RESEARCH NOTE

Massive open online courses on biomedical informatics

[version 1; peer review: 2 not approved]

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v1 **First published:** 14 Feb 2019, **8**:180
https://doi.org/10.12688/f1000research.17693.1
Latest published: 14 Feb 2019, **8**:180
https://doi.org/10.12688/f1000research.17693.1

Abstract

This study aimed to identify the characteristics of massive open online courses (MOOCs) related to biomedical informatics offered in several plataforms. We conducted an observational study on specialized MOOCs platforms to find courses related to biomedical informatics, in 2018. Our search identified 67 MOOCs on biomedical informatics. The majority of MOOCs were offered by Coursera (71.6%, 48/67), English was the most common language (95.5%, 64/67). The United States developed the majority of courses (73.1%, 49/67), with the vast majority of MOOCs being offered by universities (94%, 63/67). The majority of MOOCs were in bioinformatics (56.7%, 38/67) and data science (47.7%, 32/67). In conclusion, the MOOCs on biomedical informatics were focused in bioinformatics and data science, and were offered in English by institutions in the developing world.

Keywords

computer-assisted instruction, medical informatics, bioinformatics, education, continuing education

This article is included in the Bioinformatics Education and Training Collection collection.

Open Peer Review

Approval Status ✗ ✗

	1	2
version 1 14 Feb 2019	✗ view	✗ view

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Any reports and responses or comments on the article can be found at the end of the article.

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Author roles: Quispe-Juli CU: Conceptualization, Formal Analysis, Investigation, Methodology, Project Administration, Writing – Original Draft Preparation, Writing – Review & Editing; **Moquillaza-Alcántara VH**: Formal Analysis, Investigation, Methodology, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Arapa-Apaza K**: Formal Analysis, Investigation, Methodology, Writing – Original Draft Preparation, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: This research was funded with a contribution of Peruvian National Science and Technology Fund (FONDECYT).
The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

How to cite this article: Quispe-Juli CU, Moquillaza-Alcántara VH and Arapa-Apaza K. **Massive open online courses on biomedical informatics [version 1; peer review: 2 not approved]** F1000Research 2019, **8**:180 https://doi.org/10.12688/f1000research.17693.1

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Introduction

Biomedical informatics (BI) is "the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving and decision making, motivated by efforts to improve human health"[1]. BI has an important role in healthcare therefore health professionals well-trained in the use of information and communication technology are needed[2].

In developing countries, a few of they have developed training programmes in biomedical or health informatics[3]. These programmes are short courses, Master's programmes and even sub-specialty programmes[3]. However, these do not supply the need for health professionals with BI skills. The internet allows health professionals to have easy access to educative sources through platforms such massive open online courses (MOOCs)[4].

MOOCs are accessible through the web and open to registration for people all around the world that want to participate in higher education courses; they are recognized for their educational quality and flexibility schedules[4,5]. MOOCs materials are free of charge, however, in some courses one can pay to get a certificate of completion[4,5].

They represent one strategy to reduce costs and enable continuous education in developing countries; especially learners with English language proficiency, computer literacy, and internet access[5]. This study aimed to identify the characteristics of MOOCs related to biomedical informatics.

Methods

A search of MOOCs was performed in several learning platforms, including Coursera®, EdX®, FutureLearn®, Udacity®, FunMOOC®, UniMOOC®, MiriadaX®, Alison®, Iversity®, Open2Study® and P2PU®, in order to find courses about biomedical informatics. The search was made from 31 October to 27 November, 2018. The following keywords were used: biomedical informatics, telemedicine, telehealth, remote consultation, mobile health, mHealth, eHealth, medicine technology, biomedical technology, IT Health and bioinformatics.

Information was obtained on the platform where the MOOC was hosted, data regarding the institution offering the course, and the original language. The disciplines were categorized into: Bioinformatics, Images, Clinical Informatics, Public Health Informatics and Data science (a course could approach more than one discipline). Likewise, the data of the duration of the course and its cost in dollars were also obtained.

The data obtained were analyzed in STATA version 14. The categorical results were reported by frequencies and percentages, while the numerical results were reported by measures of central tendency and dispersion, after analysis of normality using the Shapiro-Wilk test.

Results

The analyses of the data identified 67 MOOCs offered on biomedical informatics in the world. The majority (71.64%) were offered by Coursera, followed by EdX (13.43%) and FutureLearn (13.43%). The majority of MOOCs were offered from institutes from the United State of America (73.13%). Out of these, the majority were offered by universities. The large majority of these MOOCs, were offered by the University of California San Diego, followed by Johns Hopkins University. Finally the language breakdown of MOOCs related to biomedical informatics shows that the vast majority of MOOCs (95.52%) were offered in English (Table 1). The details of each course are shown in the Table 2.

Table 1. Characteristics of massive open online courses about biomedical informatics.

	(N =67)	%
Plataform		
Coursera	48	71.64
EdX	9	13.43
FutureLearn	9	13.43
Udacity	1	1.49
Country		
United States of America	49	73.13
China	3	4.48
United Kingdom	3	4.48
Russia	3	4.48
Denmark	2	2.99
Netherland	2	2.99
Others	5	7.46
University		
Yes	63	94.03
No	4	5.97
Institutions		
University of California San Diego	14	20.90
Johns Hopkins University	8	11.94
Icahn School of Medicine at Mount Sinai	6	8.98
Columbia University	3	4.48
Georgia Institute of Technology	3	4.48
University of Illinois	3	4.48
Others	30	44.74
Original lenguaje		
English	64	95.52
Ruso	3	4.48

Table 2. Characteristics of each massive open online course on biomedical informatics.

ID	Platform	Course name	Institution	Lenguage (Subtitle)	Topic				
					Bioinformatics	Images	Clinic	Public health	Data Science
1	Coursera	Algorithms for DNA Sequencing	Johns Hopkins University	English (English)	X				X
2	Coursera	Algorithms on Strings	University of California San Diego	English (English)					X
3	Coursera	Analysis of Algorithms	Princeton University	English (English)					X
4	Coursera	Basics of Extracellular Vesicles	University of California, Irvine	English (English)	X				
5	Coursera	Big Data Science with the BD2K-LINCS Data Coordination and Integration Center	Icahn School of Medicine at Mount Sinai	English (English)	X				
6	Coursera	Big Data, Genes, and Medicine	University of New York	English (English)	X				X
7	Coursera	Bioconductor for Genomic Data Science	Johns Hopkins University	English (English)	X				
8	Coursera	Bioinformatic Methods I	University of Toronto	English (English)	X				
9	Coursera	Bioinformatic Methods II	Icahn School of Medicine at Mount Sinai	English (English)	X				
10	Coursera	Bioinformatics Capstone: Big Data in Biology	University of California San Diego	English (English)	X				X
11	Coursera	Bioinformatics: Introduction and Methods 生物信息学: 导论与方法	Peking University	English (English)	X				X
12	Coursera	Biology Meets Programming: Bioinformatics for Beginners	University of California San Diego	English (English, Portuguese)	X				
13	Coursera	Command Line Tools for Genomic Data Science	Johns Hopkins University	English (English)	X				X
14	Coursera	Comparing Genes, Proteins, and Genomes (Bioinformatics III)	University of California San Diego	English (English)	X				
15	Coursera	Data Science in Stratified Healthcare and Precision Medicine	The University of Edinburgh	English (English)		X	X		X
16	Coursera	Dynamical Modeling Methods for Systems Biology	Icahn School of Medicine at Mount Sinai	English (English)	X				X
17	Coursera	eHealth: More than just an electronic record	The University of Sydney	English (English)				X	
18	Coursera	Finding Hidden Messages in DNA (Bioinformatics I)	University of California San Diego	English (English)	X				
19	Coursera	Finding Mutations in DNA and Proteins (Bioinformatics VI)	University of California San Diego	English (English)	X				

ID	Platform	Course name	Institution	Lenguage (Subtitle)	Topic				
					Bioinformatics	Images	Clinic	Public health	Data Science
20	Coursera	Genome Assembly Programming Challenge	University of California San Diego	English (English)	X				
21	Coursera	Genome Sequencing (Bioinformatics II)	University of California San Diego	English (English)	X				X
22	Coursera	Genomic Data Science and Clustering (Bioinformatics V)	University of California San Diego	English (English)	X				X
23	Coursera	Genomic Data Science Capstone	Johns Hopkins University	English (English)	X				
24	Coursera	Genomic Data Science with Galaxy	Johns Hopkins University	English (English)	X				X
25	Coursera	Genomics: Decoding the Universal Language of Life	University of Illinois at Urbana-Champaign	English (English)	X				X
26	Coursera	Health Care IT: Challenges and Opportunities	Icahn School of Medicine at Mount Sinai	English (English)			X		
27	Coursera	Health Informatics on FHIR	Georgia Institute of Technology	English (English)			X		X
28	Coursera	HI-FIVE: Health Informatics For Innovation, Value & Enrichment (Administrative/IT Perspective)	Columbia University	English (English)			X		
29	Coursera	HI-FIVE: Health Informatics For Innovation, Value & Enrichment (Clinical Perspective)	Columbia University	English (English)			X		
30	Coursera	HI-FIVE: Health Informatics For Innovation, Value & Enrichment (Social/Peer Perspective)	Columbia University	English (English)			X		
31	Coursera	Integrated Analysis in Systems Biology	Icahn School of Medicine at Mount Sinai	English (English)	X				
32	Coursera	Interprofessional Healthcare Informatics	University of Minnesota	English (English)					X
33	Coursera	Introduction to Genomic Technologies	Johns Hopkins University	English (English)	X				
34	Coursera	Julia Scientific Programming	University of Cape Town	English (English)					X
35	Coursera	Mathematical Thinking in Computer Science	University of California San Diego	English (English)					X
36	Coursera	Metagenomics applied to surveillance of pathogens and antimicrobial resistance	Technical University of Denmark	English (English)	X				

ID	Platform	Course name	Institution	Lenguage (Subtitle)	Topic				
					Bioinformatics	Images	Clinic	Public health	Data Science
37	Coursera	Molecular Evolution (Bioinformatics IV)	University of California San Diego	English (English)	X				X
38	Coursera	Network Analysis in Systems Biology	Icahn School of Medicine at Mount Sinai	English (English)	X				
39	Coursera	Pattern Discovery in Data Mining	University of Illinois at Urbana-Champaign	English (English)					X
40	Coursera	Programa especializado Bioinformatics	University of California San Diego	English (English, Chinese)	X				
41	Coursera	Programa especializado Data Mining	University of Illinois at Urbana-Champaign	English (English)	X				X
42	Coursera	Programa especializado Data Structures and Algorithms	University of California San Diego	English (English, Spanish)					X
43	Coursera	Programa especializado Genomic Data Science	Johns Hopkins University	English (English, Russian)	X				X
44	Coursera	Programa especializado **Машинное обучение и анализ данных**	Moscow Institute of Physics and Technology	Ruso (Russian)					X
45	Coursera	Python for Genomic Data Science	Johns Hopkins University	English (English)	X				
46	Coursera	Whole genome sequencing of bacterial genomes - tools and applications	Technical University of Denmark - DTU	English (English)	X				
47	Coursera	**Введение в биоинформатику** (Introduction to Bioinformatics)	Saint Petersburg State University	Russian (Russian)	X				X
48	Coursera	**Введение в Биоинформатику: Метагеномика** (Introduction to Bioinformatics: Metagenomics)	Saint Petersburg State University	Russian (Russian, English)	X				X
49	EdX	Big Data Analytics in Healthcare	Georgia Institute of Technology	English (English				X	X
50	EdX	Bioinformatics	University of maryland	English (English)	X				
51	EdX	Data Analytics in Health – From Basics to Business	KU Leuven University	English (English)			X		X
52	EdX	Demystifying Biomedical Big Data: A User's Guide	Georgetown University	English (English)	X				X
53	EdX	eHealth – Opportunities and Challenges	Karolinska Institutet	English (English)				X	

ID	Platform	Course name	Institution	Lenguage (Subtitle)	Topic				
					Bioinformatics	Images	Clinic	Public health	Data Science
54	EdX	Global Health Informatics to Improve Quality of Care	Massachusetts Institute of Technology	English (English)				X	
55	EdX	Introduction to Genomic Data Science	University of California San Diego	English (English)	X				X
56	EdX	Medicine in the Digital Age	Rice University	English (English)			X		
57	EdX	Trends in e-Psychology	KU Leuven University	English (English)				X	
58	FutureLearn	Bacterial Genomes: From DNA to Protein Function Using Bioinformatics	Wellcome Genome Campus Advanced Courses and Scientific Conferences	English (English)	X				
59	FutureLearn	Clinical Bioinformatics: Unlocking Genomics in Healthcare	The University of Manchester	English (English)	X		X		
60	FutureLearn	Data Science for Healthcare: Using Real World Evidence	EIT HEALTH	English (English)					X
61	FutureLearn	Digital Health for Cancer Management: Smart Health Technologies in Complex Diseases	Taipei Medical University	English (English, Chinese)			X		
62	FutureLearn	eHealth: Combining Psychology, Technology and Health	University of Twente	English (English)			X		
63	FutureLearn	Health Data and Analytics	EIT HEALTH	English (English)					X
64	FutureLearn	Protecting Health Data in the Modern Age: Getting to Grips with the GDP	University of Groningen	English (English)			X		
65	FutureLearn	Social Media in Healthcare: Opportunities and Challenges	Taipei Medical University	English (English, Chinese)			X		
66	FutureLearn	The Power of Data in Health and Social Care	University of Strathclyde	English (English)					X
67	Udacity	Health Informatics in the Cloud	Georgia Institute of Technology	English (English)				X	X

From the MOOCs, disciplines related to biomedical informatics courses were analyzed. Some courses taught more than one subject at a time. The majority of these MOOCs, 56.72% (n = 38), were in bioinformatics and 47.76% (n = 32) in data science (Figure 1).

The average cost of the courses was $49, which ranged from zero cost (free) to $672. Likewise, the average length of the MOOCs considered for the review was 5 weeks (Min: 2, Max: 36), with an average activity of 3 hours per week (Min: 1, Max: 30).

Discussion

Within the educational platforms, Coursera® offered the majority of courses focused on BI, as showed in a previous study of health and medicine[5]; authors prefer to upload their content more often in Coursera® because this is the most used platform[6].

Regarding the countries, The United States, China, and the United Kingdom develop the majority of courses. There appears to be a correlation between countries that generate more MOOCs and those with higher scientific output[7]. It's important to

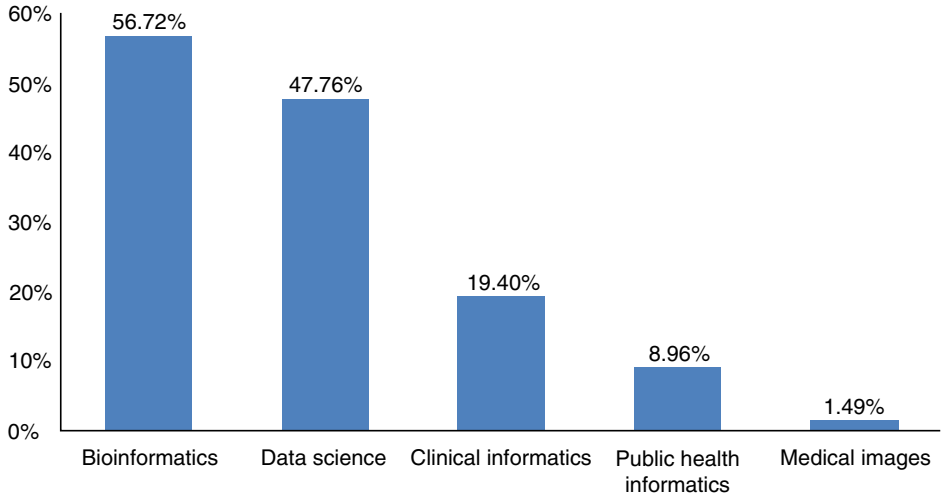

Figure 1. Disciplines addressed in MOOCs on biomedical informatics.

consider that Russia appears among the leading developers of MOOCs; this could be explained by the student exchanges that the Russian educational institutions have been promoting[8].

The majority of courses were offered in English, with a few having subtitles in other languages such as in previous studies[9]. A possible explanation for this might be the vast majority of them were made in an English-speaking country. Another explanation could be the development level of BI in these countries.

Most courses approached both bioinformatics and data science, maybe because both are tools to personalized medicine and this was been a growing field in the last few years[10]. Therefore it is necessary to develop more courses focused on health informatics.

This study has some limitations, such as such as only English language courses being included, and the incomplete coverage of all MOOC platforms. However, the platforms studied are those that have the most health or medicine courses[5]. This is the first study that has assessed MOOCs in the area of BI. In addition, the data shows a list with all the names, languages and prices of the courses.

The recommendation of this study is to diversify the BI courses into other disciplines. We suggest further studies in this area that focus on evaluating the quality of MOOCs.

Conclusion

The majority of MOOCs on Biomedical informatics were focused in bioinformatics and data science, they were offered in English by institutions in the developing world.

Data availability

Underlying data is available from figshare

Figshare: Dataset 1. Data base of Massive Open Online Courses on Biomedical Informatics https://doi.org/10.6084/m9.figshare.7582016.v2[11]

Grant information

This research was funded with a contribution of Peruvian National Science and Technology Fund (FONDECYT).

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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http://www.doi.org/10.6084/m9.figshare.7582016.v2

Open Peer Review

Current Peer Review Status: ✗ ✗

Version 1

Reviewer Report 25 February 2019

https://doi.org/10.5256/f1000research.19345.r44480

✗ **Tharindu Liyanagunawardena**
University College of Estate Managment, Reading, UK

This study aimed to identify the characteristics of MOOCs related to biomedical informatics and it was an interesting read. However, there are some serious issues in the presentation of this work. I find some of the sentences difficult to parse. For example, Introduction - second sentence, Introduction - second paragraph, first sentence. Overall, I think a professional proof reading would improve the article's readability considerably.

- This study has searched for MOOCs using many well-known MOOC platforms. It would have improved the search had the search included MOOC aggregation service for searching.
- In the Results section it is claimed that "67 MOOCs offered on biomedical informatics in the world" - I think this needs to account for the methodology and scale back to what the search was - selected platforms.
- It is a little confusing to hear about the "average cost of courses" given that the searches were on MOOCs and whether these were fees to access the course materials or for certification.
- The authors need to acknowledge that major non-English MOOC platforms such as Edraak and XuetangX were not consulted in this search when making statements about course languages.
- "However, the platforms studied are those that have the most health or medicine courses[5]" - can this statement be substantiated?
- "This is the first study that has assessed MOOCs in the area of BI" - can this be substantiated?

I find the conclusion "The majority of MOOCs on Biomedical informatics were focused in bioinformatics and data science, they were offered in English by institutions in the developing world" not supported by the evidence and misleading.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Learning Technology, MOOCs, OERs, Accessibility

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 15 February 2019

https://doi.org/10.5256/f1000research.19345.r44479

Edward Meinert
Healthcare Translation Research Group, Department of Paediatrics, University of Oxford, Oxford, UK

The authors have developed a manuscript examining the use of biomedical informatics in current MOOC implementations. This contribution could be very useful for those looking to examine MOOC implementations in this subject domain.

There are a few areas I believe the authors could further develop to improve the work:

1. While the manuscript introduces the subject matter, there is not background for why the course of investigation is merited. There is most likely a clear rationale for this investigation, the authors could improve the manuscript to provide it.

2. Methodologically the authors have not provided details on data extraction methods nor how their keywords were classified and harmonised among the various MOOC platforms. Additionally,

to be medical literature, it would have been useful to use a systematic search method applied with this context as this would be more familiar to readers.

3. The authors examine cost, number of implementations and further classifications. In their own right, these are big areas and the authors would do well to consider analysis and comparison of factors of economic impact, learning design, etc - the current discussion and analysis is only approaching these areas at a superficial interpretive level.

I recommend the authors address the rationale, strengthen the methodological approach and pick particular areas of analysis to strengthen the richness of this manuscript.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
No

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Digital health; eLearning

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.