

Towards a framework for assessment in pervasive environments

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Abstract:

Pervasive assessment is defined as delivering and taking part in assessment activities that involve mobile technologies and other mobile applications. In this paper we study the possibilities to provide learner assessment in pervasive environments through an analysis of an assessment scenario in these environments. We also provide an overview of the main issues that can be faced when this type of assessment is offered as part of the teaching–studying learning process.

Keywords: Pervasive assessment, semantic Web, QTI, Web 2.0, peer assessment

1. Introduction

Assessment is an important part of the learning process as it allows the learner to keep track of their progress in the knowledge acquisition process. We may distinguish between several types of assessment. *Self assessment* is a process in which the creator of an assessable piece of work is responsible for assessing it. *Interactive assessment* occurs when students are actively encouraged by teachers to think through the progress they make in terms of learning capabilities during the assessment process. In this case assessment is considered as part and parcel of the teaching, learning and assessing cycle in the class (Hamp Lyons & Tavares (2008)). *Peer assessment* is a subcategory of interactive assessment that involves the assessment of a piece of assessable work by one of the creator's peers (Bhalerao et al., 2001).

With the recent emergence of new pedagogy approaches related to active learning, peer assessment has been deployed in the past few years as a means by which the learner is more deeply involved in assessing their mastery of the knowledge there are presented with. Indeed active learning enhances the student's critical awareness as well as their thinking and writing skills, and it is persistently recommended as a key teaching method. In this context peer assessment presents us with an innovative tool to implement more rigorous processes of learning and evaluation. Indeed student assessment of other students' work holds many benefits both for the assessor and the assessee, particularly as it encourages student autonomy and higher order thinking skills (Boud et al., 1999). Here is it useful to recall that two people are considered 'peers' if they are in some sense placed in the same situation- for example, two students who belong to the same class or read the same subject are defined as peers for our

purposes-. In other words, peer assessment in a given subject is the assessment of a student's work by another student of that subject.

Our aim is to provide learners with the possibility to be involved in an assessment process that is adapted to their individual context of learning. Thus, we need to deliver assessment activities which are most commensurate with their specific situation.

Technologies embodied in web 2.0 tools enable a process of social information sharing through the creation of collective structures. Nevertheless, the large diversity of these tools makes it difficult to distribute and filter information which is processed through the active combination of a variety of platforms (blogs, wikis, social environments, RSS feeds,.....).

Three main functionalities which are offered by Web 2.0 tools can be used to enact a learning process (Gilliot et al., 2009):

- *Social bookmarking*: using tools such as delicious for sharing bookmarks, or other tools such as Flickr or Slideshare for sharing documents and social networks
- *Microblogging*: for exchanging short text messages
- *Collaborative work*: deploying tools such as blogs and wikis. Indeed Blogs help to collect and diffuse pedagogical resources such as projects, learning instructions, support documents, student productions, etc. They facilitate the creation and sharing of multimodal information such as text, images and sound in real time. They also enable the multilateral treatment of different interactions involving key actors in the learning process (learners, tutors, etc). In addition, Wikis are useful for the diffusion of pedagogical resources and are especially appropriate for group discussions

Current research on the Semantic Web (Berners-Lee et al., 2001) can offer useful venues towards achieving this objective, particularly with respect to the notion of ontology, which plays a key role in facilitating the sharing of meaning and semantics. The Semantic Web architecture is powerful enough to satisfy requirements for computer-aided assessment. Moreover, assessment material is semantically annotated and, for every new assessment request, it may be easily combined with a new test.

The paper is structured as follows. The next section presents a use case scenario including pervasive assessment and peer assessment. In section 3 we analyze the proposed scenario and outline the main challenges that need to be accounted for in such a scenario. Last we think through potential routes to implement such use case scenarios while taking stock of key advantages offered by semantic Web.

2. Use case scenario for pervasive assessment

In this section, we illustrate the context of our research using a use case scenario that includes pervasive learning and requires various types of assessment. Consider the following situation: Student engineers attend a course on information systems and design methodologies. As part of their course projects, Students have to work in groups to propose an information system that manages specific data in a given company department. This activity is deployed in three main phases. The first phase consists in drafting a specification document; the second consists in drafting a modeling document, and the last phase concerns the prototyping of the system.

This paper focuses on phase one and proposes a scenario for collaborative work between learners. The phase consists in the preparation a specification document for a company information system in small groups of learners. The group has to designate a coordinator who supervises the workflow and information delivery between the members. The coordinator will ask every member of the group to access their blog in order to get a clear idea on the work progress, the planning follow-up and the list of tasks to be carried out next.

In this phase we may distinguish between the learning process and the assessment process, which can occur either sequentially or in parallel. Tasks in each process may cross-cut.

a. Learning Process

- **Task1: Preparing the Specification document structure.**

The group needs to achieve an in-depth understanding of the necessary requirements to write a specification document for an information system and to structure such a document correctly.

During this step some members will access the web in order to collect further information on the overall structure of a specification document, download some reference documents or share the bookmarks/links using delicious or Diigo.

Some other members will go to the university library and search references for books that describe the modeling process of information systems. In case some of the references are not available, these students can communicate with their colleagues using a micro blogging tool, such as Twitter, to check the availability of that material in other sites (other university libraries, Amazon, etc).

- **Task2: Visiting the company**

Some members will pay out a visit to the company, during which they will collect information about the information system and interview its prospective users. The interviews will be recorded and shared through Video sharing tools such Vimeo,

In addition, information on the existing systems will be collected. For instance some of the members will gather information from the company concerning the current systems in use and their functionalities. All information gathered will be shared through their blogs.

Based on the information that has been collected, other members may suggest ways to improve the data and work process. This phase is called “Critique of existing”. The results of this phase are shared with the group members who are on site. The latter should visit again the company employees that will use the system in the future, and validate the proposed improvements or new functionalities for the information system. In this case discussions will take place that should be recorded and shared on video sharing tools.

The other members will access the results of these discussions and accordingly redefine the specifications of the information system that they need to develop.

- **Task3: Finalizing the specification document**

The group will write collaboratively the specification document using Google Docs and Etherpad. The document should contain the description of the functionalities of the proposed information system and the main actors. The document will be shared using e.g. Diigo with

other groups of learners; thus the group will gain access to a platform on which all learners upload their specifications documents. The group has been prepared in advance by the tutor.

b. Assessment process

- **Pervasive self assessment.**

During the first, second and the third task learners may need to access their mobile device (e.g. a PDA) to check the knowledge attained in some courses, such as the design of information systems and databases, or project management. This knowledge checking process depends on learners' current context. For example, learners in charge of data collection at the company may need to check their knowledge on Database architecture to be able to understand existing information systems better. Learners at the library may need to check their knowledge on some key concepts on the specification of information systems in order to be able to select the most appropriate references.

Learners will then receive a set of randomly selected questions to be answered. Once they post their answers, they should receive some recommendation to those parts of the course to review before moving to practice. They may also have the possibility to receive a list of names including friends or tutors who are connected on social platforms at the same time, and who can provide them with help in case they have difficulties performing their practice work.

- **Peer assessment of other specifications documents**

Learners may also have the possibility to enrich their knowledge by assessing the work done by other learners. Each group of learners will now access the specification document drafted by another group of its choice.

The tutor has already uploaded on his/her blog the assessment criteria that need to be used in order to evaluate the specification document.

Learners may post their comments and ask for clarification of some assessment criteria. Once a specification document is selected each group will work collaboratively and remotely to assess the document. For that every learner will be asked to deliver an assessment scheme that includes his/her appreciation and share it with his/her group members on e.g. Google Docs. Once all assessment schemes have been filled for the selected specification document, the group coordinator should summarize the grades given for each assessment criteria. The coordinator then shares on Diigo the group assessment report of the selected specification document, which should also contain the group feedback on the specification assessed. This peer assessment phase, as well as the assessment report that each group will receive, may give them an opportunity to review their own specification document and propose a new version.

3. Scenario analysis and requirements

A few challenges can be encountered in the situation described above:

- *Diversity of web 2.0 tools:* The learner in a pervasive context may use different tools to communicate with his/her peers and carry out his learning assessment activities. It is therefore necessary to adaptively recommend the tools appropriate for the type of assessment to deliver and make a semantic usage of the information that is transferred.

- *Difficulty to search and filter information:* In formative assessment contexts, the learner may have an important quantity of data and activities to share with their peers. It is thus important to be able to search and filter the information appropriate to their individual needs and to the nature of the context.

- *Dynamic attribution of resources and resources interoperability:* learners may feature different levels of progress in the learning process. Tutors' availability and knowledge capacities may also vary. It is therefore necessary to enact a flexible process of resource attribution depending on the availability and knowledge standards of learners and tutors alike. Moreover, In order to be able to deliver assessment in pervasive environments, we need to find a way to efficiently retrieve and exchange key resources. This task can be achieved through enhancing the interoperability of these assessment resources by being compliant to same standards such as QTI (QTI, 2010).

To deal with these challenges, it is necessary to retrieve relevant data for learning assessment activities from different tools. Unfortunately, social media applications are data silos. Only people may have access to data, not computers. Reuse and exchange of data among social tools are only possible by means of API. Semantic web provides a common framework that allows data, information and knowledge to be shared and reused across applications. Linked data describes a method of exposing, sharing, and connecting data, information and knowledge on the Web (Bojaars, Breslin et al. 2008; Gruber 2008). It provides a standardized, uniform and generic method for data discovery, distributed queries against several data repositories, integration or semantic mash-up, uniform access to metadata, data, information and knowledge. To ensure interoperability at semantic level, it is necessary to use common vocabularies among Web 2.0 tools. These vocabularies can be semantic models necessary to design technology-enhanced learning systems. Some of these semantic models are highlighted in the following paragraph.

4. Semantic models for assessment in pervasive environments

In order to tackle these challenges and the design of future technology-enhanced learning systems, we need to maintain a framework containing a certain number of semantic models, which not only allow us to handle and manage various types of data, but also enable assessment in pervasive environments. These models, and their possible features, are outlined in the following:

- **User model**

We need to receive timely information on the various users and contexts of learning. Ontologies such as SIOC and FOAF may help us receive information on the fly about users of a mobile learning process. User profiles also have to be maintained to be able to personalize the assessment according to learners' preferences and characteristics

- **Assessment model**

In order to provide assessment in future pervasive environments we need to be able to select the appropriate assessment strategy and recommend assessment resources in a given context. In some situations approaches of peer assessment can be deployed. To do so, the learner should be able to select the resource for which they have to deliver the assessment, gain access to the evaluation criteria, and post their comment on the

assessment criteria in order to receive further explanation from their peers and tutors. On the other hand, some courses require self-assessment resources which help to evaluate the ongoing state of knowledge of a learner and their progress in the learning process.

In addition, we need to maintain an e-portfolio for every learner, which contains their history and assessment results. Some models based on MDA and QTI has been proposed (Radenković et al, 2008).

- **Context model**

This model allows to identify and to recognize the current context of every learner we identified, and should therefore reference context ontology.

- **Domain model**

The delivery of assessment in pervasive environments should be grounded in an efficient manner to retrieve key resources. This task can be achieved through metadata annotation of the assessment resources. In addition, we should refer to domain ontology and make it easier the retrieve and select resources which are adapted to a given domain.

- **Resource model (metadata model)**

The domain and resource models are used to index resources. Some metadata can be generated automatically (sometimes on the fly) from the tool databases according to common vocabularies like Dublin Core, SKOS, SIOC, FOAF, OPO, etc. Most of these vocabularies are lightweight ontologies that can fit well database schemas. On the contrary, learners and/or teachers need to define the relevant domain concepts describing a post (for instance).

5. Conclusion and future work

In this paper we have presented a scenario for learning and assessment in pervasive environments. This scenario allowed us to uncover the main challenges and issues that have to be face in order to deliver assessment in such environments. It also helped us define semantic models to enhance information retrieval and discovery in pervasive environments.

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