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Virtual Patients in Massive Open Online Courses – Design Implications and Integration Strategies

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Abstract. Massive Open Online Courses (MOOCs) are raising extensive attention across disciplines, while it becomes evident that rethinking of learning designs that work well in these environments is needed. In the field of medical education, where the technology of MOOCs is not widely adopted yet, we wish to investigate the potential offered by virtual patients for the purpose of clinical reasoning skills training. In this paper we describe three use case scenarios employing virtual patients' features in MOOCs: (1) collective evaluation of decision making in the context of uncertainty; (2) collective repurposing of cases and division of discussion into subgroups focusing on local variances in healthcare; (3) division of content in short cases for flexible selection and adaptive learning with virtual patients. We also present technical requirements for implementing the use case scenarios and future work plans.

Keywords. Massive open online courses, virtual patients, e-learning, medical education, integration.

Introduction

Massive Open Online Courses (MOOCs) form a recent trend in education, raising extensive attention across disciplines. Heralded as the new disruptive innovation, it promises open access to prestigious universities' courses, on an unprecedented scale [1]. The rise of MOOCs is fuelled by rapid advances in the development of Internet technologies, predominantly offered by cloud computing infrastructure [2]. Yet, for many communities, including healthcare education, the true added value in terms of educational benefits remains uncertain [3].

Despite the fact that the first MOOCs were created taking an innovative, connectivist stance featuring collaborative learning, many of the massive courses that followed took a behaviouristic approach that emphasizes individual learning and passive knowledge transmission [4]. This is regarded by many as a step back in the evolution of education that calls for rethinking of MOOCs' learning designs [5]. For instance, Chris Dede argued that from the three features required in high quality

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teaching – cognitive knowledge, situated learning and a learners' community – MOOCs provide only the first one [6]. Another issue raised by Grünewald et al. regards the need of MOOCs to provide opportunities for experiential learning [4].

The healthcare education community has noticed with curiosity the emergence of the MOOC technology [7], however in terms of implementation the discussion has just begun. In this paper we wish to focus the attention of the discussion on the potential offered by MOOCs to foster clinical reasoning – a skill fundamental for the quality of healthcare services. In a seminal paper Cook et al. suggested virtual patients (VPs) as the key technology to enhance the skills of clinical reasoning [8]. VPs defined as "interactive computer simulations of real-life clinical scenarios" [9] have potential features to remedy some of the problems addressed currently in MOOCs, enabling interactivity, experiential learning and fostering specific medical skills.

The purpose of this study is to discuss the opportunities of extending MOOCs with VPs focusing on clinical reasoning. We aim to leverage and combine the unique benefits provided by both educational environments. We investigated in particular:

- How can VP features leverage MOOC possibilities?
- What are the technical requirements for implementing VPs in MOOCs?

1. Methods

1.1. Exploring scenarios for use of VP features in MOOCs

The starting point of our analysis was a framework for design and evaluation of MOOCs by Grover et al [10]. Maximization of utility for utmost diverse learners' groups was set in that paper as the imperative for effective construction of MOOCs. From the indicated approaches we selected two for further research on the possibility of their implementation using VPs at massive scale: a) Distributed nature of intelligence; in particular, moving the instructors' roles from the instructors to the participants, to enable greater learner self-organisation and opportunities for sharing knowledge. b) Mass customization; understood in the context of education as offering different learning outcomes for different learning groups. Next, we made a thematic literature review of VP features, known from previous projects, and potentially addressing the desired MOOC qualities. Analysed were in particular outcomes of the eViP project, a pan-European initiative aimed at adaptation of VPs for diverse context [11]. This led finally to the presentation of scenarios for utilizing the explored VP features in MOOCs.

1.2. Investigation of technical requirements

The identified scenarios were further analysed to elaborate technical requirements for their practical implementation as MOOC learning activities. We have systematized this task by the activity theory – already applied before in the analysis of VP activities [12]. In order to focus on the required technical tools we selected a variant of the framework proposed by Wilson, being a harmonization of Bedny and Engeström approach [13].

At this stage we also considered technical requirements imposed by the context of the planned application: the integration of the edX MOOC platform with Open Labyrinth VP system. Access to the MOOC platform was enabled by the joining of the authors' institution in 2013 to the edX initiative [14]. Open Labyrinth [15] is at the moment of writing the most advanced, free available, open-source VP system. We looked also into existing standards to support the integration task, and our previous experience in (non-massive scale) integration of Virtual Learning Environments (VLEs) with VPs [16].

2. Results

2.1. Scenarios for using VP features in MOOCs

Use Case A: Collective evaluation of decision making in the context of uncertainty. In this scenario we provide the wide audience with VPs containing ill-defined clinical problems: i.e. with sparse or conflicting clinical data. In such situations even experts are not uniform in their decisions. The unfolding of the case will stop at this stage for a few days enabling collection of responses in an answer format following the Script Concordance Testing (SCT) approach [17], implemented already in some VP systems (e.g., CASUS; "Network Answer" [18]). In the resolution of the case, participants in the course are presented with a summary of answers given by the mass audience, may discuss their responses on-line, and benchmark their overall performance based on a scoring process adopted from SCT [17]. This requires that weights of experts' answers are high and fixed. For regular users it may evolve starting from the zero level and increase based on the learner's performance. In that way the distributed intelligence of the MOOC audience informs the individual clinical reasoning process.

Use Case B: Collective repurposing of cases and division of discussion into subgroups focusing on local variances in healthcare. Even though the foundations of medical knowledge ought to be globally the same, the diagnostic and treatment process undergoes variations following cultural, legal and financial differences. The narrative of the VPs story introduces a context that could be discussed by the mass audience in separated discussion boards to address the optimal proceeding e.g., at the national or regional level. Repurposing of the context of VPs, but not on a massive scale, has been already tested in the eViP project leading to interesting insights [19]. Transfer of this activity on a massive scale will deepen discussion and enable addressing learner's individual healthcare context.

Use Case C: Division of content into short cases for flexible selection and adaptive learning with VPs. We propose to design VPs for MOOCs by building short cases focusing just on the most important step in the decision making process (as in key-feature VPs [20]), rather than presenting long and complex patient stories. This enables building large VP collections from which learners can select those which meet their individual objectives. When expanding this idea, the next step is to integrate those cases with computational models allowing experimenting with the content ("what-if-nodes") or generating populations of similar VPs ("multiple-case-packages") [21].

2.2. Technical requirements

Fig. 1 depicts our approach to identify the technical requirements for implementing the proposed use cases. This focused our discussion on the tools ("T" in Fig. 1) needed to enable interactions between the elements of the information system.

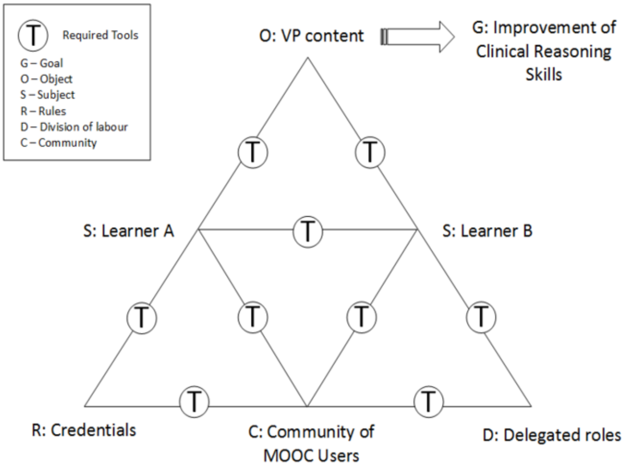

Figure 1: Identification of tools required for introduction of VPs in MOOCs using the activity theory [13].

The relationships between the learners, type of access to VP content depending on the role of the MOOC participant, and rules for acquiring credentials, require an identity management mechanism to be shared between the MOOC platform and VP system. We envision this being implemented by sharing authenticated sessions using the IMS LTI standard [22]. The personalized access to content is to be achieved by a systematic indexation of the VPs with metadata, preferably using Healthcare LOM standard [23], as demonstrated by projects as eViP [11]. Filtration and prioritization require also the implementation of competency assessment tool executed on enrolling users in the MOOC [24]. We plan to enable a self-formation of a hierarchy in the MOOC user community using a karma point mechanism [10]. This would enable assigning more teaching roles to the learners (e.g., in moderation of discussion or influence on SCT grading). Distributed discussion of the VP content addressing cultural adaptation requires a wiki-like mechanism enabling forking of the case into local in parallel-edited adaptations, managing different versions and provenance of the changes. Finally, documentation of achievement of the planned learning objectives in VPs requires a technical infrastructure for digital badges [7]. We expect its implementation to be simplified and standardized by the application of MedBiquitous' specifications for reporting learning competences and activities [23].

3. Discussion

In this paper we investigated the possibility of extending MOOCs by VPs, aiming at improving clinical reasoning skills. We signaled in three use cases how features known from VPs: SCT questions; cultural repurposing; short "key-feature" cases and integration with computational models, may leverage the mass customization and distributed intelligence. The practical usefulness of the solutions and the exact roles of the stakeholders are to be addressed and evaluated in planned future studies.

Technical requisites for these scenarios, but also opportunities arising from existing standards and collected experience were discussed; the proposed solutions are currently in early stages of implementation in Open Labyrinth and edX platform, but we envision they generalize well to different MOOC platforms and VP systems.

Even though there is still a long way to go for a full implementation, our results point out new ideas for extensions of MOOC platforms in the healthcare context. This leads from the passive presentation of videos, common in contemporary MOOCs, to more discipline-specific solutions, taking advantage of the audience's distributed intelligence and enabling mass customization.

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