Adapted E-Assessment System: Based on Workflow Refinement

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Abstract. In this paper, we define a fundamental model of e-assessment in e-learning based on the analysis of the needs of learners and tutors. Therefore, we describe an innovative approach to specify an adapted workflow for flexible e-assessment system. This approach is based on refinements techniques which are specified by UML activity diagram language. Firstly, we propose an e-assessment generic workflow composition based on workflow refinement. Secondly, we provide from a composed generic workflow a flexible e-assessment workflow. We define a flexible e-assessment workflow as an e-assessment workflow tailored to each learner profile. This flexibility is defined by an adaptation workflow refinement. Based on adaptation workflow functions, we define a set of adaptation rules to specify a flexible e-assessment workflow.

Keywords: e-assessment; flexibility; workflow; specification approach; adapted workflow; UML-AD workflow refinement.

1   Introduction

The importance of e-learning has considerably grown with the progress of the Internet and the performance of personal computers. The greatest benefit of e-learning is to be capable to take delivery of education in spite of proximity and distance between tutor and learner. However, e-learning faces many challenges and problems which have been reported by works published in [14,15]. Among these problems, the major one is that the number of learners signing up for a course and never finishing it is quite important (between 50% and 80%). As it is mentioned in [14,15], this is due to:

- The need of identification of the real problem or need for analyzing the e-learning problem.
- The poor overall strategic design of the structure of courses.
- The need of detailed instructional design of the e-learning and e-assessment processes and the need of their evaluation and revision.
- The problem of the automatic production, reproduction and distribution of pedagogic resources and modules in e-learning and e-assessment processes.

To fulfill these needs, we propose, in this paper, a generic specification and design approach for e-learning and e-assessment processes based on workflow technology and learner profile adaptability.

As mentioned above, e-learning needs to be more adaptive and flexible to support any kind of learner according to his/her capability. In e-learning process, e-assessment plays a most important role not only to evaluate student knowledge but also to gather student feedback relatively to a learning content. An e-assessment activity is the fact that the learner responds to question given by the tutor to evaluate the learner knowledge. Therefore, in e-learning environment, learning and assessment processes must work together as a complete learning process.

Consequently, we need a solid e-assessment approach to evaluate efficiently the learner knowledge in one hand, and on the other hand to allow tutor to regulate, update and improve his teaching strategy. Such e-assessment approach could not be suitable for all types of learners as they present different knowledge profiles and learning behaviors. Some of them need to be assessed on the complete learning materials to evaluate their overall knowledge. Others may only need to estimate their knowledge at a particular stage of the learning process in order to access to the suitable learning material.

Hence, we need a flexible e-assessment approach which evaluates each learner's knowledge relatively to its learning behavior profile.

To attempt this objective, we propose an approach to specify a generic e-assessment process. We use workflow technology to coordinate different tasks and to model e-assessment process. To specify this e-assessment workflow process, we use UML activity diagram language [2]. Then, our approach is based on a workflow composition by refinement to reduce complexity. In addition, we define a set of refinement rules to adapt the e-assessment process for each learner.

The rest of the paper is structured as follows. In Section 2 we describe steps of our approach. Section 3 illustrates how to build a workflow e-assessment process. In section4, we define a workflow composition by refinement. Section 5 presents a flexible e-assessment refinement. We briefly conclude with the summary of the paper and outline the directions of the further work in Section 6.

2   Generic E-Assessment Specification Approach

We propose a generic approach for the e-assessment to fulfill the need of a strategic design of e-learning and e-assessment process. As mentioned in the introduction, the proposal of this approach is argued by the need of:

- A generic and pedagogic strategy adapted to different learner profiles.
- Standard models of e-assessment process allowing their evaluation and revision.
- Workflow structure and enactment engine to coordinate between different pedagogical modules and learning activities permitting the automatic production, reproduction and distribution pedagogic resources and modules.

Therefore, we propose a generic e-assessment specification approach based on the following steps:

- ***Step1: Generic E-assessment workflow:*** consists of describing the generic workflow model of e-assessment process. At this step, we analyze the existed LMSs and we identify their main and common activities or tasks. Then, we use a workflow technology for coordinate these activities, in order to acquire a workflow e-assessment process. As we could not separate the e-assessment process from the learning process, we propose to specify both of them in a same workflow pattern. To express and specify this e-assessment workflow process, we use UML AD [2] as a standard modeling Language.
- ***Step2: Refinement for composition of e-assessment Workflow:*** from step1 we get a generic e-assessment workflow. This workflow is composed of an important number of activities. We propose in this step an e-assessment workflow refinement. This refinement allows reducing the complexity and facilitating the management and analysis of this generic workflow.
- ***Step3: Refinement for e-assessment workflow flexibility:*** builds, for each learner, an adaptable and personal workflow relatively to his knowledge level and his availability. This adapting is defined by a set of refinement rules specifying the flexibility of the e-assessment workflow.

3   Generic E-assessment Process

In this section, we provide a generic e-assessment workflow process. To build this generic process, we are brought about following the next steps and activities. Our process to provide this generic e-assessment process is:

- ***Analyze and study the existing LMSs functionality:*** We studied and analyzed a set of existing LMSs (Learning Management System) such as [10,11,12,13] explored the functionalities that they offer to realize the e-assessment process. LMSs provide several e-assessment tools and not a global e-assessment process. Learning Management Systems (LMSs); such as Moodle, OLAT and LAMS.
- ***Collection of e-assessment tasks from exist LMSs:*** In this step we collect the e-assessment tasks used by several LMSs to specifying and define generic e-assessment tasks or activities. A typical e-learning system is represented by the following important concepts: (Student, Teacher, Course Administrator, Course, Content, Class, Goals, Test, Assignment, Assessment, …).
- ***Creation of workflow:*** Define e-assessment process by coordinating specified generic e-assessment activities in a workflow structure. By this we define a generic and an abstraction view of the assessment process. We use workflow technology to have flexible e-assessment systems. A workflow consists of a set of linked activities. It represents an abstract and global view of the work of a person or a group of persons. Therefore, workflow manages, in an abstract manner, the synchronization of e-learning and e-assessment activities of the course development between learners and tutors. This e-assessment workflow model should be a good communication axe between teachers, learners and the e-assessment system.

Due to the lake space, we reduce our e-assessment process to a normal scenario: we try to test learner on each level of training to guarantee its comprehension and to

help him to reach a high level of knowledge. In our work, we are interested in the formative e-assessment because learners are more concerned in how they have performed their activities more than to compare their work to other learners. Furthermore, we are interested in the two varieties of question: objective and subjective tests.

As presented in **Fig.1**, the learning starts by choosing his studied course. Then, the e-learning content is composed into smaller parts to facilitate deployment and execution assignment. After the reading of each part, the learner carries out a set of objective test activities. The e-assessment system corrects automatically these activities and gives a score according to the answers of the learner. Learner passes to following part only when it reaches a score determined by the teacher. This score and the interval time of the execution activities are saved into file log. These files help teacher to follow learner behavior. If the result is under the score given by e-assessment system, the system must, for example, allow the tutor to add additional stages for a student to help him exceed her difficulty. In fact, learners need regular feedback in order to know how their performance was evaluated, and how they can improve it, and also how their grades are computed. At the end of the lesson, tutor proposes a set of subjective questions in order to observe the complete view of what a student comprehend from the lesson, as presented in **Fig.2**. If results are under the score given by e-assessment system, the teacher would give more clarification to learner. This, feedback could be presented more frequently for the users who have started to make more mistakes, and feedback can be delayed to slow down students who are answering too quickly and sloppily.
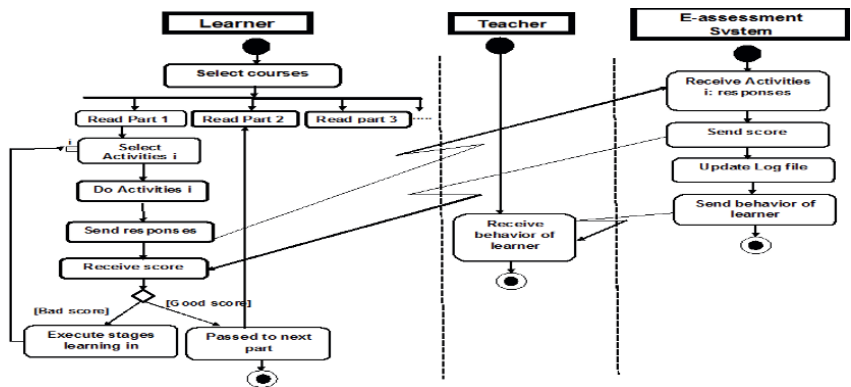

Fig. 1. Workflow e-assessment part

After correction of activities, system affects score and updates a file log. Using the generated file log, the tutor will define the design of the following lessons according to the behaviour of individual learner.

- *Use of standard model notation:* As we propose a generic approach for the e-assessment, we use UML AD as a standard workflow notation. The use of UML activity diagrams in the description of workflows is argued in several works such as works presented in [5] [4]. Thus, the advantage of UML activity diagrams is that they provide an effective visual notation and facilitate the analysis of workflows composition.
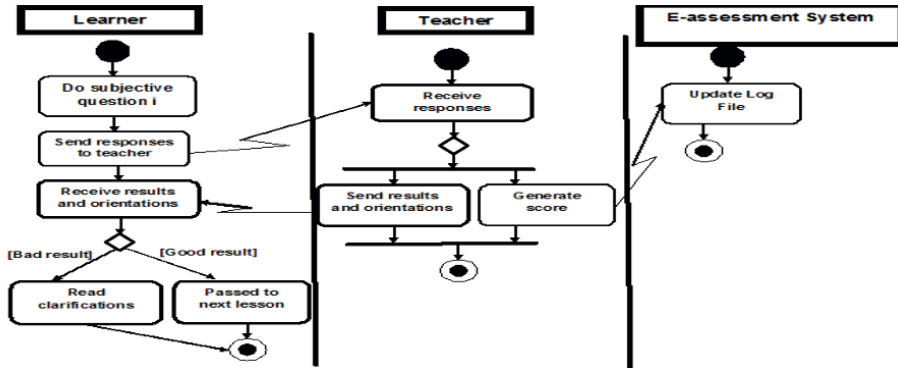
Fig. 2. Workflow e-assessment Lesson

4 Generic workflow: refinement for composition

As e-assessment process contains important number of activities, it is considered as one of the most large and complex process. To reduce this complexity and facilitate the e-assessment management and analysis, we propose in our generic specification approach to define the e-assessment workflow through several abstraction levels. Therefore, the e-assessment process is described at a high level of abstraction by a single UML AD activity. It represents the goal of the e-assessment. We consider this activity as a composed activity which will be subject of a series of iterative refinements. These refinements provide details for the e-assessment model. This model specifies the generic e-assessment workflow, presented in **Fig.3**. Thus, we use workflow composition by refinement based on UML activity diagram language [2] inspired form work presented in [7]. In the following, we present the architectural view of the generic approach for detail the refinement process that we use to provide a generic e-assessment workflow.

1) *First level of the composition; Abstract level:* This level specifies the process e-assessment activity which should be achieved by each learner.

2) *Second level of composition; First Refinement:* We have use a UML activity diagram to specify the global progression behavior and the work part of both actors: the learner, the teacher and e-assessment system. Each swim line of the activity diagrams represents a role of the workflow actor (teacher or learner or e-learning system). Workflow e-assessment Activity is composed in two alternative sub-process:

- *E-assessment Part*: it consists to test learner on each part of lesson content by using objective tests.

- *E-assessment Lesson*: consists to test learner on the whole of lesson content by using subjective tests.

3) *Third level of composition: Second Refinement:* We refine the workflow *E-Assessment Part* into activities performing the e-assessment for each part of lesson, presented in **Fig.1**. We refine the process *E-Assessment Lesson* into some activity, presented in **Fig.2**.
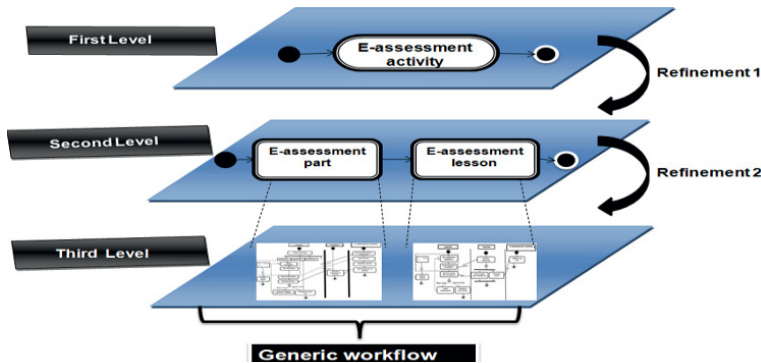
Fig. 3. Refinement for composition

5   Flexible e-assessment workflow

The flexibility of e-assessment systems provides accommodation for the evalua-
tion of different types of learners styles in assessments. Students learning styles con-
tribute significantly to the manner of how they assimilate information during the
learning process. This paper is concerned a procedure to formalize and build learners
personalized e-assessment. The approach suggests combining learner's dynamic as-
sessment with adaptive course presentation. We observe the user during a learning
process and adapt to his progress the learning and assessment materials. If the learn-
er's performance does not meet the pre-defined expectations, the presentation of the
course content is adapted to his level of knowledge and selection of the appropriate
assessment content is then performed. Each learner is therefore able to get a highly
personalizes course appropriate to his level of knowledge. Our approach is suitable
for individual learners tacking a self study distance learning course. Generally, the
level of assimilation of each learner is not the same. Thus, the number and the kind of
e-assessment activities and the courses contents are not similar. The delivering of the
same e-learning workflow model to different learners is not adapted to the specific
needs of personal learners. In fact, to specify an adaptive and flexible e-assessment
workflow, we need to provide an e-learning content according to a particular learner's
needs, therefore a personal and adapted workflow model. Consequently, we propose
to refine the generic e-assessment workflow in order to adapt it for each learner pro-
file (Fig.4). This refinement is on a number of refinement rules such: *AddAC*, *DelAC*
and *EditAC* based on the knowledge learner and some exception. We define three
refinement rules based on the following refinement functions: *AddAc*, *DelAc* and
EditAc. Applying these functions on a generic workflow, we provide an adapted e-
assessment workflow relatively to the learner profile. An adaptation rules is defined
as follows:

if *Condition* then *Action*

Where *Condition* specifies a criteria choice of the adapted rule and the *Action*
represents the adapting action based on the relative adaptation function.

Next, we detail the role and the choice criteria of each of these functions.

1)   *AddAc:*

a) *Choice criteria*: When a learner has difficulty in such part of the course content or he wants to be moreover evaluated in such part, we can insert a new activity which makes him to concrete his needs.

b) *Description*: Insert a new activity in a generic or adapted workflow *W*:

AddAc : $\mathcal{W} \times \mathcal{A}c \rightarrow \mathcal{W}$

$$(\mathcal{W}i, AC) \rightarrow \mathcal{W}f$$

Here, $\mathcal{W}$ represents a set of generic and adapted e-assessment workflow. $\mathcal{A}c$ is a set of standards activities such Do question, send activities, send result… .

2) **Del Ac:**

a) Choice criteria: Our e-assessment approach is flexible and can treat exception. For example, when the teacher builds a work plan, he can stop possible assistance points besides pertinent points (necessary for tutoring).

b) Description: Delete activity from workflow.

Del Ac : $\mathcal{W} \ / \ \mathcal{A}c \rightarrow \mathcal{W}$

$$(\mathcal{W}i, AC) \rightarrow \mathcal{W}f$$

3) **EditAc**

a) Choice criteria: If the teacher detects that the same exception arises at the same point in all workflow cases (the learners meet the same problem) then he can decide to modify the process model. It should be noted that adapted workflow can be constructed using the proposed rules. Then an adapted workflow is generated by applying the three rules.

b) Description: Modify one or some activities of workflow.

DEdit Ac : $\mathcal{W} \times \mathcal{A}c \times \mathcal{A}r \rightarrow \mathcal{W}$

$$(\mathcal{W}i, AC, AR) \rightarrow \mathcal{W}f$$

$\mathcal{W}f$ is the workflow results from replacing AC by AR.
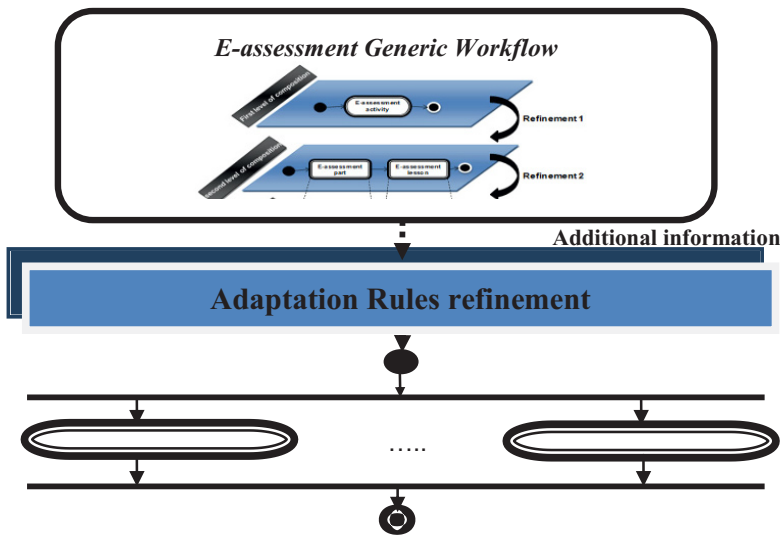

Fig. 4. Flexible workflow refinement

6   Conclusion And Future Work

In this paper, we have proposed a generic e-assessment approach based on flexible workflow for adaptation individual profile learner. We have specified the workflow model by a standard modeling language, the UML activity diagram language. We have used in our approach an UML-AD refinement technique for modeling and describing workflow applications. Based on this refinement, the first step of the approach provides an UML-AD specification of a generic workflow. In the second step, we have defined a set of adaptation rules to achieve an adaptable workflow for each learner. As future work, we plan to continue with the implementation of our approach to more improve our idea in flexible e-assessment system.

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