YourMOOC4all: a recommender system for MOOCs based on collaborative filtering implementing UDL

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Abstract. YourMOOC4all is a pilot research project to collect feedback requests regarding accessible design for Massive Open Online Courses (MOOCs). In this online application, a specific website offers the possibility for any learner to freely judge if a particular MOOC complies Universal Design for Learning (UDL) principles. User feedback is of great value for the future development of MOOC platforms and MOOC educational resources, as it will help to follow Design for All guidelines. YourMOOC4all is a recommender system which gathers valuable information directly from learners to improve aspects such as the quality, accessibility and usability of this online learning environment. The final objective of collecting user's feedback is to advice MOOC providers about the missing means for meeting learner needs. This paper describes the pedagogical and technological background of YourMOOC4all and its use cases.

Keywords: accessibility, MOOCs, recommender system, UDL, collaborative filtering, design for all.

1 YourMOOC4all recommender system

Massive Open Online Courses (MOOCs) are attracting a wide range of disabled learners, but there is still a gap in providing accessible platforms and educational resources to them [1]. Choosing which MOOC to enrol in, among many options, is one influential decision learners must undertake during online lifelong learning. The ambiguity of the factors to be considered may lead learners to miss chances or make wrong decisions that could affect their professional development.

Recommender systems have recently been used in the educational context advising learners to enrol in specific courses depending on learners' performance in previous courses [2]. The recommendations can be applied to particular parts of MOOCs, such as the forums where discussions can be difficult to track [3] or using external sources like opinions in social media [4]. The curriculum recommendation mechanism has not gone unnoticed by the big MOOC providers, edX or Coursera, for whom trying to offer courses of interest for their learners is a priority in their sustainable development and business model [5].

The objective of the recommender systems is to show learners elements according to their interests in a personalised way, but recommendation based on content has the disadvantage of not recommending elements that have never previously been sought by

the learner. The add-on of collaborative filtering helps to recommend new elements based on learner's preferences and also on the ratings of other learners on those appreciations [6, 7]; that is, the system makes automatic predictions about the interests of a user after accumulating opinions of many users [8] in a *"person-person correlation"* [9]. Applying the memory-based method, also called neighbourhood-based filtering algorithms, the recommendations made to a user are based on other users with similar ideas to that target user [10], building what is known as a neighbourhood.

Due to the high amount of MOOC offerings in the world, over 800 universities globally have launched at least one MOOC, existing more than 9K MOOCs [11], the need for specific recommender sites is indisputable. The work presented here, called YourMOOC4all[1], is a recommender system influenced by other systems that use learners' feedback. There exist several MOOC aggregator sites, such as CourseTalk[2], where learners can add feedback about the MOOCs they are participating in and receive recommendations based on their feedback. It is also possible to review different pedagogical aspects of the MOOCs, for instance by rating them or adding free text comments, which includes giving an opinion about the content of the MOOC, the provider, or the instructor.

There is a critical point ignored in the MOOC recommender systems while dealing with inclusive design and it is the lack of detailed information regarding the accessibility level to ensure that all learners can access the platform and the educational resources. Universal Design for Learning (UDL) offers a framework to evaluate MOOC design and determine possible improvements to make at an early stage of development [12]. Therefore, YourMOOC4all targets the accessibility in MOOCs for all learners aiming to get recommendations directly from user needs.

2 YourMOOC4all prototype

In this work, collaborative filtering is used and learner feedback is organised from a wide range of participants into a coherent and actionable structure. Among the advantages of the recommender systems based on collaborative filtering is the ability to represent elements based on the opinions of the community of participating learners. Learners are the best to provide compliments and criticisms of course designs, especially those with diverse needs [13]. YourMOOC4all is a programmed prototype in a testing stage [14]. The current version of the prototype includes the evaluation framework using UDL; the next version will link the questionnaire information into the recommender system through the learner's profile.

The evaluation process is created following the framework proposed by UDL principles[3]. These indicators have been developed by the authors based on the last guidelines version from 2018 implementing its three principles: (1) provide multiple means of engagement, (2) provide multiple means of representation and (3) provide multiple means for action and expression [12]. Table 1 shows the selected search criteria, the

[1] YourMOOC4all, http://yourmooc4all.lsi.uned.es

[2] Course Talk, https://www.coursetalk.com/

[3] UDL guidelines 2.2, http://udlguidelines.cast.org

information harvested from the MOOC providers and the UDL indicators for managing user's evaluation.

The technologies used throughout the project have been all open source, and are listed below:

- **Web server.** Ubuntu Server operating system version 17.4, with Apache to serve the static pages and Passenger to serve as an application server.
- **Harvesting**. To obtain information from MOOC providers, a gateway has been implemented using the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) standard that defines the XML (e.g., format, labels) of the content that can be collected.
- **Programming language and framework**. The language used for business logic is Ruby version 2.3.6. Ruby On Rails has been used in version 4.2.10, for the Framework used in the back-end of the web application. HTML5 and CSS have been used as layout languages.
- **Database.** The web hosting database server is PostgreSQL.

Table 1. Search criteria, harvested information and UDL evaluation

Search criteria	Harvested information	UDL evaluation
1. Course title 2. Theme 3. General information	1. Name 2. MOOC platform 3. Provider institution 4. General information 5. Learning objectives 6. Previous knowledge required 7. Target group 8. Accessibility information	1. UDL 31 indicators (Likert scale) a. Means of engagement (10) b. Means of representation (12) c. Means for action and expression (9) 2. Free text evaluations

Table 2. YourMOOC4all use cases

Use cases	
1. Search a course in the system. 2. Change system language. 3. Register\ Login the system. 4. Recover\ Change password.	5. Evaluating a MOOC. 6. Select a course as interesting. 7. Harvest information from platforms and MOOCs. 8. Manage the courses, institutions, platforms, languages, previous edition and users.

Table 3. Evaluating the use case success scenario

The action of the registered user	The system's response
1. The user enters the home page (home).	2. The system displays the homepage for unidentified users.
3. User clicks on the link "Login"	4. The system shows the login.
5. User fills in the email and password and clicks on the button "Login".	6. System checks that it is a valid user and shows the home page.
7. User does a search of the MOOC in which he is interested.	8. The system shows the results.
9. User clicks the evaluating icon.	10. The system displays a UDL form.
11. User completes the questionnaire and clicks on the button "Create evaluation".	12. The system records the evaluation and shows the new evaluation.

Eight use cases have been included, as shown in Table 2. The use case to evaluate a MOOC is formed by the following components and scenario (Table 3):

- **Main actor**: Registered user

- **Preconditions**: User must have an active account in the system.
- **Post-conditions**: User logins and evaluates a MOOC.
- **Alternative flow:** User clicks on the cancel button (11). The system returns to show the detail of the course that was being evaluated and discards the scores marked for this course (12).

3 Outcomes

In this work, learners' experiences on MOOC platforms are used to fulfil other learners' interests and diverse needs following UDL principles through a recommender system based on collaborative filtering. The aim of the project is to provide information to MOOC providers to integrate accessibility features into the platforms and educational resources, and to the learners who are in search of relevant and accessible MOOCs.

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