Recommendation Systems for Knowledge Reuse Management in MOOCs Ecosystems

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ABSTRACT

One of the most important open education resources nowadays are the MOOCs environments (Massive Open Online Courses). With the growing number of MOOCs providers appearing on the web, many students find it difficult to choose the best course. A promising approach is to treat it as MOOCs ecosystems inspired in the field of software ecosystems, which brings balance of the ecological environment and the strength of interactions. However, in MOOCs ecosystems, each student usually has individual characteristics, tastes and purposes. Therefore, recommendation systems have emerged with the purpose of assisting students in this decision process. This Master thesis aims to combine recommendation systems and MOOCs providers' platforms to help users to achieve their own specific goals based on a combination of courses or course modules. As a result, we aim to reduce users' knowledge gaps (new knowledge according to stakeholder's interests from different courses or parts of them) and to achieve knowledge reuse (platforms' software demands, improvements and sharing). In addition, this work investigates MOOCs ecosystem characteristics, exploring how this perspective can support providers' basic processes (e.g., MOOC learning support services functionalities, work team partnerships or alliances among companies which would benefit all stakeholders).

Keywords

MOOCs; Recommendation System; Software Ecosystem; Knowledge Reuse Management;

CCS Concepts

•Information systems→Information retrieval •Information systems→Recommender systems

1. INTRODUCTION

Massive Open Online Courses, also known as MOOCs, has been explored in recent years by users of several areas. MOOCs present some facilities that attract these users in search of knowledge. As the name suggests, MOOCs are open: they do not need a login, being free and available to start at any time, according to Frolov and Johansson [1].

This openness is a characteristic of the Open Online Education group, which MOOCs are part of, as shown in Figure 1. Open Education is one of the most important educational movements of the 21st century. It goes beyond mere access to content and resources and is associated with a new educational philosophy, new values based on openness, ethics of participation, and finally collaboration [2]. This fact differentiates MOOCs themselves from formal courses offered by universities, as shown in Figure 1, because these courses select participants, charge tuition, have credits, and apply limits to ensure interaction with instructors [3].

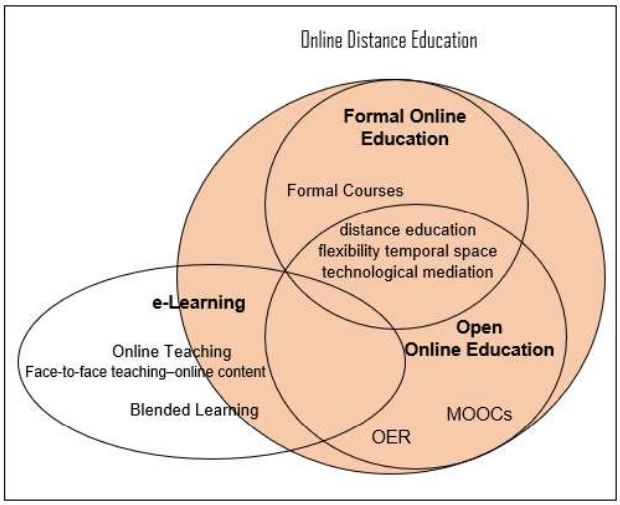

Figure 1. Constructs linked to Online Distance Education. Source: [2]

Nonetheless, formal online courses can share characteristics with MOOCs and other resources of this open education philosophy (acronym OER to Open Education Resources). As shown in figure 1, both are mediated by the technology, for example. According to

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Aires [2], e-learning (Figure 1) can represent all (or a part of) the educational model in which online courses are applied, exploiting electronic devices to allow access, evolution and improvement of education and training. MOOCs have some characteristics of e-learning, but also address the fact that "the participants are not part of the group of students enrolled in the institution; the courses are designed for an indeterminate number of participants and for free access via web; no tuition fee is charged; usually, credits are not assigned to participants at the end of the MOOC" [2].

In this context, the network composed of students, teachers, monitors, platforms and their developers can be observed from the perspective of software ecosystems, or more specifically, MOOC ecosystems [4]. However, some difficulties faced by MOOCs providers (sometimes, the same classic difficulties in Technology Enhanced Learning, or TEL) [5] are also transferred to these ecosystems. Students without feedback, lack of interaction among students and evasion level can be reduced if the ecosystem is in regular operation, i.e., allowing students to reduce knowledge gaps, acquire new knowledge according to his/her interests, and then achieve knowledge reuse.

An existing TEL difficulty is the choice of a specific course from several existing ones over a plethora of MOOCs providers that are currently available to several areas. Users have difficulties in knowing what the best courses (or course modules) for their personal goals are. In other words, the choice of a wrong course often leads to increased evasion rates for courses based on such platforms. [6]

Therefore, this Master thesis investigates how to combine recommendation systems and MOOCs providers' platforms to help users to achieve their own specific goals based on a combination of courses or course modules. As a result, we aim to reduce users' knowledge gaps (new knowledge according to stakeholder's interests from different courses or parts of them) and to achieve knowledge reuse (platforms' software demands, improvements and sharing). This work also investigates MOOCs ecosystem characteristics, exploring how this perspective can support providers' basic processes (e.g., MOOC learning support services functionalities, work team partnerships or alliances among companies which would benefit all stakeholders).

2. MOTIVATION

Based on the context presented in Section 1, we argue that this work is relevamnt to Information Systems since it involves studies on recommendation systems, knowledge reuse management and software ecosystems. In addition, it is relevant for Computes in Education, as out work investigates the context of technologies applied to MOOCs.

In order to solve the problem of choosing courses (or parts of them) from MOOCs' providers, some authors have already proposed solutions. Dhekne [7] presents a MOOCs' aggregator system from different providers. However, this aggregation does not recommend courses for students. Symeonidis and Malakoudis [8] explored course recommendations using approaches already known in the recommendation systems field.

Additionally, Raghuveer *et al.* [9] demonstrated that a feedback-based approach has greatly improved assistance to the learners. To do so, the authors use an algorithm called CRBL. This algorithm is based on learner parameters such as skills, preferences and knowledge, which are increased while the student interacts with the topics in a course learning path. However, it does not consider recommendations of part of courses, i.e., small modules forming an ideal set for the student's learning objective.

Based on those gaps, this Master thesis aims at improving the recommendation process, creating recommendations for parts of courses to achieve knowledge reuse in MOOCs ecosystems. Our goal is to optimize knowledge management and ensure benefits for all stakeholders.

3. RESEARCH PROJECT

The first step of this work was to define a research question that will lead us to better explore the technical literature in order to propose a solution. The research question defined is:

What structures and components are needed to reduce knowledge gaps in the MOOCs ecosystems by considering stakeholders' interests so that these MOOCs platforms are improved?

3.1 Methodology

The research methodology adopted in this work consisted of three phases: I) literature investigation through planning and executing a systematic mapping study; II) specification and implementation of a recommendation system for MOOCs ecosystems; and III) evaluation of the proposal based on a quali-quantitative method.

In order to answer our research question and follow the second phase of our research methodology, some important steps were identified in this work:

I) **First step**: fill the existing gap in modeling MOOCs ecosystems. As addressed by Shanyun *et al.* [4], MOOC is "the new development of distance education", but several elements come from virtual learning community ecosystems, failing to reflect the uniqueness of the MOOCs learning community ecosystem;

II) **Second step**: use a structure of a MOOCs aggregator system compiled by Dhekne [7], known as MOOCLink. According to the author, with MOOCLink, a user can make an informed decision by just visiting the MOOCLink website and he/she can quickly compare courses offered by several MOOC providers in the same place. The aim of this system is to helps a user to solve one of the biggest problems of looking through multiple course providers [7];

III) **Third step**: after collecting the MOOCLink structure, we will specify and include a recommendation module. The goal is to create a recommendation system to recommend courses or part of them to users.

3.2 Data Gathering

With the recommendation system organized and the MOOCs ecosystems modeled, it will be possible to achieve our objective: to use the recommendation as a mechanism to support learning using the knowledge generated in this process.

To do so, the course data will be extracted from four MOOC providers (Coursera, Udacity, Khan Academy, and OCW). These providers offer means to obtain data based on the open perspective of the MOOCs. All of them have APIs that allow, for example, the extraction of information from several courses. This data will be stored and organized in LOD (Linked Open Data), thus following the MOOCLink system standard, according to the second step of our methodology. In the next section, the third and last phase of the methodology is presented.

4. EVALUATION PROJECT

The third phase of our methodology requires planning and executing a quali-quantitative method to evaluate our solution and collect evidence to answer the research question. In the first stage (quantitative), we will conduct a controlled experiment to analyze performance, efficiency and effectiveness of the recommendation system for MOOCs ecosystems, comparing results with those from related work. As explained in Travassos [10], an advantage of a controlled study is that qualitative data promote comparison and statistical analysis and it can help to build a reliable knowledge base and thus reduce uncertainty.

The second stage is classified as qualitative and will contain a feasibility study, evaluating the solution in a real world situation where two groups of subjects: one group will perform the tasks using the proposed solution and the other will not. At the end of the study, results will be compared. The sample is formed by students of the Brazilian federal education institution. There are several courses for technical high school and undergraduate programs. Some students have already been employed and they are mostly concluding their courses. The main aspect to be investigated is the effectiveness of the proposed recommendation system and whether it can be more optimistic than the existing solutions (related work). We will apply an evaluation questionnaire to get feedback from participants and we will collect data from repositories and applied documents to analyze elements of our proposed solution.

At the end, this step seeks to identify if our recommendation system works successfully. This will be positive if our solution satisfies users' needs, i.e., suggest exactly the best MOOCs (or parts of them) according to the user's needs. Moreover, we intend to use the evaluation to better understand MOOCs ecosystems' components and the clarity of ecosystem modeling. Finally, we hope to collect information regarding the dropout rate.

5. PERFORMED ACTIVITIES

This project initially aimed at structurally reinforcing the modeling of MOOCs ecosystems (item I of section 3). There was an initial effort of researching and writing research background based on current gaps (Section 2). It was observed that this problem was not sufficiently expandable for a Master research. As such, was decided to invest in other aspects that were presented previously in this article, including recommendation systems as a research context and the context of software ecosystems as our motivation in the Information Systems area.

After this change, few steps have already been taken. The literature study stage has been consistently taken (it is considered complete). Another step that has been taken is the proposal definition, as presented in previous sessions. As part of this Master thesis, a systematic mapping of recommendation systems for MOOCs is ongoing. This is the first phase of our methodology and aims to investigate frequency/quantity/variety of publications in the literature. As such, we can narrow the coverage of this research. We also obtained the open source MOOCLink provided by [7] to execute the step described in item II of Section 3.

6. CONCLUSION

The increasing use of MOOC platforms around the world contributes to the knowledge globalization. Improving the functioning and optimization of these environments is an important research contribution to the open education community.

From the technical side, when the proposed solution is reached, this work will provide other contributions already discussed in this research, such as better understanding on the characteristics MOOCs' recommendation systems and their effect on a MOOC environment; a model for MOOCs platform providers explore the ecosystem perspective; and an evolution of a process for recommending courses (and parts of them) to any other context.

Step III of Section 3 will be performed. It refers to specification and implementation of a recommendation system for MOOCs ecosystems. After concluding this step, the quali-quantitative evaluation (Section 4) will be planned and executed so that it can allow us to analyze data and compare results.

7. REFERENCES

[1] Johansson, S. and Frolov, I. 2014. An Adaptable Usability Checklist for MOOCs : A usability evaluation instrument for Massive Open Online Courses.

[2] Aires, L. 2015. E-Learning, Online Education and Open Education: A Contribution to a Theoretical Approach. *RIED Revista Iberoamericana de Educación a Distancia*, 19. https://doi.org/10.5944/ried.19.1.14356. (In Portuguese)

[3] Goto, M.M.M. 2015. O impacto dos MOOCs (Massive Open Online Courses) nas instituições de ensino superior: um estudo exploratório. https://doi.org/10.11606/D.12.2015.tde-01102015-172501. (In Portuguese)

[4] Shanyun, K., Qin, S. and Guolin, Z. 2016. Research on the Construction of MOOC Learning Community Ecosystem Circle. *Proceedings - International Conference of Educational Innovation Through Technology EITT 2015*, 2, 199–203. https://doi.org/10.1109/EITT.2015.49

[5] Kalz, M. and Specht, M. 2014. Assessing the crossdisciplinarity of technology-enhanced learning with science overlay maps and diversity measures. *British Journal of Educational Technology*, 45, 415–27. https://doi.org/10.1111/bjet.12092

[6] Bousbahi, F. and Chorfi, H. 2015. MOOC-Rec: A Case Based Recommender System for MOOCs. *Procedia - Social and Behavioral Sciences*, Elsevier B.V. 195, 1813–22. https://doi.org/10.1016/j.sbspro.2015.06.395

[7] Dhekne, C. 2016. MOOCLink: Linking and Maintaining Quality of Data Provided by Various MOOC Providers.

[8] Symeonidis, P. and Malakoudis, D. 2015. MoocRec.com : Massive Open Online Courses Recommender System. *Social and Behavioral Sciences*,. https://doi.org/https://doi.org/10.1016/j.sbspro.2015.06.395

[9] Raghuveer, V.R., Tripathy, B.K., Taranveer, S. and Saarthak, K. 2014. Reinforcement learning approach towards effective content recommendation in MOOC environments. https://doi.org/10.1109/MITE.2014.7020289

[10] Travassos, G.H. 2002. Introdução à Engenharia de Software Experimental. (In Portuguese)