

# Education in Biomedical and Health Informatics in the Web 3.0 Era: Standards for Data, Curricula, and Activities

## Contribution of the IMIA Working Group on Health and Medical Informatics Education

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### Summary

Web 3.0 is transforming the World Wide Web by allowing knowledge and reasoning to be gleaned from its content.

**Objective:** Describe a new scenario in education and training known as "Education 3.0" that can help in the promotion of learning in health informatics in a collaborative way.

**Methods:** Review of the current standards available for curricula and learning activities in Biomedical and Health Informatics (BMHI) for a Web 3.0 scenario.

**Results:** A new scenario known as "Education 3.0" can provide open educational resources created and reused throughout different institutions and improved by means of an international collaborative knowledge powered by the use of E-learning. Currently there are standards that could be used in identifying and deliver content in education in BMHI in the semantic web era such as Resource Description Format (RDF), Web Ontology Language (OWL) and Sharable Content Object Reference Model (SCORM). In addition, there are other standards to support healthcare education and training. There are few experiences in the use of standards in e-learning in BMHI published in the literature.

**Conclusion:** Web 3.0 can propose new approaches to building the BMHI workforce so there is a need to build tools as knowledge infrastructure to leverage it. The usefulness of standards in the content and competencies of training programs in BMHI needs more experience and research so as to promote the interoperability and sharing of resources in this growing discipline.

### Keywords

Competency-based education, medical Informatics education, educational technology, health personnel, semantics

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### Introduction

Web 3.0 transforms the original World Wide Web of information, augmented by the social connections of Web 2.0 into a new Web that adds a further layer of semantic structure and allows knowledge and reasoning to be gleaned from its content. Web 3.0 requires what those in biomedical and health informatics (BMHI) have strived for over decades, which is the adoption of standards so data and systems can be interoperable [1, 2]. In the framework of BMHI education, this means standards for all activities of education, including data, curricula, and actions. Transforming the Internet we knew to a 'read, write and collaborative web', this new technology has the potential of promoting learning that could be more richly in a collaborative way, but it could also enable students and teachers to come closer to 'anytime anyplace' learning by providing intelligent and smarter solutions for web searching, document management and organization of content.

The recently published Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics lay the foundation for the standards of Web 3.0. These recommendations have mainly focused on educational needs for health care professionals in order to acquire knowledge and

skills in information processing and information and communication technology (ICT). The educational needs with the recommended and optional learning outcomes were divided in 2 types of students: health-care professionals as IT users and health Informatics specialists. The recommendations also proposed different student workload and credits according to the stage of career progression (bachelor, master, doctorate). Regarding the modes of education, the recommendations described that lectures and practical experience should be combined and that different model of learning (besides in-person classes), such as flexible, distance and supported open learning should be actively pursued [3].

Currently many universities and organizations offer distance-learning courses as part of their training programs in BMHI. This both allow local and foreign students that have some kind of barrier, for example geographically dispersed and/or time-constrained in taking in-person classes but wish to pursue a career in health informatics [4-7].

### The Semantic Web as an Educational Tool

The Semantic Web is currently being developed and different components are being developed that will help in the

pursue of cooperatively sharing or intelligently finding data. These tools will help to identify and personalize resources based on training needs not only based on the objective or aim of the student defined by keywords but also by the possibility of using distributed, adaptive learning environments and learning management systems, that could provide content through the web in any kind of computer or portable device such as smart phones, tablet devices, or e-readers.

It has been proposed that education is reaching an inflexion point powered by different issues, such as the development in technology and social networking together with a deeper understanding of the educational process preparing itself the scenario for "Education 3.0". An example of semantic web related to education would include open educational resources created and reused by students throughout different institutions improved by materials created by the new group so as to promote collaborative knowledge by the creation of regional, and international collaboration projects to create repositories of educational content. These resources should be properly identified by means of standards that assure that the material is compatible and accessible. The development of open, flexible learning activities can also promote the use of social networking for training purposes. The use of E-learning will help in the development of distributed learning environments that would consist of a portfolio of different applications that could also be shared between institutions [8].

## Standards in e-learning

There are different standards that can help in the development of educational material that are part of the Semantic Web [9-11]:

- Resource Description Format (RDF) is a standard metadata data model for data interchange on the

Web based on XML. RDF is a knowledge representation language that allows to model information based on a general method for conceptual description.

- Web Ontology Language (OWL), which is an ontology language that is a formal specification of a knowledge domain.

Since most of the courses in the semantic web era will be delivered through e-learning there is also a collection of standards and specifications for web-based e-learning known as Sharable Content Object Reference Model (SCORM).

Currently MedBiquitous (<http://www.medbiq.org/>) has developed standards to support healthcare education and training, professional competence assessment, certification, licensure, professional and scientific publications, and healthcare professional online communities and portals education with the objective of stimulating professional competence, collaboration, and better patient care.

Some of the standards oriented to healthcare education useful to BMHI education include [12]:

- *Competency framework*: Provides a format for describing the relationships among competencies and their relation to resources. This standard could help in the development of proper curriculum and tracking of competencies according to the type of student (IT user or BMHI specialist).
- *Healthcare learning object metadata (healthcare LOM)*: It is based on the IEEE Learning Object Metadata standard, provides a common format for describing healthcare education resources. It can help in the correct definition of learning resources according to each one of the mentioned levels of knowledge and skills in the BMHI recommendation.
- *SCORM for healthcare*: It is based on the ADL SCORM model, that it is group of specifications for e-

learning content that uses the Healthcare LOM for the description of the learning activity. This type of specification could help in the implementation and exchange of BMHI resources between courses and institutions.

Other standards developed for healthcare education are activity report, healthcare professional profile, medical education metrics, point of care learning data and virtual patient.

## Experience in the Use of Standards in e-learning in BMHI

Although this is a new topic in healthcare and health informatics different groups have analyzed the use of standards for evaluating their courses.

Konstantinidis and Bamidis have proposed a theoretical framework for e-learning in medical education that integrates SCORM for Healthcare allowing the use of Web 2.0 tools such as podcasts, videocasts, blogs and wikis demonstrating that these resources can be interoperable and used in other ubiquitous computing environments as smartphones or portable computing devices [13, 14].

Recently a French project described the creation of an open repository network designed to enrich the visibility, accessibility and sharing of the teaching resources produced at the country's Schools of Medicine. The authors used a Learning Object Metadata standard that integrated the MeSH thesaurus [15].

Hersh et al. described their efforts to assist in the access to competencies and e-learning content in the BMHI domain working on the linkage by content-competency associations using the standards of MedBiquitous. The authors first worked on identifying the competencies in medical informatics and content with which to link them in an introductory course to Biomed-

cal Informatics. After creating the list of competencies for the course they mapped them using the IEEE Reusable Competency Definitions (RCD) Draft Standard for Learning Technology and later linked the competencies to developed learning objects content that was associated using Healthcare LOM [16].

Web 3.0 offers new approaches to building the BMHI workforce so critical to worldwide expanded use of health information technology [17]. It will be critical to build the tools as well as the knowledge infrastructure to leverage it.

## Conclusion

The potential that the Web 3.0 has in the promotion of a learning environment that could be more collaborative by means of allowing knowledge and reasoning to be gleaned from its content shows that there is still the need to continue exploring the usefulness of standards in the content and competencies of training programs in BMHI so as to promote the interoperability and sharing of resources in this growing discipline that could enhance the field of education.

## References

- Giustini D. How Web 2.0 is changing medicine. *BMJ* 2006 Dec 23;333(7582):1283-4.
- Giustini D. Web 3.0 and medicine. *BMJ* 2007 Dec 22;335(7633):1273-4.
- Mantas J, Ammenwerth E, Demiris G, Hasman A, Haux R, Hersh W, et al. Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics. First Revision. *Methods Inf Med*. 2010 Jan 7;49(2):105-20.
- Hersh W, Williamson J. Educating 10,000 informaticians by 2010: the AMIA 10x10 program. *Int J Med Inform* 2007 May-Jun;76(5-6):377-82.
- Masic I, Novo A, Kudumovic M, Rama A, Džananovic A, Guso E, et al. Web based distance learning at Faculty of Medicine of Sarajevo University. *Bosn J Basic Med Sci* 2006 May;6(2):71-5.
- Naidr JP, Adla T, Janda A, Feberova J, Kasal P, Hladikova M. Long-term retention of knowledge after a distance course in medical informatics at Charles University Prague. *Teach Learn Med* 2004 Summer;16(3):255-9.
- Otero P, Hersh W, Luna D, Gonzalez Bernaldo de Quiros F. A medical informatics distance-learning course for Latin America. Translation, implementation and evaluation. *Methods Inf Med* 2010;49(3):310-5.
- Keats D, Schmidt JP. The genesis and emergence of Education 3.0 in higher education and its potential for Africa. *First Monday* 2007;12(3-5).
- Clark K, Parsia B, Hendler J. Will the Semantic Web Change Education? *Journal of Interactive Media in Education* 2004;3:2.
- Devedzic V. Education and the semantic web. *International Journal of Artificial Intelligence in Education* 2004;14(2):165-91.
- Konstantinidis S, Kaldoudi E, Bamidis P. Enabling Content Sharing in Contemporary Medical Education: A Review of Technical Standards. *The Journal on Information Technology in Healthcare* 2009;7(6):363-75.
- Smothers V, Greene P, Ellaway R, Detmer DE. Sharing innovation: the case for technology standards in health professions education. *Med Teach* 2008;30(2):150-4.
- Konstantinidis S, Bamidis P. E-learning environments in medical education: how pervasive computing can influence the educational process. 3rd Balkan Conference in Informatics; Sofia, Bulgaria 2007. p. 291-300.
- Bamidis PD, Konstantinidis ST, Kaldoudi E, Bratsas C, Nikolaidou MM, Koufogiannis D, et al. New Approaches in Teaching Medical Informatics to Medical Students. Proceedings of the 2008 21st IEEE International Symposium on Computer-Based Medical Systems. 1439437: IEEE Computer Society; 2008. p. 385-90.
- Soula G, Darmoni S, Le Beux P, Renard JM, Dahamna B, Fieschi M. An open repositories network development for medical teaching resources. *Stud Health Technol Inform* 2010;160(Pt 1):610-4.
- Hersh WR, Bhupatiraju RT, Greene P, Smothers V, Cohen C. Adopting e-learning standards in health care: competency-based learning in the medical informatics domain. *AMIA Annu Symp Proc* 2006:334-8.
- Hersh W. The health information technology workforce: estimations of demands and a framework for requirements. *Appl Clin Inform* 2010;1:197-212.

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