e-Health – For Continuity of Care
C. Lovis et al. (Eds.)
© 2014 European Federation for Medical Informatics and IOS Press.
This article is published online with Open Access by IOS Press and distributed under the terms of the Creative Commons Attribution Non-Commercial License.
doi:10.3233/978-1-61499-432-9-788

Virtual Patient Repositories - A Comparative Analysis

Julia KÜFNER[a,1], Andrzej A. KONONOWICZ[b,c], Inga HEGE[a]
[a] *Institut für Didaktik und Ausbildungsforschung in der Medizin, Klinikum der Ludwig-Maximilians-Universität München, Germany*
[b] *Department of Learning, Informatics Management and Ethics, Karolinska Institutet, Stockholm, Sweden*
[c] *Department of Bioinformatics and Telemedicine, Jagiellonian University Medical College, Krakow, Poland*

Abstract. Virtual Patients (VPs) are an important component of medical education. One way to reduce the costs for creating VPs is sharing through repositories. We conducted a literature review to identify existing repositories and analyzed the 17 included repositories in regards to the search functions and metadata they provide. Most repositories provided some metadata such as title or description, whereas other data, such as educational objectives, were less frequent. Future research could, in cooperation with the repository provider, investigate user expectations and usage patterns.

Keywords: virtual patient, repository, metadata, Healthcare LOM, eViP

Introduction

Virtual Patients (VPs) are defined as "specific type of computer-based programs that simulate real-life clinical scenarios; learners emulate the roles of health care providers to obtain a history, conduct a physical exam, and make diagnostic and therapeutic decisions" [1]. Today, VPs are an important component of medical education, but the amount of labor and expense involved in their creation and maintenance is high [2].

Addressing the issue of labor and expense, recent VP-related research has been focused on enabling faculties to share VPs to reduce effort and costs. This can be realized in different ways: To foster the exchange of VPs, the MedBiquitous Virtual Patient (MVP) standard has been developed and implemented over the past years [3, 4]. Moreover, medical schools have undertaken efforts to collaboratively develop and use VPs in the recent past. For example, Berman et al. [5] describe the creation of pediatric VPs that were used by more than 70 medical schools. Finally, web-based repositories allow faculties to either access VPs directly or download, adapt and further use them.

Concerning the latter, little has been published to date about available repositories, which resources they provide and how teachers and learners can use them. For example, a PubMed search for "virtual patient collection" and "virtual patient repository" in title/abstract returned no results.

[1] Corresponding Author: Julia Küfner, E-mail: julia.kuefner@med.uni-muenchen.de

To be able to use and search such repositories in an efficient way, the provision of meaningful metadata and a sophisticated search and filter functionality are indispensable components.

A widely adopted standard to describe metadata in healthcare education is the Healthcare Learning Objects Metadata standard [6], which extends the Learning Objects Metadata (LOM) standard [7], adding healthcare specific descriptions such as keywords from medical taxonomies. Healthcare LOM was also the basis for the development of the eViP profile [8] – a selection of relevant metadata to describe and exchange VPs.

The aim of our research was to provide an overview of VP repositories and the metadata they provide for users.

1. Methods

1.1. VP repositories

We systematically searched PubMed, Scopus, EMBASE, PsycINFO, CINAHL/EBSCO, and ERIC using the search terms "virtual patients" and "virtual patient" in title and/or abstract. The last date of our search was May 30, 2013. We excluded all non-educational and non-English-language articles, as well as articles not mentioning the word “virtual patient” within the text. All articles were scanned for references to VP repositories. In addition, we checked cross-references from repositories to other repositories.

1.2. Analysis of repositories

For our analysis, we included publicly accessible repositories (with or without registration) that contained at least one virtual patient. We analyzed the repositories with regard to the metadata, search functionality and filter criteria they provide. As a basis, we used the metadata defined in the Healthcare LOM Standard. We also counted the number of VPs by applying filter and search functions provided. If "virtual patient" was not available as a criterion, we used similar terms, such as "cases". The analysis was done in August 2013.

2. Results

2.1. VP repositories

We identified 573 citations, applying our search strategy. We included and scanned 289 articles for our study, excluding 21 non-English-language and 263 non-educational articles. Overall, we discovered references to 31 repositories from which 14 were excluded – six were not (publicly) available and eight did not contain any VPs. Table 1 gives an overview of the 17 included repositories.

Table 1: Overview of the 17 repositories.

Repository	Number of VPs (languages)	VPs only	Search/ Filter	Feedback/ Evaluation
BMJLearning [9]	745 (en)	No	Yes	comments, rating
CHEC_CESC [10]	86 (en, fr)	No	Yes	comments
EHLS [11]	5 (en)	No	No	comments
e-MedEdu [12]	23 (en)*	No	Yes	comments
eViP [13]	340 (en, de, pl, se, ro)	Yes	Yes	-
HEAL [14]	1 (en)	No	Yes	-
IML [15]	22 (de)	No	Yes	-
Jorum [16]	79 (en)	No	Yes	-
KELDAmed [17]	304 (en, de)	No	Yes	-
LRSMed [18]	118 (en, de)	No	Yes	evaluation
MedEdPortal [19]	36 (en)	No	Yes	comments
MedU [20]	145 (en)	Yes	Yes	-
Meducator [21]	32(en, gr)	No	Yes	-
MERLOT [22]	16 (en)	No	Yes	comments, rating
MyCourses [23]	70 (en)	No	Yes	-
PINE [24]	60 (en)	Yes	Yes	-
VirtualPatient-Work.net [25]	89 (en, de, es)	Yes	No	-

* Other resources were in Korean and could not be evaluated.

None of the repositories indicated how many users had accessed a VP.

2.2. Analysis of repositories

Basic descriptive data - for example, title, author and description - are provided by more than 50% of the repositories, whereas metadata such as target group or educational objectives were less prominent. Table 2 gives an overview of the metadata most often provided by the 17 collections.

Table 2: Overview of most the common metadata provided by the 17 repositories, based on the eViP profile and the LOM / Healthcare LOM (HLOM) standards.

Metadata	Number of repositories	in eViP profile	(H)LOM
Title	17	Yes	LOM 1.2
Author/Institution/Contact details	15 / 10 / 3	Yes	LOM 2.3
Description	14	Yes	LOM 1.4
Date of Upload / Last Update	10 / 3	Yes	LOM 2.3
Discipline	10	Yes	HLOM 1.5
Language	10	Yes	LOM 1.3
Keywords	9	No	LOM 1.5
Learning Resource Type	10	No	LOM 5.2
Copyright Information	9	Yes	LOM 6.2
Target group	7	No	HLOM 10.1.4
Educational objectives	4	No	HLOM 9.3
(Typical) Learning time	3	No	LOM 5.9

Further metadata are covered by single collections only. These are: level of interactivity (LOM 5.1 & 5.3), version and status of VP (2.1 & 2.2), costs (LOM 6.1, eViP profile), and other non-LOM- (but eViP-profile-) covered data, such as age and sex of the VP, and the VP system in which the VP was developed.

Not included in any collection were metadata like difficulty (LOM 5.8), description of how a VP can be used (LOM 5.10), and the user's role within the VP (LOM 5.5).

3. Discussion

3.1. VP repositories

We identified 17 publicly available repositories that contained at least one virtual patient. 12 of these contained many other e-learning resources, but four provided VPs only. For our study, we focused on the identification of metadata and search functionalities, but future research could target other aspects, focusing particularly on the specialized VP collections. Interesting aspects might include, for example, usability, usage pattern and statistics (who is using the collections and how). This type of analysis could give important input into the discussion of whether and how such collections support the exchange and sharing of virtual patients among institutions.

An advantage of sharing VPs through a repository is the possibility to provide tools for feedback (e.g., commenting or rating), which are implemented in seven repositories. Teachers and students who have used a VP can provide feedback on the quality or share their experience on how they integrated the VP into the curriculum. We did not systematically investigate whether and how such feedback tools are used, but our impression was that it is rarely used in most repositories. Reasons for this could be that the VPs have not yet been accessed very often (this information is not provided by the repositories), or that users do not go back to the repository after accessing a VP.

3.2. Analysis of repositories

In order to efficiently support an exchange of VPs, a repository should, apart from other aspects, be easy to use and efficient in providing the VP that a user (teacher or student) is looking for. This means that both search functionality and the metadata describing the VP need to be designed carefully.

Our study showed that "basic" metadata, such as title, description or author information, are available in most of the repositories. Surprisingly, other metadata, such as target group or educational objectives, are neither included in the eViP profile nor frequently provided in the repositories. We did not conduct a survey on user expectations or usage patterns to judge user preferences. However, we expect that such data is indeed relevant for users in assessing whether a VP is suitable for a required purpose. To further elucidate this, a survey of user expectations is required. Using medical taxonomies, such as ICD-10 or MeSH, which have also been recommended for the eViP profile, can improve the quality of free text metadata, such as keywords or discipline. It is also important to note that even if repositories support the structured entry of all relevant metadata, it is still up to the VP provider to enter all data in a meaningful way. So far, it remains unclear which way of sharing VPs – collaborative development, repositories, or direct exchange via MVP – is more frequent or more conducive to fostering an exchange. Some collections, such as MedU [5,20], have been developed through a collaborative interfaculty approach, while others, such as eViP [13], offer VPs for both direct access and download as MVP packages. In our opinion, such combinations of approaches could give direction to future repository concepts.

The aim of our study was to give a rough overview of the existing repositories containing VPs and the metadata they provide. We did not, however, investigate details of the VPs (e.g., characteristics or quality of content) provided in the repositories or evaluate user expectations and usage patterns. These interesting aspects could be addressed in cooperation with the repository providers in future studies.

References

[1] Candler C. Effective use of educational technology in medical education. Washington D.C.: *AAMC* Institute for Improving Medical Education. 2007; 7p.

[2] Huang G, Reynolds R, Candler C. Virtual patient simulation at U.S. and Canadian medical schools. *Acad Med*. 2007; 82(5): 446-451.

[3] Kononowicz AA, Heid J, Donkers J, Hege I, Woodham L, Zary N. Development and validation of strategies to test for interoperability of virtual patients. *Stud Health Technol Inform*. 2009; 150: 185-189.

[4] Smothers V, Azan B, Ellaway R. ANSI/MEDBIQ VP.10.1- 2010 MedBiquitous Virtual patient standard. *MedBiquitous Consortium* [Internet]. 2010 Apr 6 [cited 2014 Jan 18]. Available from: http://tinyurl.com/noy2xdt

[5] Berman NB, Fall LH, Chessman AW, Dell MR, Lang VJ, Leong SL, Nixon LJ, Smith S. A collaborative model for developing and maintaining virtual patients for medical education. *Med Teach*. 2011; 33(4):319-24.

[6] Smothers V. ANSI/MEDBIQ LO.10.1-2008 Healthcare learning object metadata specifications and description document. *MedBiquitous Consortium* [Internet]. 2009 Sep 30 [cited 2014 Jan 18]. Version No.: 1.1. Available from: http://tinyurl.com/l7w9gv

[7] Institute of Electrical and Electronics Engineers, Inc. Draft standard for learning object metadata. IEEE-Standards Association Learning Technology Standards Committee [Internet]. 2002 Jul 15 [cited 2013 Nov 18]. IEEE 1484.12.1-2002 Available from: http://tinyurl.com/6rwxxha

[8] eViP Technical Reference Group. VP Profile implementation and conformance testing. [Internet] 2009 Jan 1 [cited 2014 Jan 18]. Deliverable number: D2.2. Available from: http://tinyurl.com/okb4l39

[9] BMJ Learning [Internet]. UK: BMJ Publishing Group [cited 2013 Aug 15]. Available from: http://www.bmjlearning.com

[10] CHEC-CESC [Internet]. CA: The Association of Faculties of Medicine of Canada [cited 2013 Aug 15], Available from: http://chec-cesc.afmc.ca/library

[11] EHLS [Internet]. US: University of Utah [cited 2013 Aug 15]. Available from: http://library.med.utah.edu/km/onlinetutorials.php

[12] E-MedEdu [Internet]. Korea: Sungkyunkwan University School of Medicine [cited 2013 Aug 15]. Available from: http://www.mededu.or.kr/

[13] Electronic virtual patients (eViP) [Internet]. EU: Evip Electronic Virtual Patients [cited 2013 Aug 15]. Available from: www.virtualpatients.eu

[14] HEAL [Internet]. US: University of Utah [cited 2013 Aug 15] Available from: http://library.med.utah.edu/heal/

[15] IML [Internet]. CH: University of Bern [cited 2013 Aug 15]. Available from: http://e-learning.studmed.unibe.ch/

[16] Jorum [Internet]. UK :University of Manchester [cited 2015 Aug 15]. Available from: http://dspace.jorum.ac.uk/xmlui/

[17] KELDAMed [Internet]. DE: University of Heidelberg [cited 2013 Aug 15]. Available from: http://www.umm.uni-heidelberg.de/apps/bibl/KELDAmed/

[18] LRSMed [Internet]. DE: Essen University Hospital [cited 2013 Aug 15]. Available from: http://www.lrsmed.de/

[19] MedEdPortal [Internet]. US: Association of American Medical Colleges [cited 2013 Aug 15] Available from: https://www.mededportal.org/

[20] MedU [Internet]. US: MedU [cited 2013 Aug 15]. Available from: http://www.med-u.org/

[21] Meducator [Internet]. GR: mEducator consortium [cited 2013 Aug 15]. Available from: http://www.meducator2.net/searching/

[22] MERLOT [Internet]. US: California State University [cited 2013 May 11]. Available from: www.merlot.org

[23] Mycourses [Internet]. US: Harvard Medical School [cited 2013 May 11]. Available from: http://mycourses.med.harvard.edu/public/

[24] PINE [Internet]. CA: Inukshuk Wireless, Northern Ontario School of Medicine, Laurentian, McMaster, and Ryerson Universities and Confederation College [cited 2013 Aug 15]. Available from: http://pine.nosm.ca/pine/

[25] Virtual-Patient-Work.Net [Internet]. DE: Institute of Occupational and Environmental Medicine, University of Munich [cited 2013 Aug 15]. Available from: http://www.networm-online.eu/