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Personalized feedback for self assessment in lifelong learning environments based on semantic web

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ABSTRACT

Feedback constitutes an important component of assessment in learning environments, as it allows learners to evaluate their progress in the learning process and helps tutors to personalize learning content according to learners' needs and profiles.

In this paper we propose an intelligent personalized feedback framework based on Semantic Web technologies, one that provides personalized feedback for self-assessment and that is appropriate for Lifelong Learning environment. The framework takes into consideration the level of complexity of each question in a self assessment test in order to decide on the type of individual feedback required. This process provides accurate information about the learner's level based on the result of their own participation in the assessment. The framework is based on semantic models for user information and feedback generation that ensure interoperability and reuse of Assessment and learning resources.

In our approach, a personalized feedback framework based on web services uses the information contained in the learner's profile to proactively assist them by suggesting personalized feedback and helping them overcome their shortcomings in a particular field of knowledge.

1. Introduction

There are several critical challenges, opportunities, and movements in learning that must be considered in the development and implementation of new learning environments. These include encouraging lifelong learning, valuing both informal and formal learning, addressing the open and social dimensions of learning, and recognizing the different contexts in which learning takes place, as well as the fundamental changes in the perception, technology and use of the Web in recent years. It is also crucial to address what today's learners need. As part of lifelong e-learning environments we observe that assessment plays a crucial role, as it helps learner have an idea on progress made in the learning process.

Indeed, the main objective of assessment is to generate information or feedback to learners which has several functions. The assessment information or feedback helps learners and teachers identify what e-Learning solutions to improve and how (Peterson & Irving, 2008). Several previous studies showed that learners find e-Learning systems more interesting from the moment when assessment and feedback are inextricably linked. If the assessment is an integral part of the learning process, feedback must play a central role in the evaluation process (Mayen & Savoyant, 2002) and the e-Learning environments in terms of expected results and access to information. In the ongoing web based assessment, educational feedback could directly affect what students learn and how they should proceed to be effective (Kerka & Wonacott, 2000).

Tutors' support is particularly important to facilitate feedback in online learning environments (Collis, De Boar, & Slotman, 2001). In addition, researchers discuss "the practical implications of feedback in spending time, clear expectations of learners and the efficiency of the management of global communication and feedback processes" (Mayen & Savoyant, 2002).

During the debate on the effectiveness of feedback in distance online education, it has been admitted that in a traditional learning environment, one could not provide strategic information at the same level if one was in a situation of online courses, even if the synchronous information was available in a classroom. These results indicate that the electronic feedback of the web based assessment process could be more effective than a traditional course (Mayen & Savoyant, 2002). Nowadays, personalization of

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feedback is increasingly becoming a crucial research topic in e-Learning systems. Indeed, personalized feedback can transform self assessment experience into a learning experience for learners.

Although implemented in different ways, current assessment management systems share a core common weakness: the assessment process do not focus on feedback and its utility for personalization of learning and assessment. Besides, while life-long learning is increasingly influencing university and the workplace, some critical issues still have to be worked out to make it achieve its full potential. There is then a need that assessment in this environment provides further feedback appropriate to each learner's profile to guarantee learning progress and to address the assessment expectations of learners. From this standpoint and recognizing the inadequacy of current assessment systems in higher education to achieve performance visibility, we suggest that we need to rethink the design of enhanced self assessment processes that make use of all information available in the learning environment and provide a personalized feedback to every learner.

In this paper, we describe our approach of a generic personalized feedback framework which starts from registered users' profile to enforce personalized feedback services where the user can receive a positive or negative feedback reflecting their skills. Furthermore, the approach takes into account the level of complexity of each question within a test or an exam. Our feedback framework has been integrated in a personalized web based assessment tool using semantic web technologies.

This paper is structured as follows: Section 2 provides insight into feedback classifications and work related to personalization of feedback. In Section 3, we describe the personalized feedback framework in a use case scenario. In Section 4, we use feedback and user's profile ontology in a system that generates personalized feedback. In Section 5, we explain how to generate personalized feedback and processing algorithm. The system architecture and web service are described in Section 6. A discussion of future perspectives concludes this paper.

2. Feedback in e-learning systems

Feedback is an important part of the assessment process as it allows teachers and students to take actions to overcome the difficulties of learning that are often demonstrated in assessment tests. The concept of feedback in assessment processes has several definitions. Feedback is defined as “information about the gap between the actual level and the reference level of a system parameter which is used to alter the gap in some way” (Walker, 2009). If this information is capable of producing changes in the general method, it can be seen as a learning process. If this process was then applied to the students, the return would be feedback on the learning process based on specific predefined objectives.

In our research, we propose an approach to customize feedback for knowledge assessment on semantic web. In this first study we present a process that provides personalized feedback to the learner within a web based assessment system.

A wide range of technologies, both generic and purpose-built, can be used to support almost all aspects of assessment and feedback. This includes support for the administration, management and design of authentic tasks, as well as the provision of feedback and screen tests. Although there are few examples of effective practice in this area, many institutions have not yet built a sustainable technology-enhanced assessment and practice of personalized feedback.

Several types of ranking feedback are presented in current literature (Dirks, 1997; Hancock, Shen, Forlines, & Ryall, 2005; Mason & Bruning, 2001). Effective feedback provides the learner with two types of information (Mason & Bruning, 2001): Verification which consists in informing the learner whether their answer is correct; and Development, which is related to tips and stimulation that guide the learner to the correct answer. Development may be informational, topic-specific or response-specific.

Feedback can be classified according to the level of verification and elaboration (Kulhavy & Stock, 1989):

- No feedback: simply gives the proportion of correct answers.
- Knowledge-of-response: tells the learner if the answer is correct or not.
- Answer-until-correct: provides verification without development and requires the learner to stay on the test to give a correct answer.
- Knowledge-of-right-answer: provides individual verification of the question and gives the correct answer to the learner.
- Topic-quota: provides verification elements and general elaborative information about the target subject.
- Response-contingent: provides feedback on the answer, which is why the correct answer is correct and the wrong answer is wrong.

In other classifications, the feedback can be immediate or delayed; and it can be presented in text, graphics, audio or video (Saul, Runardotter, & Wuttke, 2010; Vasilyeva, Puuronen, Pechenizkiy, & Rasanen, 2007).

In addition, feedback can be categorized into positive and negative. While negative feedback indicates a deviation from the expected answer, positive feedback indicates that a correct answer has been provided.

It is useful to ensure that the feedback, whether positive or negative, remains at the level of destination and does not affect the level of identity. There is therefore a need of a great vigilance when providing a personalized feedback.

The literature features some assessment systems that address feedback personalization. In Silva and Restivo (2012) a Feedback Module has been developed which uses both visual representations: a static visualization for the knowledge domain and a dynamic time-oriented visual representation for the student performance that helps students and teachers better understand the knowledge acquisition and change the interactions in the classroom for effective learning. In (Gouli, Papanikolaou, & Grigoriadou, 2002) the PASS System is described, which is a web based personalized assessment system. It also comprises a general feedback component to the learner, the question's parameters such as the initial difficulty level, the assessment parameters such as the termination criteria, as well as the weight of each educational material page and each prerequisite concept denoting their importance for the outcome concept. In (Lazarinis, Green, & Pearson, 2010) the authors describe iAdaptTest system, which is a desktop-based modularized adaptive testing tool conforming to the IMS QTI (IMS QTI), the IMS LIP (IMS LIP, 2005) and XML Topic Maps in order to improve the reusability and interoperability of the data. iAdaptTest provides only a few question types and the implemented feedback and help is rather simple and does not enable personalized support. The COMPASS (COnceptMapASSessment tool), described in (Gouli, Gogoulou, Papanikolaou, & Grigoriadou, 2004) is an adaptive web-based concept map assessment tool, which aims at assessing learners' understanding as well as supporting the learning process. COMPASS provides different informative and tutoring feedback components, tailored to the learner's knowledge level, preferences and interaction behavior. Besides both adaptive assessment systems SIETTE (Conejo et al., 2004) and CosyQTI (Lalos, Retalis, & Psaromiligkos, 2005) provide adaptive testing and present the learner with questions that are adapted to