HIR
Healthcare Informatics Research

Massive Open Online Course for Health Informatics Education

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Objectives: This paper outlines a new method of teaching health informatics to large numbers of students from around the world through a Massive Open Online Course (MOOC). **Methods:** The Health Informatics Forum is one of examples of MOOCs through a social networking site for educating health informatics students and professionals. It is running a MOOC for students from around the world that uses creative commons licenced content funded by the US government and developed by five US universities. The content is delivered through narrated lectures with slides that can be viewed online with discussion threads on the forum for class interactions. Students can maintain a professional profile, upload photos and files, write their own blog posts and post discussion threads on the forum. **Results:** The Health Informatics Forum MOOC has been accessed by 11,316 unique users from 127 countries from August 2, 2012 to January 24, 2014. Most users accessed the MOOC via a desktop computer, followed by tablets and mobile devices and 55% of users were female. Over 400,000 unique users have now accessed the wider Health Informatics Forum since it was established in 2008. **Conclusions:** Advances in health informatics and educational technology have both created a demand for online learning material in health informatics and a solution for providing it. By using a MOOC delivered through a social networking platform it is hoped that high quality health informatics education will be able to be delivered to a large global audience of future health informaticians without cost.

Keywords: Distance Education, Medical Informatics, Professional Education, Social Media, Computer-Assisted Instruction

I. Introduction

Health informatics education has evolved in many ways over the past few decades. From a small number of post-graduate courses for medical professionals, health informatics is now taught to undergraduates in medical and nursing schools and is offered by a wide variety of undergraduate and post-graduate degree and certificate programmes.

The International Medical Informatics Association (IMIA) established an Education Task Force in 2006 and released the first edition on their recommendations in 2011 [1]. The IMIA recommendations outline how health informatics can be embedded into traditional clinical courses as a 'track' to complement other aspects of healthcare training. In addition, the task force outlined the key competencies necessary for stand-alone health informatics courses at the undergraduate and post-graduate levels.

The need to build the international health informatics workforce has been widely documented [2]. Hospitals and clinics around the world are installing new Electronic Health

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Records software and patient management systems as they transition from paper records to electronic solutions. This transition is creating demand for health informatics workers that is putting pressure on educational institutions to train these workers.

Concurrent with this upsurge in demand for new health informatics workers, there has been the spread of the "Massive Open Online Course (MOOC)" meme. Even though e-learning has existed in many forms for many years, the unique idea of an online course, accessible to tens of thousands of students, has come of age at the same time as healthcare systems have transitioned from paper to electronic systems for storing clinical and administrative data.

The curriculum development material development project has been hugely successful in the United States, with thousands of new students passing through courses using the materials; yet, there is a continuing need for training and resources internationally and particularly in the developing world [3]. In the United States, the Office of the National Coordinator for Health IT commissioned a major project of work as part of the Health Information Technology for Economic and Clinical Health (HITECH) Act to help build the Health IT workforce [4]. The project involved five leading US universities that produced 135 hours of lectures and associated learning resources (assessments, transcripts, audio, PowerPoint slides, etc.) for use by colleges and universities to deliver new health informatics courses. From initial reports, there has been widespread use of this material, including in the MOOC delivered through the Health Informatics Forum (www.healthinformaticsforum.com).

MOOCs are a new way of delivering distance learning that enable large numbers of students from around the world to access, free of charge, open online courses provided by traditional and non-traditional educational establishments [5]. MOOCs have risen to popularity over the last few years as a number of high profile start-up companies, such as Coursera, edX and FutureLearn, have begun to offer MOOC portals with courses from prestigious universities, such as Stanford, Harvard, and MIT [6]. MOOCs can be divided into two broad categories: the x-MOOC, which replicates the structure of a traditional university course and a c-MOOC, which uses an online community as the basis of the course [7]. To access an x-MOOC a student will sign up to a course of interest on a website, such as Coursera, and will gain access to video lectures, a discussion forum and assignments or quizzes. The course starts on a predetermined day and proceeds much like a traditional course to deliver new lectures and assignments through the online platform over a duration of a several weeks.

A c-MOOC may have many of the elements of an x-MOOC but is based around a community of users who will have access to a range of course material but will primarily be engaged in networking and community building activities. Course material is generally not completed according to deadlines but is available for the community to dip into and out of as they wish. The "c" in c-MOOC stands for connectivism or constructivism, a philosophy of helping students "construct" their own learning through interaction with peers and teachers. Thus, the purpose of the review is to describe Health Informatics Forum as one of prominent efforts of educating health informatics workforce through c-MOOC approach, a new method of teaching health informatics to large numbers of students from around the world.

II. Methods

The Health Informatics Forum was established in 2008 in order to help connect health informatics researchers from around the world, and particularly in developing countries, to foster professional networking and sharing of experiences developing, implementing and evaluating health informatics projects. Over the last 7 years the forum membership has grown to over 7,000 registered members and receives over 10,000 unique visitors per month (both members and non-members). The members come from around the world and range from students considering a career in health informatics to senior researchers and policy-makers.

In 2012, the Health Informatics Forum began building a c-MOOC to leverage the recently released Curriculum Development Materials from the Office of the National Coordinator for Health IT in the United States. These materials developed with the aim of increasing the health informatics workforce in the United States by allowing the time and resources of leading health informatics educators to create learning and teaching materials would help educators in other institutions to produce new courses based on the materials. The content included presentation slides (both as PowerPoint files and as narrated Flash lectures) and associated student assessment and discussion questions for each topic.

As these materials were released under a Creative Commons licence, it was possible to re-use the material to produce the MOOC on the Health Informatics Forum. After discussions with the health informatics researchers who authored the materials and led the initial grant application, it was felt that putting to use in a global health informatics MOOC would be an appropriate use that would further foster the development of health informatics as a profession

both in the United States and internationally.

The MOOC is now an integrated part of the Health Informatics Forum website. The different sections of the website are used to enhance the MOOC experience allowing students to establish a presence on the site so that they can find and interact with peers and mentors. The structure of the Forum and MOOC is outlined in Figure 1.

The curriculum development materials cover 20 components, each with around 10 units and each of these with between 1 and 4 lectures. All in all, the content amounted to 136 hours of lectures with a range of associated discussion topics and student assessments. In the first instance, the MOOC would offer all of the components, and once they were available a number of 'streams' would be established as subsets of these (for example, a "global" stream that removed the more US-centric components). The components were therefore uploaded to the Health Informatics Forum website at a rate of one component per month. Students were able to complete the components as they were uploaded and now that all 20 components are uploaded, students can review any of the components that they are interested in (Figure 2).

Clicking on a component will allow the user to see the de-

scription of the component and a list of the units. If the user clicks on a lecture title, they can view the Flash lecture and the topics for discussion. The user also allows clicking on a discussion topic, which will take the user to the forum where the discussion thread can be viewed (Figure 3).

By fully integrating the MOOC content into the social networking site, students can both learn and network in one place resulting in a "connectivist" learning network. A typical learning experience might be as follows:

1) The student visits the site and, without registering or logging in, can view the MOOC components and watch the lectures in their browser. The lectures are delivered using the Flash multi-media player and consist of slides that are narrated by a professional voice-over artist.

2) After watching a lecture and reading a discussion thread associated with the lecture on the discussion board, the student may feel they want to add their own questions or contribute to an on-going discussion. To do this, they click the sign up button and register their email address and choose a password. They could also use their existing Google or Twitter accounts to register.

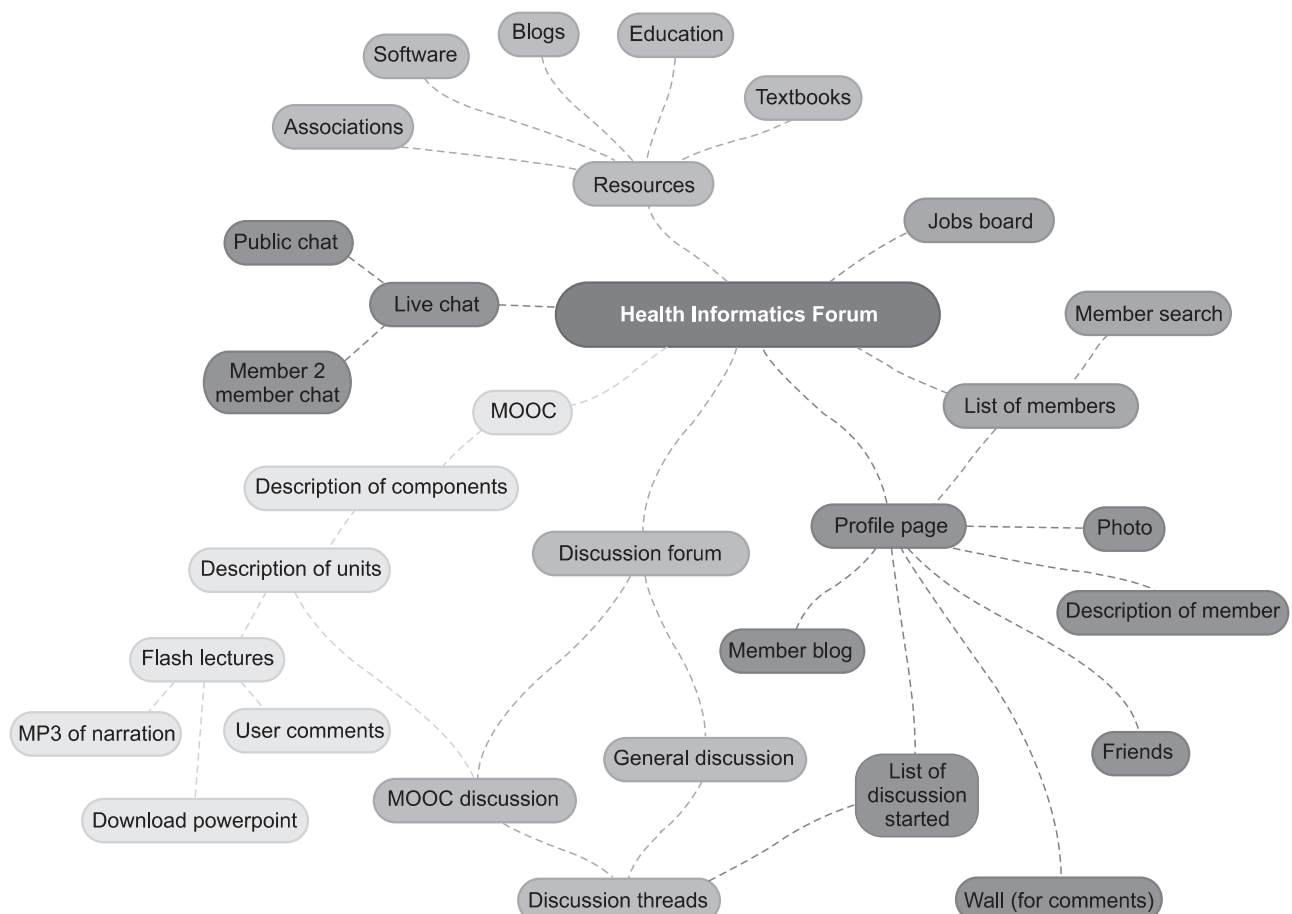3) After confirming their registration, an administrator will

Figure 1. Structure of the Health Informatics Forum and Massive Open Online Course (MOOC).

Welcome to the Health Informatics Forum Massive Open Online Course (MOOC).

This course is comprised of 20 components each with a number of narrated Flash lectures and a series of online class discussions.

The course is completely free to access and participate in but there are no certificates of completion or other qualifications at the end.

The course materials have been developed by Columbia University, Duke University, Johns Hopkins University, Oregon Health and Science University and the University of Alabama at Birmingham through a **$10 million grant from the ONC** and released under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License which is why we are able to use the materials in this MOOC. The authors and developers of each component are listed on the component home pages.

Components

For IT Professionals

1. Introduction to Healthcare and Public Health in the US
2. The Culture of Healthcare
3. Terminology in Health Care and Public Health Settings

For Healthcare Professionals

4. Introduction to Information and Computer Science

For Healthcare Professionals and IT Professionals

5. History of Health Information Technology in the U.S.
6. Health Management Information Systems
7. Working with Health IT Systems
8. Installation and Maintenance of Health IT Systems
9. Networking and Health Information Exchange
10. Fundamentals of Health Workflow Process Analysis & Redesign
11. Configuring Electronic Health Records
12. Quality Improvement
13. Public Health IT
14. Special Topics Course on Vendor-Specific Systems
15. Usability and Human Factors
16. Professionalism/Customer Service in the Health Environment
17. Working in Teams
18. Planning, Management and Leadership for Health IT
19. Introduction to Project Management
20. Training and Instructional Design

Figure 2. List of learning components at Health Informatics Forum MOOC.

review the new member's profile to ensure the user is not a spammer and then they will be able to start posting on the forum and participating in the live chat feature of the site.

4) After engaging in some discussion, the student may choose to "friend" other members of the site that they wish to show a connection with. This may be real life connections or new professional relationship generate through interactions on the site.

5) Over time, the student may visit the site more or less frequently and take any number of components and engage in discussions and debates on the site (both related to the MOOC or just to discuss recent developments in health informatics). They may make use of the Jobs Board to find new positions or use connections developed through the site to advance their careers and find new projects to work on.

In addition to the content and discussion on the website, the Health Informatics Forum is also linked to a number of external social networking websites including Twitter, Google+, Facebook, and LinkedIn.

III. Results

The MOOC has been accessed by 11,316 unique users from 127 countries from August 2, 2012 to January 24, 2014. Most users accessed the MOOC via a desktop computer, followed by tablets and mobile devices and 55% of users were female. Over 400,000 unique users have now accessed the wider Health Informatics Forum since it was established in 2008 and visitors the Forum have been recorded from 220 countries with the majority of visitors from the United States

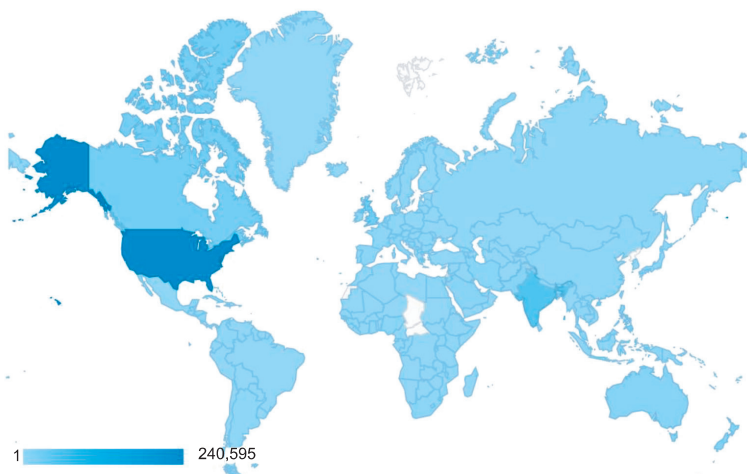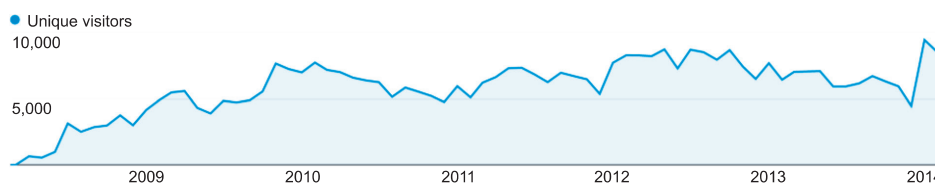Figure 3. Discussion thread of Health Informatics Forum MOOC.

Figure 4. Graphical representation of visitor statistics of the Health Informatics Forum MOOC.

(45%), followed by India (10%), UK (5%), and Canada (5%) (Figure 4).

IV. Discussion

The Health Informatics Forum MOOC is a timely project that has benefited greatly from the availability of the Curriculum Development project carried out by the Office of the National Coordinator for Health IT and the 5 US universities that produced the content. The Forum itself appears to be a suitable platform for establishing a connectivitist-MOOC with an existing connected network and the potential to ex-

pand rapidly.

Over the last 10 years, the prevalence of broadband Internet connections and more powerful computers (both traditional PCs and mobile devices) has enabled the widespread adoption of multimedia and social media websites to the majority of developed countries. In lower and middle income countries, although they have started later, there are many regions, particularly recently emerged or emerging economies where broadband speeds and accessibility have "leapfrogged" over the developed world by quite a dramatic margin, Korea being a prime example [8].

This rapid adoption of Internet technology has enabled many changes but two significant industries that have, to date, continued with a pre-Internet model of service provision, are now facing disruption: healthcare and education. Almost at the same time, the healthcare and education sectors have now started a process of conversion from paper-based and face-to-face service provision to a digitally-focused service provision that enables rapid scaling of content and the elimination of barriers erected by the physical world constraints of space and time.

These benefits have been seen first in places where these real world constraints are particularly acute. For example, indigenous people in Alaska and remote parts of Australia are now benefiting from online education to replace radio-based education and telemedicine- and telehealth-focused provision of healthcare [9]. These methodologies and their associated benefits are beginning to spread to the wider world with Skype consultations being offered by UK hospitals and the wide range of MOOCs described in the introduction to this paper gaining rapid adoption.

The MOOC offered by the Health Informatics Forum both takes advantage of and addresses these developments. The rapid adoption of information technology in healthcare has created a need to train an increasingly large workforce and enable clinicians to develop IT skills and to give IT workers the knowledge of healthcare required to provide high quality and customer-focused IT solutions. Because of the possibility of running courses online to large audiences (as established by the pioneers in MOOC provision), the ideal way to address an international workforce deficit in health informatics is to leverage this new educational delivery mechanism.

As courses have moved online, especially when they use the MOOC model, they have largely imitated a traditional model of teaching. The video lectures replace the face-to-face lectures, but the format is largely the same with regular lectures spread out over a course of weeks with assignments and class discussions. This model has probably helped considerably in establishing online learning as a relevant and trustworthy method of acquiring skills and knowledge but there may be Internet-specific effects that are not being fully harnessed by mimicking the usual university course structure. Although it has probably been necessary to be as similar as possible to universities to establish credibility, we are probably at the stage now whereby further experimentation will be acceptable and there appears to be some useful theory to back up a more Internet-focused approach.

The c-MOOC or connectivist-MOOC model, as proposed by Stephen Downes [7], is one approach that aims to leverage the significant network effects created by websites with many users. The World Wide Web has transitioned from a individually-focused experience where users are relatively passive consumers of content to one where users expect to participate in online communities in even the most mundane of browsing activities, such as a reading a newspaper story or watching an online video. In the c-MOOC model, the social nature of the Internet is fully leveraged rather than serving as an 'add-on' in the form of class discussion fora. The educational experience is created by a connected group of teachers and learners in a relatively free form online community based on the social networking model.

As a c-MOOC, the Health Informatics Forum is primarily an online community. As soon as students sign up, they are given the opportunity to upload details about themselves to their profile page, network with existing members by forming 'friendships' and by inviting their real-world friends and colleagues to join. The shape and form of the "social-graph" that has been produced by the connections on the Forum is yet to be explored fully but certainly spans many continents, educational levels and social classes.

The Forum aims to grow this community over many years, with the MOOC courses offering the members the opportunity to add to their knowledge as they develop their careers. Different members will find different courses of interest and will be able to dip into and out of material as it fits their learning requirements and time. Through the availability of the material, and the network of students and experts, the Forum aims to support the development of an international health informatics workforce that will need to grow and acquire skills more rapidly than any previous healthcare workforce.

The main challenge for the Forum and the MOOC are to remain relevant to the members over time. The rapidly changing health informatics landscape will mean that the courseware will need to be regularly updated and expanded. The currently very US-focused material needs to be augmented by internationally focused material and country specific courses. It is hoped that the community will be able to

contribute to this development over the coming years.

Informal feedback from users and the health informatics community has been very positive to date but further analysis will be required to measure the educational impact of the MOOC. It may be difficult to measure the effect of the Forum and the MOOC on the growth of the health IT workforce, but it seems likely that they will form a useful additional resource to support the health informatics community, especially in regions that are not well served by existing resources.

As well as addressing the rapidly changing content requirements, the MOOC and the wider Forum will also need to keep pace with developments in technology and online education. The delivery model may change as new methods become established and the mode of delivery will certainly change. The first challenge will be to enable the Forum and the MOOC to be readily accessible in a wider range of computing devices. Although a mobile version of the forum discussions is available, the main MOOC content is delivered using the Flash format that is not readily accessible on many mobile devices. As more people adopt mobile devices as their primarily means of browsing the Internet a mobile-first strategy will need to be implement perhaps through the development of mobile apps to access the Forum in a way that takes full advantage of the mobile technology available.

New technologies, such as Android Wear, the Apple iWatch, and Google Glass, will present both a challenge and significant opportunity to further extend the reach and applicability of the MOOC content. Context relevant course material and even live peer-to-peer (P2P) discussions could be established in the work environment. Students could use a wearable device when interning or work-shadowing in hospital and more experienced workers could use such devices for "just-in-time" learning when presented with pressing problems in remote locations or when on the move.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Acknowledgments

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