User-centered design methods for validating a recommendations model to enrich learning management systems with adaptive navigation support

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Abstract. Recommendation techniques have shown to be successful in many domains (e.g. movies, books, music, etc.). This success has motivated us to research on how to deploy a recommending system in the eLearning domain to extend the functionality of standard-based learning management systems with adaptive navigation support. An initial model of the recommendation process has been developed from informal discussions with lecturers. This is now being elaborated and validated using a scenario-based user-centered design process. This paper presents the formal methodology to carry out this validation process.

Keywords: User-centred design methods, Elicitation process, Recommender systems, Learning Management Systems, Adaptation.

1 Introduction

Recommender systems (RS) support users in finding their way through the possibilities offered in web-based environments by highlighting information a user might be interested in from the information already available in the system. The first challenge for designing a RS is to define the users and their purposes [1]. RS in education should help and support both learners and teachers [2]. In particular, the RS's goal is to improve learning effectiveness and efficiency, as well as learners' satisfaction, while reducing the teachers' workload related to the follow-up and support of the learners. The approach followed by this research focuses on suggesting learners the most appropriate actions to take by the user in the learning management system (LMS) at each moment (i.e. navigation adaptation), which can vary from reading some specific contents that have been uploaded in the file storage after the course has been packaged to posting a comment in a blog to foster the learner to

reflect what has been learnt [3]. The RS takes as input i) the user profile (which can be dynamically built from the users' interactions) and ii) the current context (e.g. course, objective, platform tool, …). With this information, the appropriate actions (e.g. links to objects in the LMS with instructions on what to do and explanations to justify it purpose) are recommended to the current user. In a first phase, the recommendations are obtained from teachers by following the methodology described below. These recommendations serve a double purpose: 1) avoid the cold start problem of RS, and 2) feed machine learning algorithms to tune the recommendations and/or produce new ones from the experience inferred by analysing the interactions of the users in the system. The later is planned for a second phase in the research.

If the RS supplies appropriate recommendations to the learners in the context where they are relevant to help them while interacting with the LMS, the teacher will be relieved from providing this specific type of support and can focus on other educational activities: preparing contents suitable for the learners' needs (e.g. learning styles) or giving more detailed advice to specific situations that are not yet covered by the RS.

In the context of this research, the first efforts undertaken to build a knowledge-based recommender for the eLearning context are described elsewhere [3, 4]. As a result, a recommendations model [3] and a standard-based recommendations service that implements that model [5] were produced. The prototype has been integrated into the dotLRN open source standard-based LMS. A formative evaluation process was carried out, which include some small-scale studies with users that are reported in [4]. Very shortly, users had to interact with a course where they were recommended different actions depending on their learning styles and their situation in the course. Afterwards, they were asked to fill in a questionnaire about their perception of the RS output and their interest for the different types of recommendations.

2 Scenario-based user-centred design approach

When trying to define recommendations using the model, we have found that we lack the content and context to think about meaningful recommendations that address the real needs of learners in eLearning scenarios. Moreover, we realized that although we had tried to involve users in our work, we had not done it properly. At this stage, having already a recommendations model and a RS providing adaptive navigation support in an LMS, we realized that we needed to go back to the users and apply appropriate user-centred design methods to get these meaningful recommendations. The objective was twofold: 1) involve users to validate (and refine if needed) the model previously obtained, and 2) obtain samples of meaningful psycho-educational sound recommendations from current teaching practices. With the collaboration of experts in Human Computer Interaction and Psychology, a formal methodology which applies scenario-based methods, was defined to help us lead this process.

Scenario-based methods [6] are used to elaborate the design. They consist on involving the user in writing stories (i.e. scenarios) about the problems taking place in relevant situations that come to their mind. On top of these scenarios, the design team proposed solutions to these situations.

As commented in the introduction, recommendations address the needs of the learners when interacting with LMS and try to suggest the most appropriate actions to take depending on the current user in the current context. However, unlike RS for the entertainment domain, where the goal is to satisfy the users' preferences, in the educational domain psycho-educational considerations have to be taken into account. What a learner prefers may not be the most adequate for their learning. For this reason, the users involved in our study to elicit these scenarios are teachers and not learners. However, the outcomes of this study (i.e. the recommendations elicited) have to be checked with learners to assure that they are useful to them to reach the desired goal: learning effectiveness and efficiency, as well as learners' satisfaction. The plan established for this study covers the following four stages:

Stage 1: Briefing and initial data gathering on the participants' background

- In an introductory face-to-face session:
  - the aims and objectives of the research are explained to potential participants as well as the nature of the participation expected of them and the benefits for them
  - sample scenarios are presented to the participants, who are asked to think about them in order to obtain other scenarios that have occurred in their work
  - a consent form describing the conditions and requests is provided to the participant, which they can take home to read carefully before signing it
- After the face-to-face session, participants are given time to digest the information.
- If they agree to participate, they have to i) fill in an online questionnaire with demographic information, including information about their teaching experience and ii) sign the consent form and give it to the research team in the next face to face session (next stage).

Stage 2: Eliciting scenarios with the participants

- Individual face-to-face semi-structured interviews are arranged with the research team to build together a couple of scenarios that reflect the teacher's experiences.
- The interview is conducted by a primary researcher who poses the questions and a secondary researcher taking notes. In this way, one of the researcher focuses on following the reasoning of the participant, and the other checks that the relevant information to identify the recommendations is being provided.

Stage 3: Identifying the recommendations in the scenarios by the research team

- From the scenarios built in the interviews, the research team identifies recommendations and attempt to map them onto the recommendations model previously defined. If the information required to describe the recommendation does not map to the model, the model will be revised to include the new information. This process is done by three members of the research team, and then checked for consistency.
- The result of this process is an enriched scenario that includes recommendations that address the problems and situations identified by the teachers in their scenarios.

Stage 4: Review of the scenarios and the recommendations elicited

- In the first step in this stage, participants analyse individually the enriched scenarios proposed by the researcher which include the recommendations identified by the research team. They are asked 1) to state the relevance of each recommendation using a five point Likert scale and 2) to propose new

recommendations (or modifications to the existing ones) within the situation described in the scenario.
- After the revision by the participants, the research team aggregates scenarios that share similar situations and present a new (and reduced in number) set of enriched scenarios.
- To validate the results obtained, a focus group is planned. It will include some of the teachers who have built the scenarios, but also we are considering involving other roles, such as experts in the online teaching practices and learners. The goal is to discuss the set of enriched scenarios.

At the end of the four stages of the process, participants are provided with detailed information about the model and how the current prototype is running in dotLRN. The teachers are asked whether they would be interested in continuing the collaboration and applying the recommender system to one of their courses. If they agree, a new face to face session will be arranged to prepare the recommendations for the course. Moreover, if the model has been modified after the study, the previous prototype of the RS has to be modified accordingly.

Although it is still too early to draw conclusions on the application of the methodology, we think that our approach can be informative to other designers, and motivate them to work on a formal methodology that apply user-centered design methods from the very beginning of their research.

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