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Review

What knowledge is available on massive open online courses in nursing and academic healthcare sciences education? A rapid review

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ABSTRACT

Background: With the recent challenges due to the Coronavirus 2019 outbreak, distance learning has been largely introduced in healthcare sciences curricula, and universities have been called upon to share learning opportunities with each other to ensure continuity of education and delivery of new graduates to the health system. However, decisions about its introduction should be supported by up-to-date evidence capable of providing an overview of available knowledge.

Objectives: To map the (a) state of research on massive open online courses in undergraduate and postgraduate health sciences education, (b) evaluation methods and tools used to measure learning outcomes, and (c) factors increasing their effectiveness as documented to date.

Design: A rapid review following the preferred reporting items for systematic reviews and meta-analysis guidelines.

Methods: PubMed, the Cumulative Index to Nursing and Allied Health Literature, Cochrane, Scopus, PsycInfo and Medline (via Ovid) were searched. Primary studies reporting one or more massive open online course (1) devoted to undergraduate and/or postgraduate students in nursing and healthcare sciences (2), written in English (3) with abstract available (4) and published up to February 18th, 2020 were all included. After having assessed the need for a review and the topic itself (a), the literature search was performed (b), studies were screened and selected (c), data was extracted (d), and the findings were summarised (e).

Results: Thirty-six studies emerged with mainly an explorative/descriptive or case study design. The courses have been developed mainly by universities alone or in collaboration with institutions mainly in US, Sweden and the UK. Their delivery has been performed at multi-national levels, mainly in English, and with a number of participants ranging from 45 to >23,000. The duration spanned from two weeks to six months on clinical topics (e.g., emergency medicine) to methods (e.g., statistics). The target audience has been mainly mixed, including students, healthcare professionals, and lay citizens. Evaluation methods and tools have been described in 28 studies, and multiple-choice questions were most frequently adopted. Factors affecting the effectiveness of massive open online courses have been identified analysing the courses themselves and the participants.

Conclusion: Massive open online courses have recently started to be studied in healthcare sciences: these can be useful to educate students, mainly as elective courses, and to educate a massive audience, thus embodying the third mission of the university. The complexity of factors increasing effectiveness suggests the need for a multidisciplinary approach both in their design and implementation.

1. Introduction

In the new century, digital technologies have become the preeminent strategy to expand academic accessibility for all students (Bendezu-Quispe et al., 2017; Daniel, 2012). In this context, massive open online courses (MOOCs) have been developed as a new form of education devoted to different topics as science, engineering, arts (Hew, 2015), and recently also healthcare sciences (Stathakarou et al., 2018b). The word “MOOC” was first used in 2008 to describe a course taught by Stephen Downes and George Siemens (Downes, 2008) entitled...
MOOCs have been reported to date, encompassing the degree of connectivity and collaboration in the field of nursing and health sciences (Maxwell et al., 2018), mainly due to participants’ limited interactions (Fricton et al., 2015) and the lack of face-to-face sessions thereby generating a sense of isolation and disconnection (Aboshady et al., 2015). Secondly, the voluntary nature of MOOCs, as well as the ease with which participants can register or stop the course, prevent their completion (Fricton et al., 2015). Thirdly, the assessment in MOOCs occurs in different forms (e.g., traditional multiple-choice questions, peer feedback) depending on the course (Chan et al., 2019), thus lacking a reliable, standardised methodology. Accordingly, institutions have been reported to be hesitant to accredit MOOCs (McAuley et al., 2010) also in healthcare sciences and available evidence (Alturkistani et al., 2020) has grown more slowly compared to other academic fields (Kearney et al., 2016).

In this context and despite its limits, MOOCs have become increasingly popular in the healthcare educational context as a response to social distancing and physical isolation imposed by governments due to the Coronavirus 2019 (COVID-19) outbreak (International Association of Universities, 2020). Accordingly, universities worldwide have introduced different strategies for distance learning (e.g., MOOCs, online lessons) in several healthcare curricula, including nursing (Dewart et al., 2020). However, decisions about its introduction should be supported by strong evidence capable of providing an overview of available knowledge in addition to that summarised by recent systematic reviews on their efficacy in teaching in medical education (Zhou et al., 2018) and their effectiveness (Rowe et al., 2019) and evaluation methods (Alturkistani et al., 2020).

Therefore, in order to address the need for strategies to overcome the limits affecting MOOCs and to fill gaps in literature, we conducted a rapid review with the aim of informing the scientific and academic community on how MOOCs devoted to nursing students and health care students have been studied in the literature, reporting their evaluation methods and factors affecting their effectiveness. Accordingly, we aimed to summarise (a) the state of the knowledge on MOOCs; (b) assessment methods of MOOCs; and (c) factors affecting effectiveness of MOOCs in the field of nursing and health science education.

2. Methods

2.1. Study design

A Rapid Review as a knowledge-generation strategy, capable of summarising evidence and using “abbreviated” systematic review methods to provide university stakeholders and policymakers with relevant and state-of-the-art evidence has been undertaken (Tricco et al., 2017). The steps proposed by Tricco et al. (2017) were followed: (a) performing an assessment of needs and selecting/defining the topic, (b) performing a literature search, (c) screening and selecting studies, (d) extracting the data, and (e) summarising the results. Methods and results have been reported in accordance with the preferred reporting items for systematic reviews and meta-analysis guidelines (Moher et al., 2009) (Supplementary Table 1).

2.2. Assessing the needs, selecting and refining the topic

Due to the COVID-19 outbreak that forced universities in Italy to close, it was decided that all healthcare professional (HCP) undergraduate and postgraduate students had to stay at home; consequently, there was the need for an immediate revision of the curriculum delivery from in person to distance learning. Amid the challenges posed by the pandemic, a meeting was held among researchers (see authors). In this context, given the changes in the curriculum (Morin, 2020), as well as the need to educate immediately students about the pandemic using open online resources (BMJ Best practice, 2020), and the lack of resources in some universities calling for cooperation in sharing learning resources (Marinoni and de Wit, 2020), three research questions were identified:

(1) “What is the state of research published to date on MOOCs in undergraduate and postgraduate health sciences education?”
(2) “What evaluation methods and tools have been used to date to measure MOOC’s learning outcomes in this population?” and
(3) “What factors have been documented to date to influence the effectiveness of MOOCs in this context?”

2.3. Performing the literature search

Five databases including PubMed, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane, Scopus, PsycInfo, and Medline (via Ovid) were searched by adopting the following keywords: “Massive open online course”, “MOOC”, “health”, “nurse”, “nursing”, and “medicine”. According to each database, the search strings were changed slightly (Supplementary Table 2).

2.4. Screening and selecting studies

As inclusion criteria, we considered primary studies with the following features: (1) that described one or more delivered MOOCs, (2) that concerned MOOCs devoted to undergraduate or postgraduate students in nursing and healthcare sciences, (3) that were written in English and Italian, (4) had an abstract available, and (5) were published up to February 18th, 2020 with no start date.

In screening and selecting the literature, the search strategy was broader and not limited to nursing students for two main reasons: firstly (a), MOOCs are intended to be massive and open in order to reach and educate a large audience of learners (especially in cMOOCs) (Downes, 2015); and secondly (b) the nursing discipline itself is encouraged to...
undertake—when appropriate—inter-professional educational strategies aimed at shaping future attitudes of students in working in multidisciplinary teams (Lennen and Miller, 2016).

Therefore, we excluded opinions, letters, and Delphi studies with full texts not available. A total of 1156 studies emerged. Two researchers (AP, JL) independently evaluated the eligibility (titles and abstracts) of the 773 studies retrieved, thereby excluding 704 studies. Three researchers (AP, BDC, JL) analysed the full text of 69 eligible studies and included 36 studies (Fig. 1).

2.5. Extracting the data

According to the research questions, the following data was extracted:

(1) research question n. 1: author(s); year of publication; study aim(s); study design; country(ies) that developed and distributed the MOOC(s); MOOC design data when available, encompassing (a) platform(s) and provider(s); (b) topic(s); (c) language(s) (mono or multilingual); (d) target population (including type, number, mono- or multidisciplinary, duration, dropout rates); (e) teaching methodologies; and (f) pedagogical foundations, if described;

(2) research question n. 2: evaluation method(s) and tools adopted;

(3) research question n. 3: facilitators of and barriers to MOOC’s effectiveness.

2.6. Summarising the findings

Data from the studies included was collected and summarised describing the following: (1) the main features of MOOCs to provide a summary of the extent and the nature of the existing literature regarding MOOCs targeting undergraduate and postgraduate nursing and healthcare science students; (2) the MOOCs’ evaluation systems documented to date: also in this case, a summary of the methods used has been developed by analysing data extracted from the primary studies; and (3) factors affecting the effectiveness of the MOOCs that have been categorised in the MOOC itself and in the participants. For each factor identified independently by two researchers and then agreed upon, the influence— as improving or hindering the effectiveness of the MOOCs—has been summarised.

3. Results

3.1. MOOCs in healthcare education: the state of the research

Thirty-six studies published from 2014 (Subhi et al., 2014) to 2020 (Canavese et al., 2020) emerged; around one third of them (13; 36.1%) were based on a descriptive/explorative study design (e.g., Canavese et al., 2020) and 13 (36.1%) on case study designs (e.g., Castle et al., 2016). Three studies were retrospective (e.g., Frank et al., 2016), and one was prospective in nature (Jia et al., 2019); only three (8%) were

Fig. 1. Flow chart of the search strategy and results according to the PRISMA statement (Moher et al., 2009).

Abbreviations: CINAHL, Cumulative Index to Nursing and Allied Health Literature; MOOC, Massive Open Online Course; n, sample size; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.
randomized control trials (Bowen et al., 2014; Hossain et al., 2015; Stathakarou et al., 2018b) (Table 1). The remaining were qualitative or mixed-methods study designs.

From the creation point of view, a total of 24 (66.7%) studies reported that MOOCs have been developed by universities, while eight (22.2%) reported joint projects between universities and other institutions (e.g., the Minister of Health; e.g., Hendriks et al., 2019) and to lesser extent with scientific societies (e.g., Frank et al., 2016). The US (nine; e.g., Evans et al., 2017), Sweden (six; e.g., Berman et al., 2017) and UK (four; e.g., Beer, 2019) emerged as the countries that most often developed MOOCs.

On the other hand, the MOOCs documented have been offered mainly at multi-national levels (14; 39% e.g., Stathakarou et al., 2018b); however, no data regarding where MOOCs have been delivered (14; 39% e.g., Darcy and Lock, 2017) as well as the language used (24; 66.6%, e.g., Alturkistani et al., 2019) have been reported in several studies. When being documented (12; 33.3%), ten studies used English (e.g., Harvey et al., 2014; Hossain et al., 2015) while platforms most commonly used were Coursera, edX, and Futurelearn (e.g., Kononowicz et al., 2018).

The students target has been varied, ranging from a general audience of students to a global audience with healthcare professional (HCPs) to laypeople (six studies; e.g., Berman et al., 2017) or to single individuals (five; e.g., Bakayev et al., 2018) such as: nursing students (four; e.g., Goldschmidt and Greene-Ryan, 2014); medical students alone (four; e.g., Frank et al., 2016) or among a general healthcare audience (three; e.g., Magaña-Valladares et al., 2018); students included in a general healthcare audience (three; e.g., Milligan and Littlejohn, 2016); physiotherapist students and physiotherapists (two; e.g., Harvey et al., 2017); dentistry students in a global healthcare audience (two; e.g., Lan et al., 2019); physiotherapist students (Hossain et al., 2015); undergraduate students in data science in healthcare (Alturkistani et al., 2019); and medical and nursing students with HCPs (Roller-Wirnsberger et al., 2019). However, the number of participants was not clarified in four studies (e.g., Stathakarou et al., 2014).

The number of participants ranged from 45 when the recruitment process of participants was selective (Darcy and Lock, 2017) to >23,000 (Fricton et al., 2015); however, high percentages of dropout rates (>90%) have been reported in several MOOCs (e.g., Berman et al., 2017; Pickering and Swinnerton, 2017). Topics varied broadly, ranging from clinical subjects like depression, genomic medicine, chronic pain, and emergency medicine (e.g., Frank et al., 2016) to research and statistics (e.g., Milligan and Littlejohn, 2016).

The reported duration of MOOCs spanned from two weeks (e.g., Shang and Liu, 2018) to six months (e.g., Canavese et al., 2020) with a mean length of five or six weeks (e.g., Berman et al., 2017). Moreover, MOOCs have been documented to be available for a defined period, such as a semester (Bowen et al., 2014) or six months (Darcy and Lock, 2017).

As reported in Table 1, the pedagogical foundations of MOOCs have been described only in 10 studies (27.8%) referring to “adult learning theory” (four; e.g., Evans et al., 2017), while other theories have been used as a foundation in other studies as for example “constructivism” (three e.g., Hendriks et al., 2020), “connectivism” (Chan et al., 2019), “transformative learning” (Beer, 2019) or “cognitivism” (Roller-Wirnsberger et al., 2019). In one study, the combination of more theories was reported (Magaña-Valladares et al., 2018).

Video lessons were used most often (25 studies; 69.4%; e.g., Aboshady et al., 2015; Jia et al., 2019), followed by podcasts (six; e.g., Berman et al., 2017). PowerPoint presentations (five; e.g., Frank et al., 2016) and more complex tools such as three-dimensional anatomical illustrations or virtual patients (e.g., Castle et al., 2016). As supportive strategies, discussion forums and social media groups have been reported in almost all studies to increase interactivity and collaboration both between peers and between students and teachers, technical staff or experts (e.g., Fricton et al., 2015). Didactic resources have been described mainly as scientific readings or articles, textbooks, and website links (e.g., Milligan and Littlejohn, 2016).

3.2. MOOCs in healthcare education: assessment methods and tools

As reported in Table 1, data regarding the assessment of learning outcomes has been reported in the majority of studies (28; 77.8%; e.g., Goldschmidt and Greene-Ryan, 2014), but only three explicated the voluntary non-mandatory nature of the final assessment (e.g. Bowen et al., 2014) or its formative intent (e.g. Swinnerton et al., 2017). Nearly half of the studies also described the evaluation and/or the assessment timing (16; 44.4%; e.g., Hendriks et al., 2019), as during and post- (11; e.g., Canavese et al., 2020) or pre- and post-MOOCs attendance (five; e.g., Harvey et al., 2017).

Among the written assessments, the multiple-choice questionnaire was the main tool used (16; 44.4%, e.g., Alturkistani et al., 2019), along with validated instruments such as the “Comprehensive Assessment of Outcomes in Statistics” (Bowen et al., 2014) and less often with open-ended questions (three; e.g., Kononowicz et al., 2015). Peer evaluations and feedback (six; e.g., Chan et al., 2019) have been also documented as assessment methods, even if only with formative intent (three; e.g., Lan et al., 2019). However, when reported, methods used to assess have been mixed, by using—for example—free text and multiple-choice questions, and multiple self-evaluations (Harvey et al., 2014), including practical assessments (Shang and Liu, 2018). Moreover, satisfaction and reasons for dropping out have been reported as being assessed in five studies (e.g., Harvey et al., 2017) and one (Chan et al., 2019) study, respectively.

The delivery of a final certificate was reported in 11 studies (30.5%; e.g., Frank et al., 2016), of which five described how to achieve it: four studies defined a cut-off passing grade point (e.g., Evans et al., 2017) and one the need to pay fees (Koch and Hägglund, 2017). To gain transferable credits for university was possible in two MOOCs for nursing students (Goldschmidt and Greene-Ryan, 2014; Shang and Liu, 2018), while obtainable, non-specified credits for completion of the course were available in four studies (e.g., Evans et al., 2017) and credits for continuing education in two reviews of MOOCs (Hendriks et al., 2019; Liyanganawardena and Williams, 2014).

3.3. Factors affecting MOOCs’ effectiveness

Factors affecting the effectiveness of the MOOCs have been identified in the MOOC itself and in its participants. For the first element (Table 2), the following have been reported to increase effectiveness: (a) promoting discussion and collaboration through forums, collective tasks, and social media groups—e.g., Facebook—(e.g., Aboshady et al., 2015); (b) using multiple resources and delivery systems—e.g., lecture, video, homework assignment, practical training via computer or mobile phone—(e.g., Goldschmidt and Greene-Ryan, 2014); (c) facilitating interactivity with face-to-face sessions or tools as virtual patients (e.g., Bowen et al., 2014); and (d) ensuring constructive communication, feedback, and support by teachers and staff (e.g., Chan et al., 2019). Difficulty accessing technology and internet connection issues have also been identified in some studies as barriers to completing MOOCs, especially in developing countries, while asynchronous resources, offline and lower-resolution versions have been adopted in order to overcome these barriers (e.g., Fricton et al., 2015). Furthermore, regular assessments have been reported to monitor participants’ progress, thus preventing a flawed learning process through the detection of missed activities (Bakayev et al., 2018). MOOCs delivered in a single language or in a limited geographical area have been reported to prevent access and understanding (e.g., Evans et al., 2017).

From the perspective of participants, learners’ motivation and engagement have been identified as affecting completion of MOOCs (e.g., Jia et al., 2019). In addition, a high knowledge level, skills and e-health literacy (e.g., Aboshady et al., 2015), and time-management skills (e.g., Lan et al., 2019) have been reported as increasing MOOC
### Table 1
Characteristics of studies included.

| Authors          | Year  | Country developed | Study aims                                                                 | Study design                                                                 | Platform providers                                      | Topic or title                                                                 | Target students | Methods (e.g., video, audio) | Evaluation and assessment systems |
|------------------|-------|-------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------|-----------------|--------------------------------|----------------------------------|
| Canavese et al.  | 2020  | Brazil, Colombia, | To describe the design, development, and assessment process of an online-based course that uses the MOOC format to offer a new and pioneering training on the topic of sexual rights and health involving intersex (LGBTI+) health promotion in Brazil | Descriptive and analytic study                                                                                           | Moodle software and a distance learning platform University and other institutions (Ministry of Health and Federal Institute) | Sexual rights and health involving intersex (LGBTI+) health promotion in Brazil Multidisciplinary | Global audience but especially HCPs, included students 3000 30 h 80% | Video or podcast; scientific text and optional complementary material | The final certificate was awarded after approval in both modules (minimum grade of 75%). Test with 5 questions at the end of each module |
| Hendriks et al.  | 2020  | NR, NR            | To investigate the quality of the instructional design of medical MOOCs that are eligible for integration in formal campus education | Explorative (33 MOOCs)                                                                                      | 10 different platforms (45% MOOCs used Coursera) Universities (26 MOOCs), partnership of institutions (3 MOOCs), health organisations (2 MOOCs) | Medical condition or disease Multidisciplinary Monolingual, English | Not explicit (general audience of students) NR NR | Formulation of personal goals, (learning or performance goals); real patients describing their experiences; videos of operations; open-access research articles; feedback largely automated or by peers, not by experts; collective knowledge via learning from each other; activities attempt to activate learners’ relevant prior knowledge or experience; complex or ill-structured problems with multiple solutions | NR |
| Alturkistani et al. | 2019 | NR, NR            | To trial data collection methods to inform course development and to reflect on evaluation methodology for future course runs | Explorative (33 MOOCs)                                                                                      | NR Health Q Data Science Essentials: Real World Evidence Multidisciplinary | Undergraduate students in data science within healthcare 191 2 months NR | Data from pre-course and post-course surveys, quizzes, and tests | | |
| Beer             | 2019  | UK, NR            | To evaluate a 2-week MOOC as part of a MSc in nursing to establish whether learners are demonstrating transformative learning | Explorative (33 MOOCs)                                                                                      | FutureLearn University Healthcare research for HCPs Multidisciplinary Monolingual, English | MSc nursing students, members of the public 1160 2 weeks NR | Video; audio; discussion of an article; peer review; quiz; test Transformative learning | Rubric for a direct measure of learning that is consistent in its evaluation | |
| Chan et al.      | 2019  | Guatemala, Colombia, Mexico, Perú | To explore students’ behaviour from a MOOC on Health Emergencies, analysing the completion and the drop-out rates | Explorative (33 MOOCs)                                                                                      | Telescope project (.LRN platform) University | Health Emergencies to introducing first aid and emergency treatment Multidisciplinary | Global audience (60% of participants studied at university) 2144 5 weeks 97.6% | Introductory unit (general aspects and methodology of MOOC); learning units (1 per week); each unit had between 3 and 5 videos (6–9 min in length); support materials (PPT presentation, interactive animations, learning activities supported by cloud-based tool) show different real-life situations in which students have to make a decision or solve a | Peer assessment (with a rubric to evaluate classmates for each learning activity); self-assessment tests; multiple-choice questions; post-questionnaire with 20 questions (Likert scale); a questionnaire related to dropout aspects for participants who did not finish the course |

(continued on next page)
| Authors          | Year | Country developed | Country delivered | Study aims                                                                 | Study design          | Platform providers                                                                 | Topic or title                                                                 | Target students                         | Methods (e.g. video, audio) | Evaluation and assessment systems                                                                 |
|------------------|------|-------------------|-------------------|-----------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------|--------------------------------|---------------------------------------------------------------------------------------------|
| Hendriks et al.  | 2019 | NR                | NR                | To specify the materials and teaching approaches available in medical MOOCs that qualify for integration in formal student education | Explorative (33 MOOCs) | 10 different platforms Universities (26 MOOCs), partnership of institutions (3 MOOCs), health organisations (2 MOOCs) | Medical conditions or diseases NR Monolingual, English | Not explicit (general audience of students) NR NR | Formal assessment structures (88%), of these 4 also offered an optional exam for continuing medical education credit. Multiple-choice questions (100%); open-ended questions with long answer (39%); open-ended questions peer reviewed (21%); open-ended questions with short answer (9%); most courses offering weekly assessment |
| Jia et al.       | 2019 | China             | NR                | To compare the differences between the “blended learners” and “social learners” in course completion, participation, performance, and online interactions | Prospective cohort study | Chinese MOOC platform iCourse 163 University | Health assessment NR NR | Blended learners (2nd year nursing undergraduates), social learners (global audience) 4106 16 weeks 92% | Videos; tests; reading materials; case discussions; participating in the online discussions NR | 423 test questions; all videos >10 min had a resident question in the middle and an in-class test with 2–15 questions at the end, test for each topic with 15–20 questions; final exam with 70 questions |
| Lan et al.       | 2019 | China             | NR                | To investigate learners’ behaviours and correlate patterns of self-regulated learning with performance and achievement | Case study             | Coursera University | Implant dentistry Monodisciplinary NR | Undergraduate dentistry students, fresh graduates, junior clinicians and senior, experienced practitioners 7608 5 weeks 83.2% | 5 modules in which there were lectures, clinical procedures videos, short webinars, discussion boards, suggested readings, practical tutorials, case studies; regular “checkpoints” and mentoring by | Completed graded course assessments expressed a final grade with passing grade > 75%; non-graded peer assessment; self-assessment; multiple-choice quizzes; |
Table 1 (continued)

| Authors                          | Study aims Study design                                                                 | Platform providers                                                                                                                                                                                                 | Topic or title                                                                 | Target students | Methods (e.g., video, audio) | Evaluation and assessment systems                                                                 |
|----------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------|-------------------------------|------------------------------------------------------------------------------------------------|
| Roller-Wirnsberger et al. 2019  | To provide background information on MOOCs in general, and specifically to describe a MOOC under the umbrella of the international project “Screening for Chronic Kidney Disease among Older People across Europe” Case study | ICT platform iMoox Pan-European Consortium; Horizon 2020 programme of the European Commission; University | Screening for chronic kidney disease among older people across Europe; chronic kidney disease and its management in older patients with complex care needs Multidisciplinary Monolingual, English | Medical and nursing students during their first years of education and training as well as general practitioners NR NR NR | 3 courses designed with chapters and learning goals; video clips (15–20 min.); documents, links, asynchronous communication possibilities, textual description, graphics animations and audio (interactive mode); initial-guided course; a teacher available to guide students through the whole MOOC; every 2 weeks 1 course has to be finished Extended MOOC: theories of “cognitivism” | Assessment after all modules with passing grade > 75% score and SCOPE “C certificate” |
| Bakayev et al. 2018               | To show the demand for the developed online course “Physical Culture: Theory” in the educational process among students Case study | Open Education University | Physical Culture: Theory Multidisciplinary NR | University students, independent trainers, lecturers, university staff 4400 6 weeks 46.5% | Lectures; recording video; 6 modules, 22 academic hours, including 18 in electronic formats, individual work of students and its control takes 50 h; kick-off lecture for university students is mandatory NR | Successful completion of the course to get a certificate, opportunity to transfer credit in higher education institution; final test; for external different variants of passing final test (online testing, “blended online and offline proctoring format” in another university classroom equipped with video cameras) Assessment for every module. A “cube of competencies” was designed. |
| Magaña-Valladares et al. 2018    | To show that carefully designed educational interventions can improve service professionals’ competencies and that regardless of the modality, face-to-face, blended learning, or MOOC, high graduation rates can be achieved Pre-post | Moodle Local ministries of health | Breast cancer Multidisciplinary NR | Primary HCPs and medical students 11,569 40 h 12% | Video; interactive exercises; gamification. Stratification based on different profession profile with different learning strategies Constructivism theory | Assessment for every module. A “cube of competencies” was designed. |
| Shang & Liu 2018                 | To describe a blended learning course, which combine online self-learning with classroom teaching and to evaluate the teaching effects Case-control study | iCourses (Chinese university MOOC platform) University | Medical physiology NR Monolingual, Chinese | Nursing students at 4-yr bachelor’s degree programme at university 54.55 2 weeks NR | Video lesson (5–15 min.); 6 study blocks, each containing a study outline, 1–3 micro-lesson videos, and 1 online quiz; 1 h classroom question session and a 2-h student presentation and discussion session during and after the online study weeks; online homework and quizzes; experimental videos; PPT lecture NR | 8 online quizzes; final student grade was then composed of a final examination (70%), online credit (20%), and practical assessment (10%); multiple-choice questions; long- and short-answer questions; 13 online tasks to get full online credit. |
| Stathakarou et al. 2018a         | To describe the process of improving the quality of the virtual patients components by the application of | OpenLabyrinth 3 open source Virtual patients system University | Urology NR NR | Not explicit; learners (medical students) 378 NR NR | Interactive patient scenarios: bladder cancer virtual patients; branched virtual patients: possibility to NR | (continued on next page) |
| Authors                  | Year      | Country developed | Country delivered | Study aims                                                                 | Platform providers | Topic or title                                                                 | Target students             | Methods                                                                 | Evaluation and assessment systems |
|-------------------------|-----------|-------------------|-------------------|------------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------|----------------------------------|
| Stathakarou et al.      | 2018b     | Sweden            | Participants from 172 countries (most from USA, Sweden, India) | To explore the learners' interaction pattern with Virtual Patients in MOOCs; how branching points in a virtual patient case may influence the dropout rate of learners within the virtual patients RCT | edX University     | Introduction to Urology (common symptoms related to the urinary tract)        | Medical students: 4925      | Video components; multiple-choice questions; 3D models; glossary; discussion forum; webinar; 2 virtual patient cases | Final exam; students could acquire course credits for the activity completion (not mandatory) |
| Berman et al.           | 2017      | Sweden            | Participants from 185 countries (most from USA, India, UK)      | To explore learners' perceptions of using virtual patients in a behavioural medicine MOOCs and there by describe innovative ways of disseminating knowledge in health-related areas Case study | edX University     | Behavioural Medicine and Motivation to Change Multidisciplinary                  | Medical students: 19,236     | Video components; multiple-choice questions; free text questions; post shared in the discussion forum; 4 questions at the end of each virtual patient assignment; final course project assignment, concerned participants experience with virtual patients | 5 sections which contain 2-branched narrative interactive virtual patients (with stress and sleep problems) consisting of video recordings of a live standardized patient, with multiple clinical decision points and narration unfolding depending on learners' choices; audio, video, interactive elements; discussion forum; learners see the outcomes of their choices |
| Darcy & Lock            | 2017      | USA               | NR                 | To describe the development of 3 technology-based innovations aimed at improving outcomes for children and adolescents with eating disorders Case study | NR University and US National Institutes of Health | Family-based therapy for adolescents with anorexia nervosa Multidisciplinary     | Medical doctor psychiatrists, doctoral-level psychologists, master's level family therapists, doctoral-level graduate students, registered dietitian 45 12 weeks 22% | Training modules: 6–7 lectures, comprising 5–6 very short (3–4 min.) didactic videos on treatment model and a role-play therapy session (or series of short role-played scenarios) with a typical case of anorexia nervosa; prescribed reading; course is delivered sequentially, with a new lecture delivered every Monday morning; weight chart to track progress, intake evaluation report; discussion forum | Completion: finishing >80% of videos and assignments. Tested clinical decision making; standardised assessments |
| Evans et al.            | 2017      | NR                | Coursera University and partner institutions | To describe the development and evaluation of MOOC on Ebola virus Multidisciplinary Mono/multilingual | Coursera University and partner institutions | Ebola virus Family-based therapy for adolescents with anorexia nervosa Multidisciplinary | Medical doctor psychiatrists, doctoral-level psychologists, master’s level family therapists, doctoral-level graduate students, registered dietitian 45 12 weeks 22% | Final exam; students could acquire course credits for the activity completion (not mandatory) | Quiz (9–11 true/ false, closed-ended and multiple-choice). | 5 sections which contain 2-branched narrative interactive virtual patients (with stress and sleep problems) consisting of video recordings of a live standardized patient, with multiple clinical decision points and narration unfolding depending on learners' choices; audio, video, interactive elements; discussion forum; learners see the outcomes of their choices | Final exam; students could acquire course credits for the activity completion (not mandatory) |

(continued on next page)
| Authors                      | Year | Country developed | Country delivered | Study aims                                                                 | Study design | Platform providers                   | Topic or title                                                                 | Target students                                                                 | Methods                                                                 | Evaluation and assessment systems |
|------------------------------|------|-------------------|-------------------|-----------------------------------------------------------------------------|-------------|--------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------|----------------------------------|
| Harvey et al.                | 2017 | USA               | 170 countries     | To describe 2 MOOCs about the management of spinal cord injuries; to determine whether the MOOCs increased usage of an existing freely available online-learning module created by the International Spinal Cord Society upon which the MOOC was based | Descriptive study | Physiopedia International society   | Physiotherapy management of spinal cord injuries Monodisciplinary NR            | Physiotherapy students and junior physiotherapists 13,509 | Questions or reflections for self-checks generally at the end of each video; open-access resources and discussion board NR | Grades were calculated based on quizzes and participation in discussion boards. Quizzes were averaged and accounted for 90% of the grade. The other 10% was based on discussion posts; six were required to earn full credit. Verified certificate; passing grade (70%). Voluntary; obligatory for credits. Opportunities at different stages to assess own knowledge and clinical reasoning skills; multiple-choice self-assessments and interactive activities dispersed throughout the content; pre- and post-MOOC knowledge assessment with 20 multiple-choice questions. Online Google analytic tracking software was used to record daily usage. The course was given in three different versions: (1–2) without the possibility of paid-for certificates; (3) with the possibility to paid-for certificates. Quizzes |
| Pickering & Swinnerton      | 2017 | UK                | NR                | To assesses the use of an anatomy MOOC as part of a blended learning medical anatomy curriculum; to provide valuable | NR          | FutureLearn University               | Exploring Anatomy: The Human Abdomen MOOC Multidisciplinary NR                | HCPs and students 2711 | Video lectures; research and discussion forum NR | Automated self-assessment 21 survey questions |
| Koch & Hågglund             | 2017 | Sweden            | Participants from 162 countries (most from USA, India, UK) | To evaluate how students and teachers perceived the course | Case study  | edX University                       | eHealth - Opportunities and Challenges Multidisciplinary NR                  | Global audience of students 13,302 | Topic released at the beginning of each week; introductory video lecture followed by a series of short videos about subtopics and literature; every course assignment of the preceding weeks (estimated workload: 4–6 h per week); video clips in the form of interviews with clinicians, industry representatives, policymakers, patients, and informal carers from different parts of the world; hand-drawn illustrations of patient scenarios; 1 teaching assistant and teacher responsible for answered questions in discussion forum; course runs three times: first and third as a session-based course, second as self-paced course | |
Table 1 (continued)

| Authors                      | Year       | Country developed | Country delivered | Study aims                                                                 | Study design                  | Platform providers | Topic or title                                                                 | Target students | Methods (e.g. video, audio) | Evaluation and assessment systems |
|------------------------------|------------|-------------------|-------------------|-----------------------------------------------------------------------------|-------------------------------|--------------------|-------------------------------------------------------------------------------|-----------------|------------------------------|----------------------------------|
| Swinnerton et al.            | 2017       | UK                | 1) NR             | Explorative study aims to investigate the impact of an anatomy MOOC on, in a first phase, the general public’s uptake and engagement with a science-based course and, in the campus phase, how campus-based medical students currently studying anatomy at the host institution’s medical school would use the MOOC as part of their year 1 curriculum. | Explorative                | FutureLearn University | Exploring Anatomy: The Human Abdomen MOOC Multidisciplinary NR | (1) Pre-university and undergraduate healthcare students; HPCs: (2) First-year medical students at the university (1) 8597 (2) 9786 3 weeks (1) 94.1% (2) 96.3% | Video-based lectures; discussion forum with educators and peers; introductory, core, and advanced materials; short introductory scene-setting videos, bespoke mini-lectures using hand-drawn and animated images, detailed screencasts; interview-style videos with experts; clinical case studies and links to current medical research; transcripts, subtitles, audio recordings; cadaver demonstration videos  | Formative assessments with instant feedback positioned throughout each week; online formative multiple-choice questions |
| Castle et al.                | 2016       | USA               | participators from 47 countries | To evaluate the impact of MOOC on participants Case study | Explorative                | Coursera Research Institute and university | Introduction to Reproduction (biological foundations of reproductive health) Multidisciplinary NR | Global audience of students 289 NR NR | Lecture videos; animations; 3-dimen-sional anatomical illustrations; virtual teaching assistants with personalities voice embedded by cartoon visuals; online reading materials supplement the short video presentations and links to reproductive health tools (e.g. app for menstrual cycle tracking); real-life case studies discussion boards; online reproductive health lexicon (Repropedia)  | Content-based quiz (10 multiple-choice questions) after each module. Score of 70% or higher to adequately complete the course and certify the completion; reflective questionnaires combined with knowledge-based quizzes |
| Frank et al.                 | 2016       | USA               | Participants from 145 countries | To compare the scores on the Society of Academic Emergency Medicine exam of students trained by a “democratically open, outstanding hybrid of internet-aided, computer-aided, and human-aided education” educational tool versus traditionally trained students | Retrospective study       | NextGenU University, International Federation of Emergency Medicine, and the Society of Academic Emergency Medicine | Emergency Medicine for Senior Medical Students Multidisciplinary NR | Senior medical students at the university 4000 A semester (Q3) 0% | Readings on common emergency medicine diseases and presentations; it was instructor-led | Certification obtained through assessment with objective multiple-choice question testing; through interactions with, and assessed by, local and/or remotely available peers and mentors; Society of Academic Emergency Medicine exam; quizzes, multiple-choice questions, peer and mentor assessment |
| Milligan & Littlejohn       | 2016       | USA               | 168 countries     | To address the research question ‘How do professionals self-regulate their learning in a MOOC?’ The study examined the | Explorative                | edX University | Fundamentals of Clinical Trials Multilingual English | HCPs and student for HCPs 22,000 12 weeks NR | Video lectures; exercises; quizzes; weekly readings; textbook; articles  | Survey instrument designed to provide a measure of their self-regulation Multiple-choice assessment (continued on next page) |
| Authors | Year | Country developed | Country delivered | Study aims | Study design | Platform providers | Topic or title | Target students | Methods | Evaluation and assessment systems |
|---------|------|--------------------|-------------------|------------|-------------|-------------------|----------------|----------------|---------|-----------------------------------|
| Robinson | 2016 | USA | NR | To compare learner evaluations and ratings of a course that was previously delivered by traditional methods that is now delivered as a MOOC | Retrospective study | Udemy University | Medicine as a Business elective Multidisciplinary NR | Open to anyone, included fourth-year medical students 286 5 weeks 44% | Video presentations, reading materials, discussion forum, that could be accessed on a smartphone, tablet, or traditional computer via the internet; option of meeting with the faculty to discuss course content; a system to send messages to the course instructor | Completion of all course sections is required for successful completion; Multiple-choice questions (5-point Likert scales) for courses quality evaluation |
| Aboshady et al. | 2015 | Egypt | Egypt | To assess the prevalence of awareness and use of MOOCs among medical undergraduates in Egypt as well as to identify the limitations from enrolling in and completing these courses along with the satisfaction level with using them | Cross-sectional | Coursera, edX, Udacity, FutureLearn Universities | Medical MOOCs Monodisciplinary NR | Medical students in all 6 undergraduate years in 10 Egyptian institutions 136 NR 82.4% | Video lectures (72%) NR | Exams and assignment (64%) |
| Fricton et al. | 2015 | USA | 179 countries | To describe the course concepts in preventing chronic pain, the analytic data from the course, the course participants’ pain assessments, and post-course evaluation forms | Explorative | Coursera University | Preventing Chronic Pain: A Human Systems Approach Multidisciplinary Monolingual English | HCPs, patients, and consumers 23,650 20 modules 91% | Videos with interactive components; discussion forum; exercises; music video Transformative care and human systems theory | Voluntary. Assessment quiz that can be completed at any time during the course; a homework essay at the end |
| Hossain et al. | 2015 | Australia | Participants from 108 countries | To compare 2 ways of providing online education about spinal cord injuries to physiotherapy undergraduate students in Bangladesh to understand if MOOCs improve knowledge or confidence and lead to greater satisfaction | RCT | Physiotherapy International Spinal Cord Society (University of Sydney) | Physiotherapy management of spinal cord injuries Monodisciplinary Monolingual, English | Physiotherapy students 3523 5 weeks (3 h/week) 0% | 14 lessons; short didactic overview and between 2 and 7 activity modules each week; online discussion through Facebook where 2–5 discussion points were posted each week by coordinators; 3 h per week to study; guidance through the content, including course curriculum, objectives, weekly study plan; 1367 screens; videos; interactive lesson contains 150 videos of people with spinal cord injuries and interviews with both physiotherapists and patients from diverse countries | Online assessment. Multiple-choice self-assessments; pre-MOOC and post-MOOC knowledge assessment (20 multiple-choice questions) |

(continued on next page)
| Authors                      | Year   | Country developed           | Country delivered | Study aims                                                                 | Study design                                                                                      | Platform providers                  | Topic or title                                      | Target students | Duration | Methods                                         | Evaluation and assessment systems                      |
|------------------------------|--------|-----------------------------|-------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------|-----------------|----------|-------------------------------------------------|--------------------------------------------------------|
| Kononowicz et al. 2015       | Sweden | Participants mostly from USA, India, UK | UK (77%)          | To analyse technical challenges and solutions for offering virtual patients in health-related MOOCs and describe patterns of virtual patient use in one such course | Case study                                                                                     | edX University                     | KIBEHMEDx: Behavioural Medicine—A Key to Better Health (science of changing behaviour to improve health and quality of life) | Students (not specified) | 5 weeks  | OpenLabyrinth for Virtual Physiological Human with branching paths navigation model; scenario with treatment of stress-related symptoms; treatment of sleep problems; virtual patient scenarios consisted of 80 and 61 screen card types or decision nodes; text description; discussion forums; videos involved a professional actor, 2 clinicians, a film team (16 s–6 min in length); all videos were posted on YouTube and embedded in the virtual patient scenarios using an internal frame; some videos from week 2 were repeated in week 3, forming review nodes; virtual patient activity was planned for 1 h | Certificate for completed course; free text questions; multiple-choice questions |
| Harvey et al. 2014           | UK     | Participants from 79 countries; most from UK (77%) | UK                | To describe how a relatively new style of online learning, a MOOC, may be used to raise aspirations and widen participation in dental professions | Case study                                                                                     | FutureLearn University              | Discover Dentistry: Monodisciplinary Monolingual, English | Potential students of dental professions, dental professionals and members of the public | 6 weeks  | Discussion forum; 2–3 h of engagement per week; video; supporting text; transcript | Not offering any academic credit; short multiple-choice question assessment each week, with a longer ‘final assessment’ in week 6 covering content from throughout the course; pre- and post-course survey |
| Bowen et al. 2014            | USA    | University campuses in Northeast and Mid-Atlantic | Mid-Atlantic       | To measure the effect on learning outcomes of a prototypical interactive learning online statistics course (hybrid format with machine-guided instruction accompanied by 1 h of face-to-face instruction each week vs traditional format with 3 h of face-to-face instruction each week) on public university campuses | RCT                                                                                           | Carnegie Mellon University’s platform University | Introduction to statistics: Monodisciplinary | University students of 6 public university campuses | 1 semester | Textual explanations of concepts; inventory of worked examples and practice problems; feedback to student answers; supplemented by a 1 h per week face-to-face session | Not mandatory; self-assessment; comprehensive assessment of outcomes in statistics with 40-item multiple-choice assessment at beginning and end of semester |
| Goldschmidt & Greene-Ryan    | 2014   | USA                          | USA               | To provide a course overview, pilot data, and suggestions for further research | Case study                                                                                     | NR University                       | Gateway to Online Learning: Monodisciplinary | RN students                     | 5 modules | Data from course discussion board, anonymous Drexel course evaluation, student evaluations, student satisfaction survey; 3 credits if students completed the course | Data from course discussion board, anonymous Drexel course evaluation, student evaluations, student satisfaction survey; 3 credits if students completed the course |
|                             |        |                              |                   |                                                                                                            |                                                                                               |                                     | Management of spinal cord injuries: Monodisciplinary Monolingual, English | Physiotherapy students; physiotherapists 3523 | 3 tasks each week: specific lessons; selected readings from book that are free for | Voluntary, obligatory for credits |
|                             |        |                              |                   |                                                                                                            |                                                                                               |                                     |                                                                                       | (continued on next page) |
| Authors | Year | Country developed | Country delivered | Study aims | Study design | Platform providers | Topic or title | Target students | Methods | Evaluation and assessment systems |
|---------|------|-------------------|-------------------|------------|-------------|-------------------|---------------|----------------|---------|----------------------------------|
| Liyanagunawarden & Williams | 2014 | North America, Canada, Australia, Spain, UK, Ireland, Denmark, West Indies, Switzerland, China | NR | To provide a review of MOOCs related to health and medicine offered by various MOOC platforms in 2013, by analysing and comparing the various offerings, their target audience, typical length of course, and credentials offered | Explorative (98 MOOCs) | Coursera, Open2Study, CourseSites, Canvas, Miriada, FutureLearn, NovoEd, P2PUniversity, Rwaq, VentureLab University | Health and medicine (food, nutrition, nursing in healthcare, health for all through primary care, contraception, social context of mental health and illness, genes and the human condition, health informatics, work in the pharmaceutical industry) | Global audience included students and HCPs | Verified certificate or credits for continuing professional development |
| Stathakarou et al. | 2014 | Sweden | NR | To investigate the potential offered by virtual patients for the purpose of clinical reasoning skills training | Case study | edX integrated with OpenLabyrinth open source VP system University | Medical education | NR | Collection of responses in the script concordance testing approach |
| Subhi et al. | 2014 | North America, Southern Europe, Australia | NR | To review and to evaluate all available courses offered by the largest MOOC providers and the relevance of those courses to the seven roles identified in the CanMEDS framework | Explorative (594 MOOCs) | Coursera, edX University | Major depression, clinical terminology, genomic and precision medicine, safety in healthcare, rationing and allocating scarce medical resources, fundamentals of clinical trials | Medical expert and scholar, communicator, collaborator, manager, health advocate, professionals | NR |

Abbreviations: HCPs, healthcare professionals; ICT, information and communication technology; KIBEHMEDx, Behavioural Medicine: A Key to Better Health (edX); LGBTI+, intersex; LRN, learning resource network; MOOC, massive open online course; MSc, Master of Science; NR, not reported; PPT, PowerPoint; P2P, Peer 2 Peer; RCT, randomized controlled trial; UK, United Kingdom; USA, United States of America; +, plus; >, greater than. § as “a set of criteria specifying the characteristics of an outcome and the levels of achievement in each characteristic” (Odden, 2017).
Table 2
Factors affecting MOOCs’ effectiveness.

| Factors                                      | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|
| Discussion forum/social groups               | ↑    | ↑    | ↓    | ↑    | ↑    | ↓    | ↓    | ↓    | ↓    | ↓    | ↓    |
| Multiple methods/resources                   | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Interactivity (e.g., face-to-face)           | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Teacher/guide/staff communication            | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Promoting self-regulated learning            | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Official certificate/credits/assessment       | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Asynchronous delivery of resources           | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Offline resources                            | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Access to technology and internet            | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Regular assessment/monitoring                | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Not free access                              | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Representing a small geographic area         | ↓    | ↓    | ↓    | ↓    | ↓    | ↓    | ↓    | ↓    | ↓    | ↓    | ↓    |
| Organised, logical, simple structure         | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Positive learning approach                   | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Clinical case close to clinical work         | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Expert involvement/feedback                  | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Short video/not too time-consuming           | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Regarding participants                       | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Learners’ motivation and/or engagement       | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Background knowledge and skills              | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Time management skills                       | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Adequate time to complete sessions           | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Personalised learning and goals              | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |
| Multiple languages                           | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    | ↑    |

Legend: MOOCs = Massive online open courses; ↑ = presence of factor increases MOOCs’ effectiveness; ↓ = presence of factor decreases MOOCs’ effectiveness.
completion. However, allocating adequate time to complete sessions, personalising the schedules, and preventing excessively time-consuming activities (e.g., Castle et al., 2016) have been reported as preventing drops outs.

4. Discussion

4.1. MOOCs in healthcare education: the state of the research

To the best of our knowledge, this is the first rapid review of literature on MOOCs performed to date. The recent so-called “healthcare sciences education disruption” (Dewart et al., 2020) generated by the COVID-19 outbreak, calling for immediate curricula redesign towards a forced and wide introduction of distance learning also at the academic levels, has generated a new interest in online courses. Therefore, summarising the research in this area might support educators and policymakers who have the responsibility to undertake decisions in these challenging times.

Studies on MOOCs devoted to undergraduate and postgraduate students in nursing and healthcare fields emerged in 2014, although articles citing the term “massive online open courses” in healthcare education had been written previously (Skiba, 2012). This educational strategy seems to have grown more slowly, (Kearney et al., 2016) with around six studies/year, mainly with descriptive or case study designs instead of longitudinal studies or trials capable of also measuring MOOCs’ effectiveness.

Universities alone or together with other relevant institutions (e.g., Minister of Health) have been reported as the main MOOC developers; only in six studies has the MOOC been delivered at the national level (Brazil, China, Egypt, Mexico, Russia, and the US), suggesting that this educational strategy is aimed at embracing an international perspective. Moreover, 22 studies have documented >1000 participants, and a mix of subgroups (students of different disciplines, HCPs, or citizens) have been educated: specifically, only four studies have been focused on MOOCs devoted to nursing students. The benefits of learning with other students in interprofessional courses has already been established (Lennen and Miller, 2016). However, the picture that has emerged seems to suggest that MOOCs reflects substantially the third mission of universities, which is to develop knowledge and to create alliances with society and its representatives aiming to gain this knowledge by combining “explicit” (formal, taught at the university) and “implicit” (acquired in the practice, possessed by HCPs) dimensions of knowledge (Laredo, 2007). Moreover, MOOCs seem to include mainly undergraduate students (the so-called “mass tertiary education”) and only in a few studies (Beer, 2019; Darcy and Lock, 2017) master’s or doctoral students were involved (the so-called “professional specialised higher education and research”) (Darcy and Lock, 2017). However, despite the importance of second and third levels of education internationally, MOOCs seem to be used only rarely.

No trends in the topics taught or on the duration of the MOOCs, suggesting the wide flexibility of the tool, have emerged from the studies available. Moreover, the context in which these courses are offered (e.g., citizens, HCPs and students) as well as the high number of dropouts seem to reflect that they are mainly elective or voluntary university courses. For what concerns their pedagogic foundations, when data has been reported, theories consistent with academic education (“adult learning theory”, e.g., Evans et al., 2017) have been used. In this context, the complexity of the didactical method used (from videos to podcasts) supported by virtual communities suggests that MOOC design and implementation require competences that should be developed by universities.

Likely due to its novelty, studies available are not homogenous in the data reported and lack several data; therefore, with the additional intent of performing in the future systematic reviews and meta-analysis, a homogenous set of data should be reported in all studies investigating MOOCs.

4.2. MOOCs in healthcare education: assessment methods and tools

Data regarding the evaluation methods have been variable across studies, suggesting that in this field standardisation of the information is required. However, multiple assessment methods have emerged as pre- and post-evaluations, written or oral, or implying composite tools, with formative and summative intents. In general, findings suggest that the evaluation is designed according to the needs of the target, e.g., to acquire university credits (e.g., Shang and Liu, 2018) or credits for continuing education (Liyanagunawardena and Williams, 2014), confirming their flexibility for diverse audiences. Methods that emerged and the tools suggest that evaluation is conducted mainly to assess the knowledge acquired (e.g., Canavese et al., 2020) and only in a few cases the competences. However, university qualification frameworks established across the World require the specification of the learning outcomes based on acquired competencies, rather than on knowledge, that should, in turn, be steadily updated to current healthcare needs (Di Giulio et al., 2020). This might be one of the reasons why among healthcare sciences MOOCs have played a limited role (Kearney et al., 2016).

4.3. Factors affecting MOOCs’ effectiveness

A list of factors has emerged as promoting or hindering the effectiveness from the perspective of the MOOC itself and that of its participants, suggesting that MOOCs should be well designed and delivered by considering also the needs of the attendees or a degree of flexibility thus allowing each participant to self-design their educational pathway. In a few studies, factors documented are in conflict with each other (e.g., Hendriks et al., 2020) or to those reported in other studies (e.g., Frank et al., 2016 vs Fricton et al., 2015) suggesting that—although mainly with descriptive studies and case studies—the body of evidence available tends to be cumulative. In general, a MOOC based on multididactical strategies, methods, and resources, both delivered online and offline, promoting a constructive approach to the learning process, supported by peers and teachers, with regular feedback, and tailored to the background and the needs of attendees seems to increase the effectiveness. Further studies are needed to assess these factors in terms of effectiveness both alone and as a whole according to their reciprocal influence.

4.4. Limitations

The study has several limitations firstly due to the approach used, based on a Rapid Review where studies may have been missed (Tricco et al., 2017). In particular, we have not performed a search in grey literature and we have included only English and Italian primary studies. The selected languages might have introduced a selection bias in the studies with a consequence that studied performed in high-income English language countries (e.g., US, Sweden and the UK) merged, thus missing studies from low-income countries or written in different languages.

Moreover, the data extraction has been performed around three research questions, where factors affecting a MOOC’s effectiveness have been not differentiated with regards to their potential effects on learning outcomes, dropouts, or the degree of satisfaction reported by participants. Furthermore, factors that emerged have been summarised according to their main influence (as increasing or decreasing MOOCs’ effectiveness) without reporting quantitative data—according to the main intents of this Rapid Review. Given that the purpose of this review was to survey the evidence rather than to evaluate specific effects, a critical appraisal of the studies was not performed (Tricco et al., 2017).

5. Conclusion

MOOCs have recently started to be studied in undergraduate and
postgraduate healthcare sciences education mainly with descriptive or case studies: in addition to the lack of standardisation in the data reported across studies, the descriptive nature of those available suggests the need to increase research efforts in this research field by also establishing guidelines in order to ensure homogeneity in study reporting, allowing systematic reviews and meta-analysis.

To date, target audiences have been wide and mixed and have included students along with citizens and HCPs. Therefore, at the policymaker level, this seems to suggest that MOOCs might have two intents: as a tool to educate healthcare students, mainly in interdisciplinary elective general courses, and as the third mission where universities transfer the developed knowledge to a massive, diverse audience of both professionals and students. According to the findings, MOOCs are capable of targeting different audiences with different needs and backgrounds, as well as with different learning expectations by also ensuring transferable credits both for university and continuing education. However, more robust systems of competence evaluation should be introduced and analytically reported in studies aimed at assessing MOOCs’ contribution to the acquisition of skills expected by graduate students.

Multi-didactical strategies and methods, tailored to the needs of attendees, and delivered online and offline, promoting a constructive approach to the learning processes, supported by peers and teachers, increase MOOCs’ effectiveness. Therefore, while designing a MOOC, these factors should be considered by educators; however, considering their complexity, MOOCs require a multidisciplinary approach and, for those involved in their implementation, specific education to support the transition from traditional teaching methods to massive online courses, including also non-conventional students such as citizens and HCPs, is needed.

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Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jnelt.2021.104812.

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