

OPTIMED Platform: Curriculum Harmonisation System for Medical and Healthcare Education

Martin KOMENDA^{a,1}, Daniel SCHWARZ^a, Christos VAITSIS^b, Nabil ZARY^b,
Jaroslav ŠTĚRBA^c, Ladislav DUŠEK^a

^a*Institute of Biostatistics and Analyses, Faculty of Medicine, Masaryk University*

^b*Department of Learning, Informatics Management and Ethics, Karolinska Institutet*

^c*Department of Paediatric Oncology, Faculty of Medicine, Masaryk University*

Abstract. This contribution introduces a new web-based OPTIMED platform for an effective harmonisation of medical and healthcare curriculum. Behind the engineering background stays an original methodology covering planning model based on formal parameterisation of curriculum, which fully support the outcome-based approach to education. With the use of developed system curriculum, designers and senior guarantors can provide a clear and transparent composition of compulsory and optional courses, and easily identify potential duplicities and overlaps across a domain of medical and healthcare education. For students, it means an absolutely new way of how to understand what is really taught during a learning period, including all necessary meta information. All members across the academic community are able to search and consequently display in detail the most important domains related to the particular year, term, course, medical discipline or topic. The presented solution significantly enhances the transparency and continuity of the environment in which the authors of the teaching materials as well as their consumers work daily. Suggestions for future improvements of the OPTIMED platform are discussed.

Keywords. Curriculum. Education. Medical informatics. Planning Techniques. Program Development.

Introduction

In most cases, the use of various multifunctional virtual learning environments to manage different aspects of academic daily activities fully satisfies the need for effective teaching and learning process [1]. Despite that, many higher education institutions (HEIs) have been continuously pushing through the essential role of high-quality curriculum management, particularly in medical and health care education, because medicine does not allow any gaps and undesirable duplicities in the knowledge obtained during studies, and any error in practice may lead to fatal consequences.

Generally, curriculum management systems are characterised as online interfaces directly connected to others local institutional databases that allow transparent proposal, creation, revision, approval, audit and assessment of established curricula. Existing solutions published so far [2–8] are focused on the curriculum only from

¹ Corresponding Author. komenda@iba.muni.cz.

a certain perspective, offering the agenda together with selected functionalities and making the efforts to provide them to students and teachers of the respective institution in a well-arranged form. It seemed that existing systems, alone or in combination, were far from ideal, primarily due to a complex structure of curriculum, innovative assessment methods, and controlled vocabulary. What can be done to meet global HEIs requirements and provide curricula more transparent and simplified? Within this context, we decided to propose own methodology based on the outcome-based concept of education [9,10] including the development and implementation of modular system for medical and healthcare curriculum harmonisation.

1. Methods

In accordance with approved paradigm of learning outcomes as a fundamental building block of education [11], we have designed and implemented an original methodological model, which opens the possibility of reforming the curriculum structure effectively, as all elements are available in the form of parametric description.

We have adopted ideas from object-oriented programming and blended them with ideas from semantic data modeling and knowledge representation into a modeling framework that is more powerful than traditional techniques such as data flow diagrams or structured analysis [12]. We have applied the Unified Modeling Language notation (UML) [13], in collaboration with senior curriculum designers we carefully identified a list of top-level requirements and all basic features of the proposed system, and transformed them into a set of static and dynamic models such as use case, activity or entity-relationship diagrams. The final proposal of the curriculum data composition and its linking can be implemented without any restrictions within any database technology.

We have adopted Extreme Programming methodology [14], which is a popular framework in agile software development. It allows an easy adaptation with new and frequently changing requirements in compliance with cost reduction and code transparency. The web-oriented architecture runs on the most-used and widespread web servers – either an Apache server or a Microsoft Internet Information Server (IIS). We use Linux/Ubuntu and Windows Server operating systems for well-proven performance. All the tools were developed with the use of PHP (version 5.3.10), XHTML, CSS 2, JavaScript, AJAX and PostgreSQL database. We have also acquired the services of third party frameworks, such as jQuery (JavaScript library used for easier development of web-centric technologies), CKEditor (WYSIWYG text and HTML editor designed to simplify website content creation) and DHTMLX components (JavaScript grid control provides powerful data binding, and fast performance with large data sets) [15]. As the proposed system was intended primarily for academic staff (students, teachers and faculty management), the 3rd party authentication and authorisation services provided by eduID.cz federation [16] was employed.

2. Results

This cutting edge solution has been implemented into the practice in the OPTIMED (Optimisation of Medical Education) project [17] at the Faculty of Medicine of

Masaryk University. The primary objective is not a radical change in learning or teaching, but rather exploratory mapping of the current state of the General Medicine curriculum with a prospect to innovations towards a more transparent educational environment [18]. The authoring team, consisting of more than 320 curriculum designers, guarantors and supervisors of General Medicine, proposed a set of fundamental knowledge and skills known as GMER (Global Minimum Essential Requirements). It means 144 courses covered by 1365 learning units, including the definition of all obligatory parameters and 7053 learning outcomes, which say what students are expected to know, understand and/or be able to demonstrate at the end of a period of learning, typically as a graduate.

We have proposed a planning model for curriculum management and harmonisation, which shows how the methodological background is implemented into the iterative reform process by using the OPTIMED platform. It includes: (i) Setting up the composition of curriculum in accordance with metadata conceptual model (Figure 1). (ii) Definition of the learning outcomes (requirements on the graduate from the selected field) based on a predefined structure in an online environment including formal and semantic verification. (iii) Vertical harmonisation covering verification and further discussion within the individual module under supervision of the responsible guarantor. (iv) Horizontal harmonisation based on follow-up discussions across all modules under the management of supervisors. (v) Evaluation of all available content with the use of multidimensional standardised assessment forms. (vi) Creation of educational content according to the defined learning outcomes.

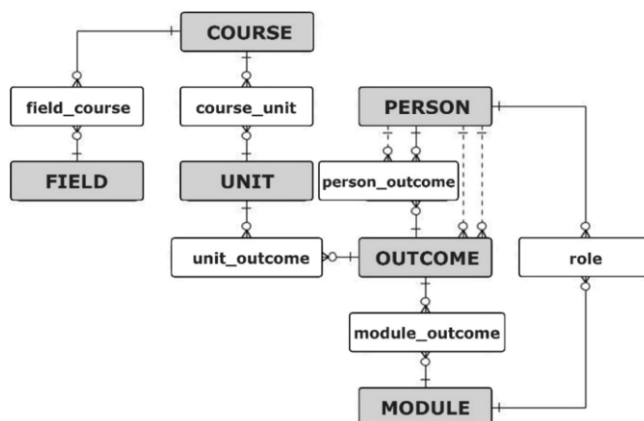


Figure 1. Simplified conceptual data model of the fundamental attributes (from individual courses down to the level of the learning units and particular learning outcomes) [18].

The introduced platform provides a graphical user interface for medical and health care curriculum metadata creation and editing in three basic modules: the Learning outcome & Learning unit registers – comprehensive tools for easy curricula management, and the Curriculum browser – a user-friendly tool for transparent browsing as well as fast and accurate searching. Moreover the Monitoring service as an internal tracking component was integrating, because a detailed statistical overview above the daily portal traffic is needed from the perspective of sustainability and long-term development. Below the OPTIMED module summary including essential functionalities is described.

- Learning outcome register provides a management of learning activities (learning outcomes in accordance with Bloom's action verb taxonomy, assessment methods, 3-level indexing covering group outcomes, name and semantic indexes, grid component for browsing, advanced filtering, smart rendering and evidence of editing).
- Learning unit register provides a management of learning units (course affiliation, teaching intensity and typology, responsible teachers and supervisors, importance and description of units, tree structure of significant terms, MeSH keywords, recommended printed and e-learning resources, feedback option, grid component for browsing, advanced filtering, smart rendering and evidence of editing).
- Curriculum browser offers global browsing tool including advanced filtering and search result customisation.
- Monitoring service contains internal user behaviour tracking system and up-to-date statistics measurement.

3. Discussion

The presented solution can be used for the potentially perpetual process of specification and subsequent upgrades in a medical and healthcare curriculum at a higher educational institution. The OPTIMED platform presented in this study serves demonstrably the purpose of an outcome-based medical education through the adequate management of its curriculum. Nevertheless, the fast changing pace of healthcare, the need for perceiving the complexity of the medical curriculum and transform it into a flexible and interoperable tool, urge for further actions towards the platform's improvement.

These fundamental reasons pushed us to think about a new original system, which was developed serving primary needs but with the ability to be expand and become an enterprise platform as healthcare demands change instead of using a commercial one. We have adopted Extreme Programming paradigm, which is a popular framework in agile software development. Based on a list of top-level requirements, which were identified during object-oriented analysis, a modular structure was proposed. Each independent module provides a separated functionality according to its practical use and systematically supports global methodological background. The developed portal platform is precisely tailored to the complicated needs of curriculum harmonisation. Now, we are able to enhance a management of medical and healthcare curriculum.

A first step towards the desired improvement involves the mapping of the medical curriculum [19] which will allow understanding better its structure and support further improvement-based actions in different directions [20,21]. Additionally, having a structured base will allow taking actions towards the interoperability of the OPTIMED platform through the careful investigation, adoption and implementation of health professions curricula standards [22] in order to effectively create a communicable medical curriculum between different educational settings with ultimate purpose to promote healthcare education comparisons in both national and international levels. This sequentially will enable the application of analytical methods through data mining techniques used successfully to obtain insights from structured data in order to extract information in terms of reporting, in interest of different groups of stakeholders like teachers, directors and students of medical education and for different kinds of

purposes like evaluation and validation of ongoing medical education according to healthcare demands. In terms of future anticipations, further machine learning processing and analysis of well-structured curriculum data stored in the OPTIMED and mining novel and potentially useful patterns are challenging.

Acknowledgement

The authors were supported from the grant project OPTIMED - OPTImized MEDical education: horizontal and vertical connections, innovations and efficiency in practice reg. no: CZ.1.07/2.2.00/28.0042, which is funded by the European Social Fund and the state budget of the Czech Republic.

References

- [1] J.T. Fernández-Breis, et al., A semantic platform for the management of the educative curriculum, *Expert Syst. Appl.* **39** (2012), 6011–6019.
- [2] J.R. Frank, D. Danoff, The CanMEDS initiative: implementing an outcomes-based framework of physician competencies, *Medical Teacher* **29** (2007), 642–647.
- [3] Y. Mong, et al., Web-based outcome-based teaching and learning - An experience report, *Adv. Web Based Learn. - Icwl 2007* (2008), 475–483.
- [4] S. Cotterill, Design, implementation and evaluation of a “generic” ePortfolio: the Newcastle experience, *Proc EPortfolio* (2004).
- [5] S. Kabicher, M. Derntl, Visual Modelling for Design and Implementation of Modular Curricula, *Z. Für Hochschulentwicklung* (2008).
- [6] T.A. Kerkiri, S. Papadakis, Learning Outcomes Design Authoring Tool: The Educator is Not Alone!, *Int. J. E-Collab. IJeC* **8** (2012), 22–34.
- [7] A. Erguzen, et al., KUZEM LMS: A new learning management system for online education, *ENERGY Educ. Sci. Technol. PART B-Soc. Educ. Stud.* **4** (2012), 1865–1878.
- [8] J. Hollowell, *Moodle as a Curriculum and Information Management System*, Packt Publishing Ltd, 2011.
- [9] S. Adam, *An introduction to learning outcomes*, Consid. Nat. 2006.
- [10] R.M. Harden, et al., AMEE Guide No. 14: Outcome-based education: An introduction to outcome-based education, *Medical Teacher* **21**, (1999), 7–14.
- [11] R. Keeling, The Bologna Process and the Lisbon Research Agenda: the European Commission’s expanding role in higher education discourse, *Eur. J. Educ.* **41**, (2006), 203–223.
- [12] J. Mylopoulos, et al., From object-oriented to goal-oriented requirements analysis, *ACM* **42** (1999), 31–37.
- [13] *Unified Modeling Language*. <http://www.uml.org/> (accessed November 6, 2014).
- [14] K. Beck, C. Andres, *Extreme programming explained: embrace change*, Addison-Wesley Professional, 2004.
- [15] M. Komenda, et al., A Framework for Curriculum Management - The Use of Outcome-based Approach in Practice, *Proc. 6th Int. Conf. Comput. Support. Educ.* (2014).
- [16] *Czech academic identity federation eduID.cz*, <http://www.eduid.cz/wiki/en/eduid/index> (accessed November 8, 2014).
- [17] Masaryk university, *OPTIMED - project documentation*, (2012), <http://opti.med.muni.cz/en/index> (accessed November 5, 2014).
- [18] M. Komenda, et al., Building platform for optimization of medical education, *EFMI STC Shar. Knowl. Tools Decis. Support Biomed. Health Care* (2013).
- [19] R.M. Harden, Curriculum mapping: a tool for transparent and authentic teaching and learning, *Association for Medical Education in Europe* (2001).
- [20] Ch. Vaitsis, G. Nilsson, N. Zary, Visual analytics in healthcare education: exploring novel ways to analyze and represent big data in undergraduate medical education, *PeerJ* **2**:e683 (2014).
- [21] Ch. Vaitsis, et al., Big Data in Medical Informatics: Improving Education Through Visual Analytics., *Stud. Health Technol. Inform.* **205** (2014) 1163–1167.
- [22] *MedBiquitous Consortium official website*, http://www.medbiq.org/about_us/mission/index.html (accessed November 6, 2014).