help us to design our adaptive assessment tool.

ALFANET Evaluation Package was developed within ALFANET project [7]. This package have two tools: First, the QTI Authoring Tool that supports the introduction of metadata in the IMS QTI items and the generation of dynamic and adaptive questionnaires based on the Selection & Ordering specification provided by IMS QTI. Second, the IMS-QTI Interpreter that provides an integrated tool for the representation of question (item) and test (assessment) data, and their corresponding results reports.

SIETTE [8] is a web-based intelligent evaluation system. The tests are generated according to teacher’s specifications and the questions are selected in adaptive form, underlying in Item Response Theory to fit the student’s level of knowledge.

Coala [9] is an intelligent tutoring system for learning Object-oriented programming. It’s implemented as Eclipse plug-in. Coala provides dynamic personalization and learning activities, sequencing adaptation by combining e-learning specifications (IMS-LD, IMS-LIP) and artificial intelligent techniques in the context of programming learning.

Univalle ECAES Evaluation System [10] is a tool for edit and to perform tests type ECAES (for his Spanish acronym, Exámenes de Calidad de Educación Superior en Colombia) developed at the Universidad del Valle, Colombia. Questions in ECAES are classified in two dimensions of competencies: First, specific competencies; second, some transversal competencies as interpretative, argumentative and proposition.

TELOS: Software Framework for Competency Modelling and Management, [2] is a set of software based on ontology for ontology-driven e-learning systems. The ontology is for designing competency-based learning and knowledge management applications. TELOS is based on MISA methodology which allows graphic design of instructional process.

Table 1 show a comparative resume, from e-learning point of view, about evaluation packages described previously. The column “Level of Assessment” can provides the following values: self assessment, formative assessment and competencies assessment, these levels of assessment are described in [1]; self assessment implies that student is auto-examined with a tool that presents to him an test and qualifies his responses, for this level, the test is usually realized as a final stage of the learning process, for formative assessment the educational system offers different types of evaluation along the learning process, in these evaluations there intervene the student, his partners and the teacher. Finally the competencies assessment involves the characteristics of the previous level but associates the targets of learning with the measurement of competencies and can overcome the scope of only one course. The column “Type of Competencies” provides the following values: specific competencies and transversal competencies. In “Adaptive Strategies” column,

fundaments of adaptive algorithms are named. In "Feedback to Learners" column shows strategies for deliver comments or instructions to learners about their errors. In "E-Learning Technologies Using" column, principal standards or specifications in e-learning are named.

TABLE I
COMPARATIVE BETEWEEN EVALUATION SYSTEMS

Evaluation System	Level of Assessment	Type of Competencies	Adaptive Strategies	Feedback to Learners	E-Learning Technologies Using
AlfaNet Evaluation Package	Summative assessment	Specific knowledge competencies	Defined by teacher as rules in the QTI. In evaluation process QTI Assessment module decides the feedback to present as result of the user's responses according to a ratification of conditions.	Feedback can include hints and solutions or both of these can be revealed in a variety of different ways	IMS-QTI specification
Web Application Siette	Summative assessment and formative assessment	Specific knowledge competencies	Item to response theory for questions selection Different test termination criteria	Final Test evaluation	Web-based and integrated with Moodle
Coala: Eclipse Plug-in with integration of results in dotLRN	Summative assessment	Specific competence in programming	Instructional Adaptation in programming learning	Fuzzy logic algorithm to feedback evaluation about the student's algorithm	Eclipse plug-in integrated with dotLRN
SEUV: Univalle ECAES Evaluation System	Summative assessment and moderate formative assessment	ECAES Specific knowledge competencies and ECAES transversal competencies	Weighting of questions as his level of difficulty	Final report of results with justification on the errors and correct responses.	Definition of transverse and specific competences in the metainformation.
TELOS: Software Framework for Competency Modelling and Management	Summative assessment and competencies assessment	Specific Knowledge and transversal competencies linked to the achievement of the previous ones.	Weight associated with products and competences for the instructional adaptation	It allows the making of a plan of acquisition, using resources associated for the competencies or new needs.	It integrates design instructional tools, e-Porfolio and competencies definition

IV. PROPOSAL

Our proposal take some desirable characteristics found in previous analysed tools for extend evaluation model in the context of the A2UN@ project. Our evaluation model has been conceived to support all levels of assessment, in particular different types of adaptive strategies for self-assessment, including teachers and peer assessment, and collaborative works. Also the most important, assessment objectives are integrated with the other key elements of learning design through IML-LD assessment structure and the monitoring process for delivering Feedback to learners in all assessment tasks.

Figure 1 describes the architecture of our Evaluation Engine proposal. Our evaluation service is composed of two packages: 1) Author Assessment Package which support assessment task in design time. This package provide services for configure the assessment model and the IMS-LD assessment structure, supporting the communication with external repositories and evaluation tools. 2) Monitoring Assessment Package which support assessment task in run time. This package provides services for monitoring user's assessment tasks and update student user model, executes adaptive transformations according the IMS-LD assessment structure configured and deliver recommendations.

Student Evaluation model is composed by four elements, teacher assessment model, self assessment model, self assessment model in collaborative tasks and a peer assessment model. In order to adaptive transformations, IMS-LD assessment structure is modified and student's user model too.

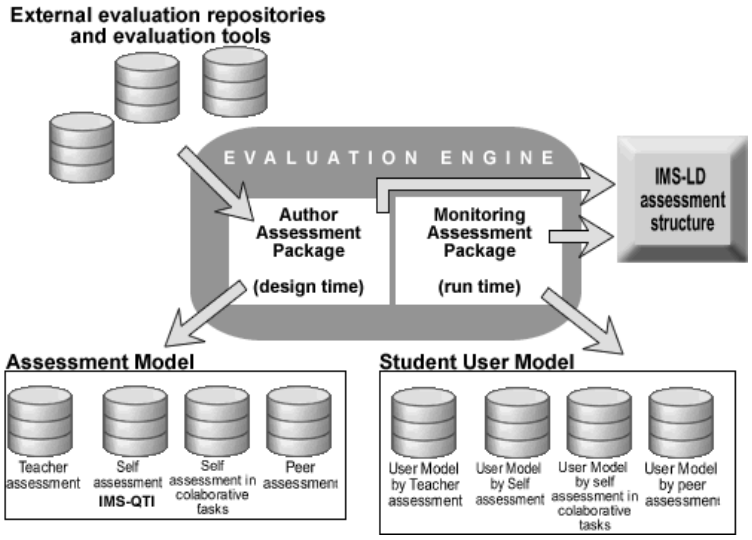

Fig. 1 Evaluation Engine Architecture

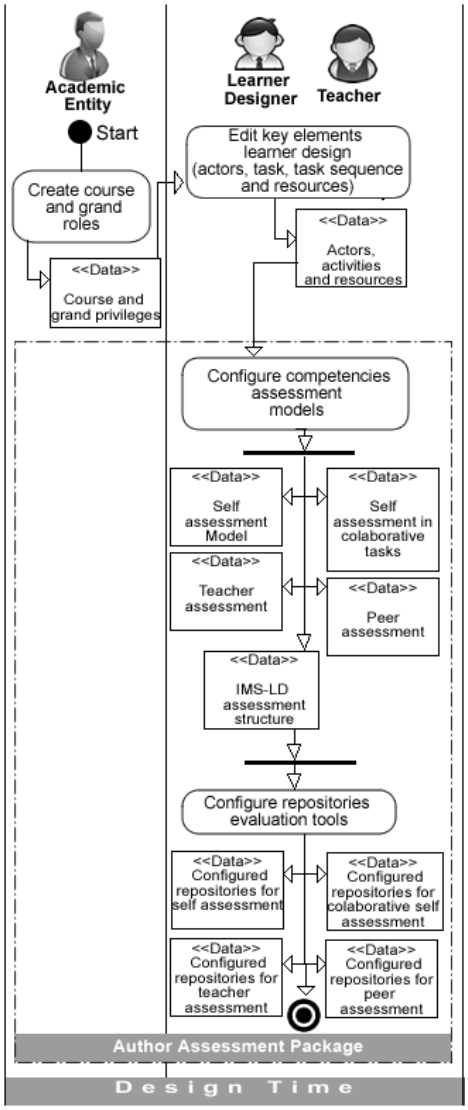

Fig. 2 Activity diagram of assessment process in design time

Figure 2 describe the assessment process at design time, using an UML activity diagram. In design time Author Assessment Package of the Evaluation Engine Architecture is used. First, learner designer and teacher configure competencies assessment models (the Evaluation Model). Finally, evaluation's repositories and tools are configured.

Figure 3 describe the assessment process at run time, using an UML activity diagram. At run time, Monitoring Assessment Package of the Evaluation Engine Architecture is used. The student performs collaborative assessment task; the training assessment activities, until student finds no more recommendations; finally, the self assessment tasks. Teacher monitors student's results and comment their work. In collaborative tasks peer students comment and qualify the performance of their partners. User model is modified due to the actions of student, teacher and peer students.

V. Some Results

In the context of ADAPTAPlan project we have developed and integral evaluation system that address a particular issue in the actual LMS which is they don't offer an evaluation tool that permit to mix several assessment types in order to generate a condensate competence indicator.

Different assessment elements related to the evidence type in the competence definition permit to measure the competences in several ways, as is show in table 2 [14].

Each type of evidence implies an independent process in the learning management system, for this reason a communication framework for integrating the systems evaluations tools and external tool was created. An example of this integration is show in the description of the Coala tool integration [9].

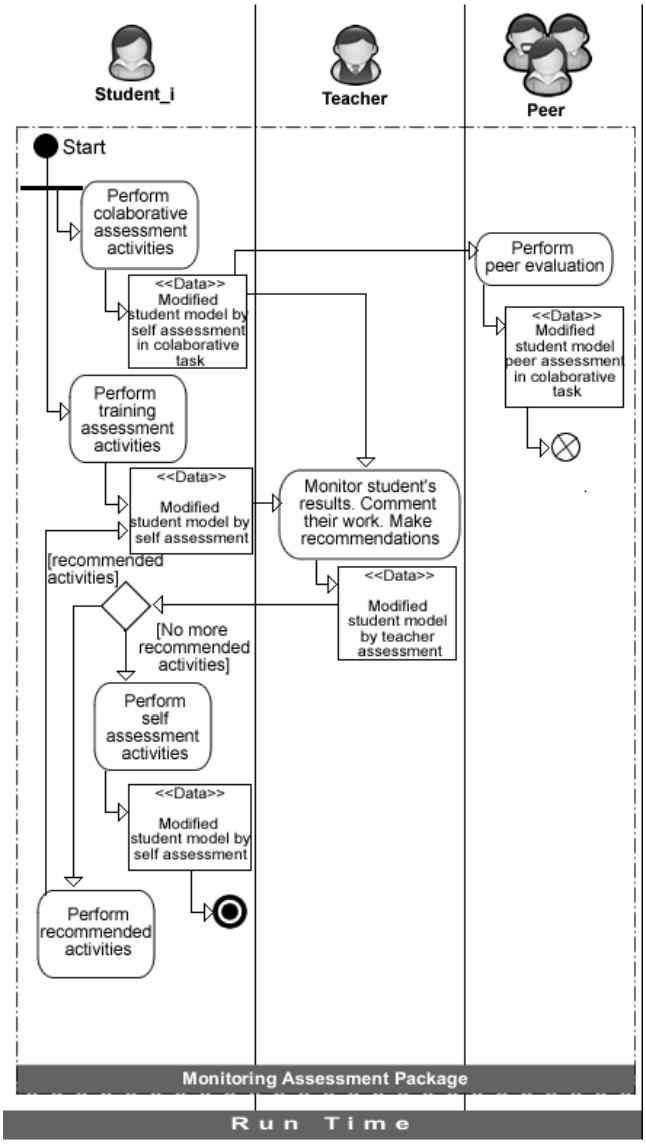

Fig. 3 Activity diagram of assessment process in run time

TABLE II
ADAPTAPLAN INTEGRAL EVALUATION SYSTEMS

Type of Evidence	Specific measure
Theoretical performance	IMS-QTI assessments
Practical performance	Coala Tool or another practical evaluation tool.
Virtual performance	Quantity and Quality of User interaction with the learning objects in the virtual environment.
Collaboration performance	User access and participation in the virtual environment.

This approach is the initial point to continue with the construction the evaluation model proposed.

VI. CONCLUTIONS AND FUTURE WORK

Our goal research is design an evaluation engine architecture to assist in the whole assessment process within the A2UN@ project, linking that tool with the other key elements of a learning design (learning task, learning resources and learning support). We have design this tool in two packages: Author Assessment Package and Monitoring Assessment Package.

Some requirements achieve in ADAPTAPlan and retake in our proposal are: Provide online test with different questions formats, supports in QTI specification: true/false questions, multiple choice questions, single choice questions, reason - consequence questions and open questions. Monitoring student's competencies levels overtake in each assessment task. Build a hierarchy of specific competencies and transversal competencies. Support assessment through a combined use of IMS-LD, IMS-QTI and assessment-specific tools. Define traditional roles in e-learning tools as student, teacher and administrator.

The resume of the most important new ideas in our proposal are: In order to support traditional, formative and competence assessment our architecture provides some strategies of evaluation as: self assessment, peer assessment and training testing. Adaptive strategies are used to select from a bank of questions, those that are more appropriate for the level of competence demonstrated by the student so far, and the objectives to evaluate. As result of training sessions too, the learner obtains specific recommendations about next task or resources proposed form him. Our tool informs the student at the end of its evaluation the justification of their wrong answers; give the right answers and the explanations to learners. Inform common misconceptions or learning tips on students' mistakes for training sessions too. The students can view their teachers' comments and the grades given to their work. The student can view their peer's comments and the grades given to their work. Thanks to monitoring the student's level of competence reached, the system is capable of giving best recommendations about the activities and resources that should suggest to each particular student.

As future work we must incorporate in the proposed architecture the perspectives of accessibility and needs of adaptation for needs for ALL in Higher Education and then develop prototypes for test the architecture.

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