Teaching modes and social-epistemological dimensions in medical Massive Open Online Courses: Lessons for integration in campus education

Hendriks, R.A.; Jong, P.G.M. de; Admiraal, W.F.; Reinders, M.E.J.

Medical Teacher

ISSN: 0142-159X (Print) 1466-187X (Online) Journal homepage: https://www.tandfonline.com/loi/imte20

Teaching modes and social-epistemological dimensions in medical Massive Open Online Courses: Lessons for integration in campus education

Renée A. Hendriks, Peter G. M. de Jong, Wilfried F. Admiraal & Marlies E. J. Reinders

To cite this article: Renée A. Hendriks, Peter G. M. de Jong, Wilfried F. Admiraal & Marlies E. J. Reinders (2019) Teaching modes and social-epistemological dimensions in medical Massive Open Online Courses: Lessons for integration in campus education, Medical Teacher, 41:8, 917-926, DOI: 10.1080/0142159X.2019.1592140

To link to this article: https://doi.org/10.1080/0142159X.2019.1592140

MEDICAL TEACHER
2019, VOL. 41, NO. 8, 917–926
https://doi.org/10.1080/0142159X.2019.1592140

Teaching modes and social-epistemological dimensions in medical Massive Open Online Courses: Lessons for integration in campus education

Renée A. Hendriks[a], Peter G. M. de Jong[a], Wilfried F. Admiraal[b] and Marlies E. J. Reinders[a,c]

[a]Center for Innovation in Medical Education, Leiden University Medical Center, Leiden University, Leiden, The Netherlands; [b]Leiden University Graduate School of Teaching, Leiden University, Leiden, The Netherlands; [c]Department of Internal Medicine (Nephrology), Leiden University Medical Center, Leiden University, Leiden, The Netherlands

ABSTRACT

Purpose: Medical Massive Open Online Courses (MOOCs) have been integrated into formal campus teaching by several universities. However, teaching attributes of medical MOOCs have not been systematically investigated. Additionally, guidelines are needed to inform integration practices. This study systematically investigated the available teaching modes and social-epistemological dimensions of medical MOOCs.

Methods: An overview of MOOCs on a medical topic was compiled and inclusion criteria were developed. A data collection tool was composed and calibrated. For data collection, out of 410 MOOCs 33 were selected based on these criteria. Investigators enrolled in selected MOOCs and analyzed teaching modes after examination of all course pages. Teaching modes were categorized in social-epistemological dimensions according to the Teaching Approach Framework.

Results: Twenty-nine different teaching modes were found, showing wide distributions. Analysis of social-epistemological dimensions showed medical MOOCs focus on constructivist and individual teaching modes as opposed to objectivist and group modes.

Conclusions: Medical MOOCs do not have a universal teaching mode profile. They contain a rich variety of teaching modes for integration in campus education of which videos, discussion boards, and multiple choice questions are used regularly. Constructivist teaching modes are readily available in medical MOOCs and can support educational innovation of formal campus teaching when integrated.

Introduction

Massive Open Online Courses (MOOCs) are fully online courses, open to anyone, in which large numbers of learners can enroll. They offer a new way to learn medical concepts and are popular among learners and faculty. Many MOOCs in the medical field have been developed in the last few years. In 2014, 225 medical courses were available (Liyanagunawardena and Williams 2014); in 2017, 511 courses were found in a similar search (Goldberg and Crocombe 2017). Medical MOOCs offer (a) the possibility to use "exemplar" learning materials from experts in their field instead of each university making their own (Sharma et al. 2014; Doherty et al. 2015), (b) access to topics not normally available in the curriculum (Doherty et al. 2015), (c) access to education from institutions that not all students can travel to (Doherty et al. 2015), (d) enhanced understanding of pathology not common to students' resident country (Sharma et al. 2014), (e) the opportunity to remove costs and inconvenience of getting to a single location (Davies 2013), (f) enhanced communication among international communities of clinicians and student clinicians, (g) innovative teaching models for student learning (Goldberg and Crocombe 2017), and (h) the convenience of creating a course once and delivering it multiple times without extra effort or cost (Sarkar and Bharadwaj 2015).

Practice points

- Medical MOOCs offer a great variety of instruction, interaction, and assessment modes for integration into formal campus teaching.
- Medical MOOCs do not have a universal profile in terms of teaching modes as each differs in variety and amount of teaching modes.
- Constructivist teaching modes are readily available in medical MOOCs and can support educational innovation of formal campus teaching when integrated.
- Group learning is usually offered through optional participation on discussion boards.
- Social and epistemological dimensions of teaching modes can inform MOOC integration practices.

At first, the impact of MOOCs was predicted to be extensive, as they challenged the traditional higher education model and offered to learn according to the principles of connectivism: diverse, autonomous, open, and connected networks of people and media create and hold knowledge (Downes 2008). For medical education, successful implementation of MOOCs was stated to require

CONTACT Renée A. Hendriks r.a.hendriks@lumc.nl Center for Innovation in Medical Education, Leiden University Medical Center, Leiden University, Hippocratespad 21, Zone V7-P, Postbus 9600, Leiden 2300 RC, The Netherlands.

Supplemental data for this article can be accessed here.

conceptual changes in understanding by instructors and students (Masters 2011).

Although originally developed for students that are not connected to the institution, integration of this type of online courses into formal medical campus education is upcoming (Reinders and de Jong 2016; Robinson 2016; Dandache et al. 2017; Swinnerton et al. 2017; Marks and Meek 2018; Maxwell et al. 2018). Studies have described health care MOOC integration in many forms; in undergraduate and graduate education, as an elective and as a mandatory component, blended or fully online, and as an addition to or as a replacement of formal courses. Additionally, a flipped classroom design has been reported (Dandache et al. 2017), and one paper described students being involved in the creation of content for an MOOC as part of an elective course (Maxwell et al. 2018).

When one desires to integrate MOOC content from their own or another institution into their formal campus teaching, it is essential to know what teaching modes are being offered in medical MOOCs and guidelines are needed to decide if the MOOC content is suitable for the given classroom context. So far little research in this area has been performed on MOOCs in general. One interesting study has investigated teaching modes in 24 MOOCs on topics in a range of different academic disciplines (Toven-Lindsey et al. 2015). They found that in the majority of the courses digital textbooks (75%) and instructor videos (58%) were used as modes of instruction. Interaction among students was possible through a combination of discussion boards (67%) and chat/study groups (25%) and with instructors through discussion boards (29%) and synchronous 'live' events (8%). Most abundant formal assessment modes were multiple choice questions (58%) and open-ended short questions (33%). Yet this investigation considered only one medical MOOC and thus is not representative for informing integration of MOOCs in medical education. Medical MOOCs are said to characteristically offer videos, discussion boards and multiple choice questions (Hoy 2014; Robinson 2016; Dandache et al. 2017), but their teaching modes have not been systematically examined.

In addition to determining the available teaching modes in each course, it is also important to take into account their educational qualities. When integrating MOOCs or MOOC materials into a specific context it matters whether the MOOC teaching approaches are more focused on individual learning or group learning and whether knowledge is transmitted or constructed. Arbaugh and Benbunan-Finch (2006) have developed a Teaching Approach Framework which characterizes these social and epistemological dimensions. In this model, two underlying dimensions are formulated: approaches can be either individual or group oriented and either objectivist or constructivist. These dimensions result in four possible combinations: (1) objectivist-individual; knowledge transfer from teacher to one individual, (2) objectivist-group; knowledge transfer from teacher to a group, (3) constructivist-individual; knowledge construction by an individual, and (4) constructivist-group; knowledge construction by a group. Toven-Lindsey et al (2015) found that of the mainly non-medical MOOCs they investigated, most had educational strategies tied to objectivist views of knowledge, which made them question how revolutionary MOOCs truly are for higher education.

In addition to classifications such as "revolutionary" or "old-school" that might be tied to teaching preferences (Harder 2013), these dimensions can offer guidelines for integrating MOOC content into specific campus contexts. For example, group learning has been found to be preferable to individual learning for difficult problems, whereas individual learning is more effective for simpler tasks (Kirschner et al. 2008). Additionally, objectivist modes might be preferred when students need to be informed in limited time and constructivist modes require more advanced knowledge and comprehension on the part of the student, and more qualitative feedback from the teacher (Huang 2002).

To our knowledge, the teaching modes and their social and epistemological dimensions in medical MOOCs have not yet been analyzed. The aim of this study is to specify the materials and teaching approaches available in medical MOOCs that qualify for integration in formal student education. To this end our research questions are:

1. What instruction, interaction, and assessment modes are present in medical MOOCs?
2. What are the social and epistemological dimensions of the teaching modes available in medical MOOCs?

Methods

MOOC selection

An overview of MOOCs on a medical topic was compiled using the course search engine www.class-central.com, selecting the categories *Disease & Disorders* and *Health Care* (part of the category Health and Medicine) as well as the category *Biology* (part of Science). Inclusion criteria for the investigation were: (1) medical condition or disease in the title to ensure relevance for medical students; (2) availability in the English language and between September 2017 and February 2018 when the study was conducted, for comprehensibility and accessibility of the courses; (3) no course fees other than for an optional certificate, as one of the main advantages of integrating MOOCs is using free materials; and (4) the target group as stated by the course information page should not explicitly exclude students as the main target group for integration purposes is students.

In the first overview, 410 MOOCs were identified, of which 33 MOOCs were included in the study based on the described criteria (Figure 1). The selected MOOCs were hosted on a variety of 10 different platforms and offered by two health organizations, three partnerships of institutions

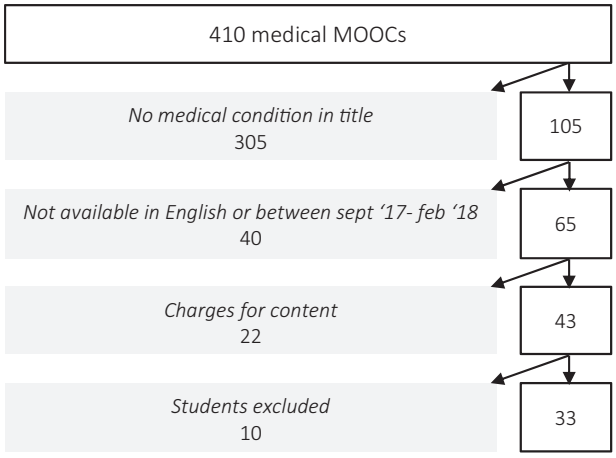

Figure 1. MOOC inclusion process.

and 26 different universities, with three courses from the same university. A list of the included MOOCs can be found in Supplemental Appendix A.

Materials

A data collection tool was composed for inventory of general information and presence and number of instruction, interaction and assessment modes, based on the above-described study (Toven-Lindsey et al. 2015). Virtual patient cases, games and external resources were added to this tool, as we knew from our experience these could be available in medical MOOCs as well. Teaching modes not predetermined in the tool but found in the courses were added in an open text field. The categories used for each teaching mode are presented in Table 1 and 2; the complete tool is available in Supplemental Appendix B.

Analysis of teaching modes

Data collection was carried out in two phases. The first phase consisted of calibration of the data collection tool. Included MOOCs were listed in a random order and the first four courses were individually assessed by the first and second author by enrolling in the selected MOOCs as a learner and examining all course pages. After each MOOC, the use and results of the tool were discussed until authors fully agreed and a diary of this calibration was kept. For the second phase, all four courses were reexamined by the first author. The first author then examined the remainder of the courses and consulted with the second author and calibration diary when unsure.

Analysis of social-epistemological dimensions

For analysis of social-epistemological dimensions, the Teaching Approach Framework (Arbaugh and Benbunan-Finch 2006) was utilized to categorize all teaching approaches as *Objectivist-Individual*, *Objectivist-Group, Constructivist-Individual* or *Constructivist-Group*. Categorizations previously implemented by Toven-Lindsey et al. (2015) were applied and newly found teaching approaches were allotted to one of the four social-epistemological dimensions. First, all authors categorized the newly found teaching modes individually, which was followed by a collective discussion about the discrepancies until all concurred. Descriptive statistics were used to present the variety of both teaching modes and social and epistemological dimensions.

Results

Teaching modes

Instruction modes. All 33 examined MOOCs offered videos in which the instructor is talking to the camera, and text-pages or digital textbooks as can be seen in Table 1. External links to webpages were available in 94% (31) of the courses. In 14 of those, instructions to use these links for assignments were offered. In 48% (16) of the courses, illustrations or simulations to clarify concepts were found, and in 30% (10) of the courses, PowerPoint presentations or screencast recordings with a voiceover were identified. Recorded traditional lectures were found in 6% (2) of the MOOCs. Three categories of instruction modes described by Toven-Lindsey et al. (2015) were not encountered at all: animation figures (that act as course guide), interactive online laboratories (to conduct virtual experiments), and whiteboard drawings with voiceover were only embedded in instructor videos and as such were not coded separately. In addition to the list of Toven-Lindsey et al. (2015), three additional instruction modes were found: audio files/podcasts thought trees/word clouds, and flashcards. These were offered in, respectively, 9% (3), 6% (2) and 3% (1) of the courses investigated. In general, the distribution of the modes of instruction varied considerably among MOOCs as shown in Figures 2 and 3.

Interaction modes. Out of 33 MOOCs, 6% (2) had no option to interact with peers or instructors. No synchronous live events or study groups were encountered in any of the MOOCs; the only form of interaction available was through general forums or an option to create forums. In addition to a general encouragement to discuss or ask questions about course topics in 94% (31) of the MOOCs, 88% (29) of the courses implemented more specific prompts. A prompt to introduce oneself to other learners was found in 70% (23) of the MOOCs, and in nine of these, it was stated that staff or instructors would also interact with students on the introduction forum. Prompts to answer content specific questions were encountered in 61% (20) of the MOOCs and in 15 of these courses, staff or instructors were stated to be active on these discussion boards. A prompt to specifically interact and respond to forum posts of other learners was found in 9% (3) of the MOOCs.

Assessment modes. All 33 investigated MOOCs included Multiple Choice Questions (MCQs) in their assessment structure. Open-ended questions were available in two forms: (1) one-word answer or fill in the blanks questions, and (2) longer, essay or reflection type answer questions. Type 1 was incorporated in 6% (2) of the MOOCs, 36% (12) of the MOOCs incorporated type 2 and 3% (1) of the MOOCs included both forms of open-ended questions. MCQs were typically automatically assessed, as were short open-ended questions. Open-ended long answer questions were self-assessed or peer-assessed. For 9% (3) of the courses, it was unclear who would or should assess the open-ended long answer questions. Variation in the distribution of the assessment modes is shown in Figures 2 and 3.

Formal assessment structures or assessments that had to be concluded for the graduation of the course were found in 88% (29) of the courses. These assessment structures consisted of one, two or three of the following five components: (1) MCQs, (2) open-ended short answer questions, (3) self-assessed open ended long answer questions, (4) peer-assessed open ended long answer questions and (5) obligatory discussion contributions. MCQs were part of the formal assessment in 73% (24) of the courses and open-ended questions with a long answer in 30% (10), of which three courses were self-assessed and seven were peer-assessed. One course included a mandatory discussion board post. Formal assessment components were spread over the course period, with most courses offering a weekly assessment.

Table 1. Presence of teaching modes in investigated MOOCs.

MOOC no.	Instruction modes												Interaction modes					Assessment modes				Multifunctional modes		
	Digital text or textbook	Recorded traditional lecture	Independent activities related to content	Links to external online resources	Prompts to use external links	Video of instructor talking to camera*	PPT slides with voice over	Audio files	Flashcards	PPT slides	Illustrations or simulations	Thought trees or word clouds	Discussion boards for asking questions	Discussion board answering questions prompted	Discussion boards for discussing course materials	Prompts to respond to peers	Discussion board prompt to introduce oneself	Multiple Choice Questions	Open ended question with short answer	Open ended question peer reviewed	Open ended question with long answer	Virtual patient cases	Virtual microscope activities	Games
1	x		x	x		x	x			x			x	x	x	x		x						x
2	x			x	x	x							x	x	x		x	x				x		
3	x			x		x	x						x	x	x		x	x		x	x			
4	x			x		x					x		x	x	x		x	x			x	x		
5	x			x		x							x		x		x	x						
6	x			x		x	x				x		x	x	x		x	x					x	
7	x		x	x	x	x				x			x	x	x			x				x		
8	x		x	x	x	x	x				x		x	x	x		x	x				x		
9	x			x		x					x		x	x				x				x		
10	x		x	x	x	x				x	x		x	x	x	x	x	x		x	x	x		x
11	x			x	x	x							x	x	x		x	x		x	x			
12	x			x	x	x							x	x	x		x	x		x	x			
13	x			x		x						x	x	x	x			x	x		x	x		
14	x		x			x		x					x		x			x						x
15	x			x		x					x		x		x		x	x			x	x		
16	x		x	x	x	x							x		x		x	x				x		
17	x			x		x							x	x	x		x	x						
18	x	x		x		x	x						x	x	x			x				x		
19	x			x		x	x				x		x	x	x		x	x						
20	x			x	x	x		x					x	x	x			x		x	x			
21	x			x		x							x		x		x	x		x	x	x		
22	x			x	x	x				x			x		x		x	x		x	x			
23	x			x		x				x	x		x		x		x	x			x	x		
24	x					x			x				x		x		x	x				x		
25	x		x	x	x	x	x				x		x	x	x		x	x						
26	x			x	x	x					x		x	x	x	x	x	x						
27	x	x		x		x					x		x		x		x	x	x					
28	x		x	x		x		x			x		x		x			x			x	x		
29	x			x	x	x				x	x		x	x	x		x	x				x		
30	x			x		x	x				x							x				x		
31	x			x		x	x				x							x				x		
32	x		x	x	x	x							x		x		x	x			x			
33	x		x	x	x	x	x				x	x	x	x	x		x	x	x			x		x
Total (%)	100	6	30	94	42	100	30	9	3	18	48	6	94	61	94	9	70	100	9	21	39	55	3	12

Table 2. Social-epistemological dimensions of teaching modes.

Teaching modes	OI	OG	CI	CG
Instruction modes				
Digital text or textbook	x			
Recorded traditional lecture	x			
Independent activities related to content			x	
Links to external online resources			x	
Prompts to use external link for activities in the course			x	
Interactive online labs			x	
Video of whiteboard with voiceover	x			
Video of instructor talking to camera*	x			
PowerPoint slide presentation with voice over	x			
Audio files	x			
Flashcards	x			
Animations	x			
PowerPoint presentation slides	x			
Illustrations or simulations	x			
Thought trees or word clouds				x
Interaction modes				
Discussion boards available for freely asking questions		x		
Discussion board posts answering questions prompted			x	
Live video conference or events with instructor				x
Discussion boards available for discussing course materials				x
Chat or study groups				x
Prompts to respond to peers on specific topics for threaded dialog				x
Discussion board prompt to introduce oneself				x
Assessment modes				
Multiple Choice Questions	x			
Open ended question with short answer	x			
Peer reviewed open ended question with long answer				x
Open ended question with long answer			x	
Multifunctional modes				
Virtual patient cases			x	
Virtual microscope activities			x	
Games	x**		x***	

*Other modes are sometimes included in videos; **MOOC 1 and 33; ***MOOC 10 and 14.

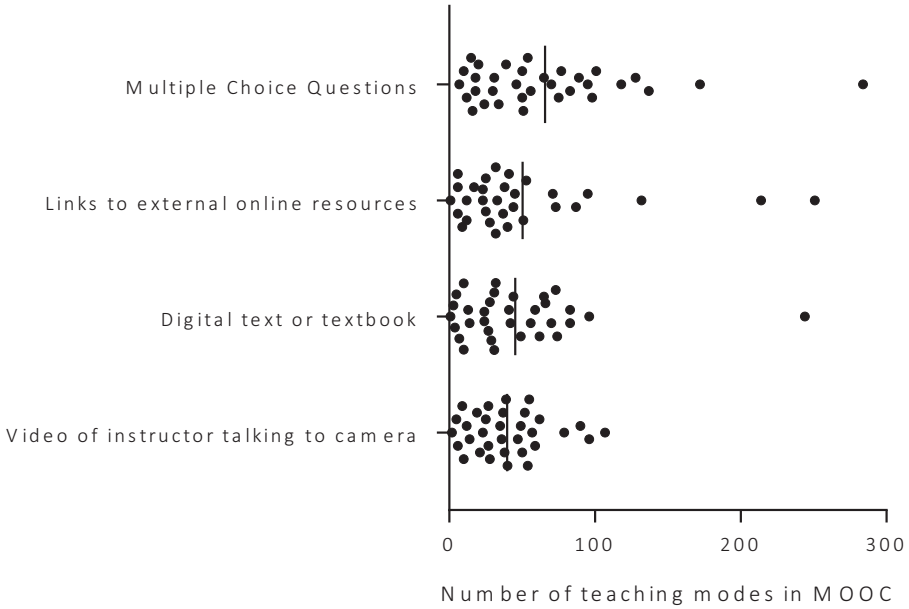

Figure 2. Wide distribution of number of teaching modes.

All courses offered multiple attempts at assessments and 88% (29) of the courses offered a certificate. Of these, 4 also offered an optional exam for formal (continuing) medical education credit.

Multifunctional modes. Three of the teaching modes were used for instruction as well as assessment. Games were used by 12% (4) of the courses, virtual patient cases by 55% (18) and virtual microscopy exercises by 3% (1). In one course, learners were asked to create a game about a virtual patient case.

Social-epistemological dimensions

In addition to the previous categorization by Toven-Lindsey et al. (2015), fifteen teaching modes were categorized into social-epistemological dimensions (Table 2). Including the modes previously categorized, of 29 teaching modes, 45% (13) were categorized as Objectivist-Individual, 3% (1) as Objectivist-Group, 31% (9) as Constructivist-Individual, and 21% (6) as Constructivist-Group.

Of the investigated courses only 6% (2) included teaching modes that are in the Objectivist-Individual and

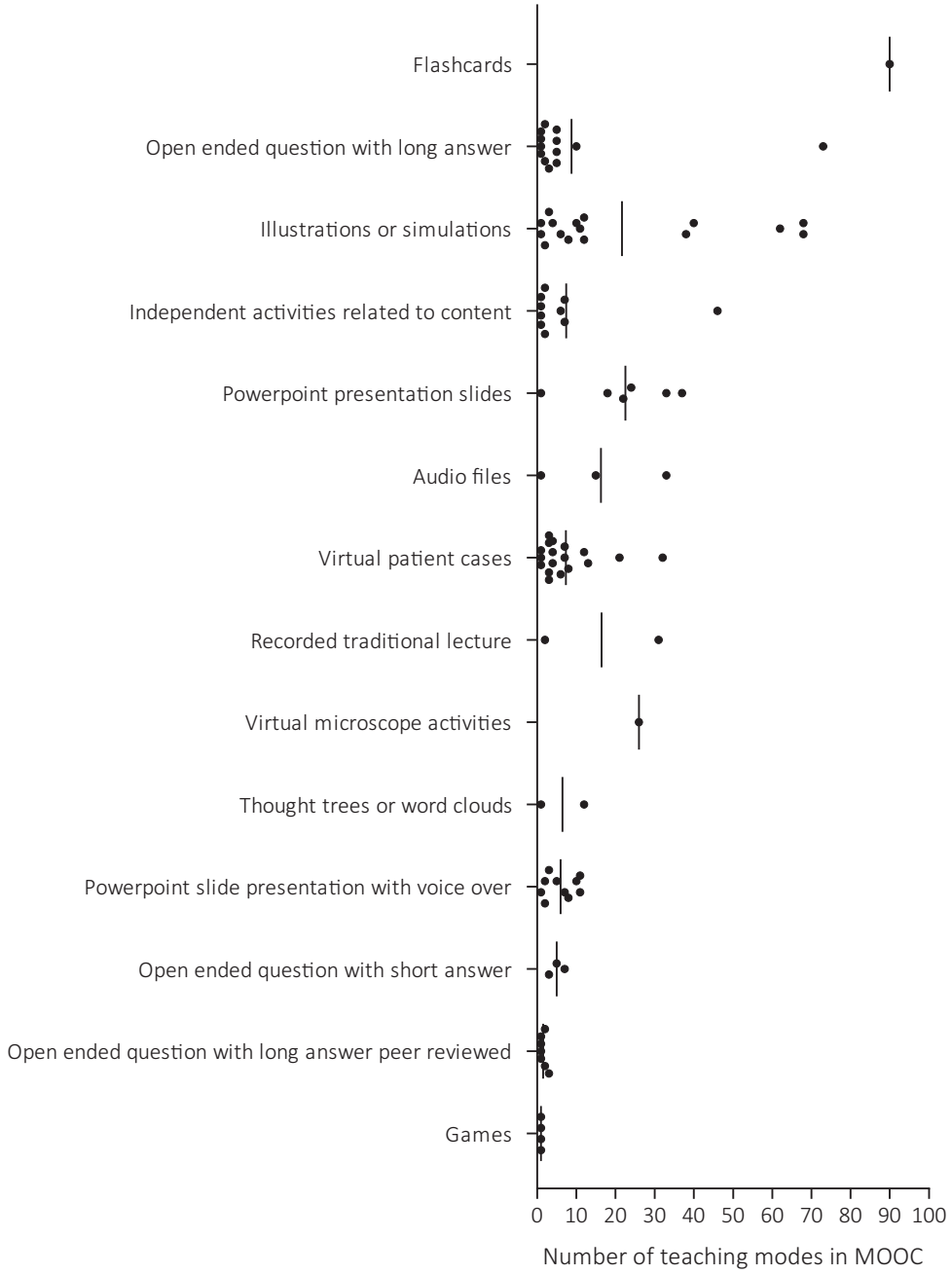

Figure 3. More narrow distribution of number of teaching modes.

Constructivist-Individual dimensions as can be seen in Figure 4. All other investigated MOOCs employed all of the social-epistemological dimensions. Courses varied in the dimensions that applied mostly, with 45% (15) of the courses focusing on constructivist modes, 39% (13) of the courses focusing on objectivist modes and the remaining 5 courses offering equal variety in objectivist and constructivist modes. All courses favored individual teaching modes, with a maximum of 100% and a minimum of 60% of the course teaching modes being individually oriented.

Discussion

This study shows medical MOOCs are richer than previously described, even richer than other, non-medical MOOCs that have been systematically investigated (Toven-Lindsey et al. 2015). Videos, discussion boards, and multiple choice questions are used regularly in that order, respectively, as main components of instruction, interaction, and assessment. However, medical MOOCs do not have a universal profile in terms of teaching modes as each differs in variety and amount of teaching modes. Many of the investigated courses focus on constructivist teaching modes and a few focus on group learning. Implications for the integration of medical MOOCs in formal campus teaching and future research are described below.

Teaching modes of medical MOOCs have been described to include video lectures (Davies 2013), multiple choice questions (Doherty et al. 2015), discussions with peers (Subhi et al. 2014) and even virtual patient cases (Robinson 2016), but they have not been systematically investigated before. In addition to previous studies, we have found audio files, virtual microscope activities, thought trees, games, and flashcards, which prove MOOC instruction modes to be more diverse than described before. Additionally, although we did not find the interaction modes of study groups or synchronous live events, MOOC discussion boards seem to have more options than

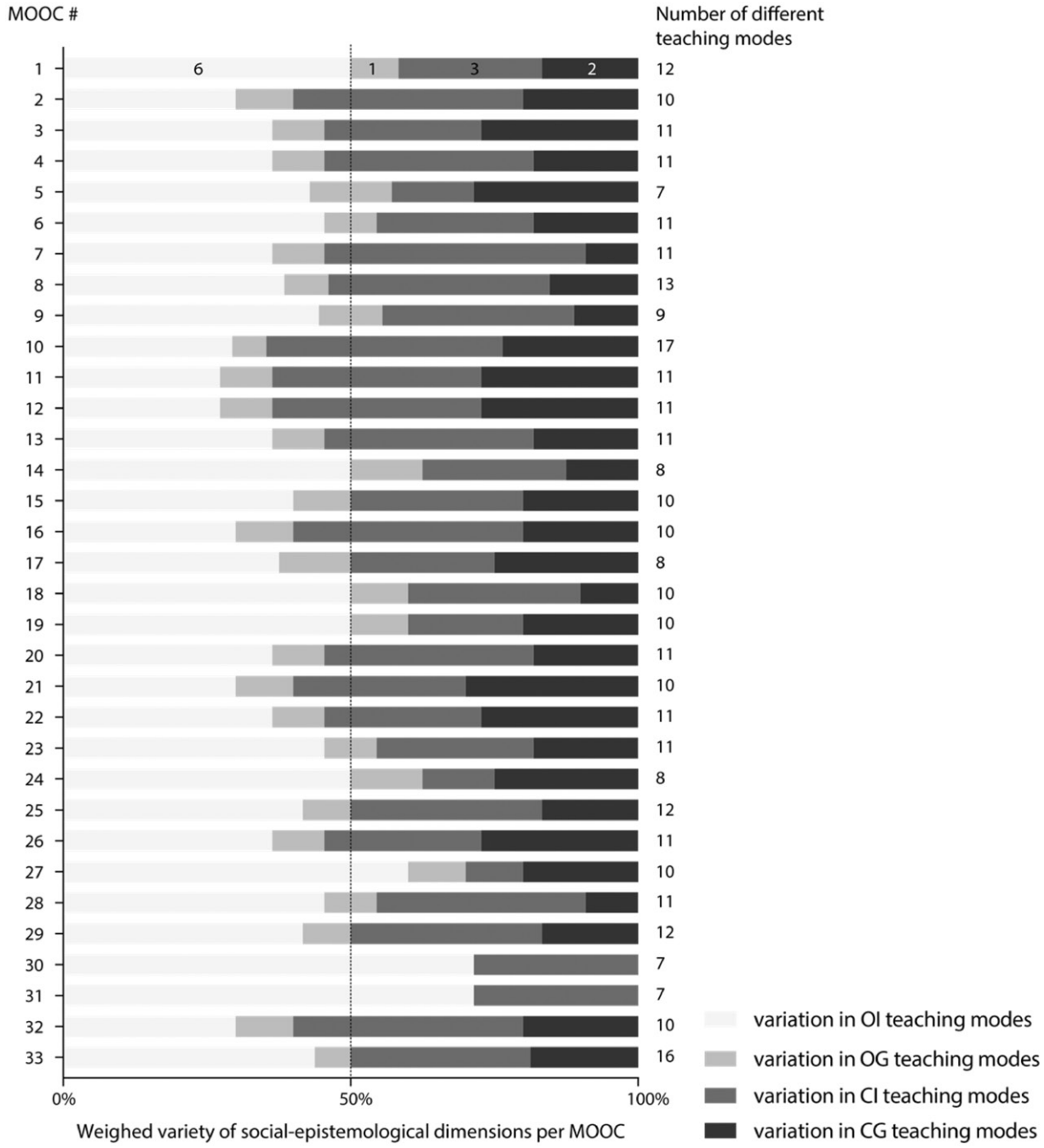

Figure 4. Weighed variety of social-epistemological dimensions.

just being available or not. The MOOCs in our sample differ in two ways: in the presence of specific prompts to use the discussion boards, and in the kinds of specific prompts used. A possible explanation for this wider variety of teaching modes is that current MOOC educators can be seen as "early adopters" that are highly interested in innovation of education, and who like to experiment with new teaching modes in the MOOC environment (Haywood et al. 2015). A reason for finding so many new teaching modes in this sample of medical MOOCs specifically could be that the previous investigation of non-medical MOOCs was conducted 3 years earlier (Toven-Lindsey et al. 2015). Some teaching modes might not have been supported by the MOOC platforms then and early adapters might since have rediscovered the possibilities for innovating in MOOCs. For expensive teaching modes, such as virtual microscope activities or serious games, medical faculties might simply be able to invest more in innovations financially.

We have found a great variety in what each MOOC offers and that no two courses offer the same combination and dispersion of teaching modes. Thus, medical MOOCs do not seem to have a universal profile in terms of teaching modes. This means that in examining the features and effects of MOOCs, a description of the MOOC's specific teaching modes profile should be part of the contextual description of the study. A comprehensive description could be helpful to describe specific MOOC teaching profiles in order to meet specific individual or contextual educational needs.

Medical MOOCs contain both objectivist and constructivist teaching modes, which makes them useful for integration into campus teaching. In contrast to Toven-Lindsey et al. (2015) finding teaching strategies mostly tied to objectivist views of knowledge, our sample showed in a majority of the courses, a focus on constructivist teaching modes as opposed to objectivist teaching modes. This

finding aligns with the idea that medical MOOCs generally offer innovative ways of student learning (Goldberg and Crocombe 2017). Medical MOOCs have also been said to be most useful for undergraduate students, as pre-medical courses are in many cases lecture based and information dense (Harder 2013). Indeed objectivistic teaching modes such as lecture videos are very fitting for the purpose of transferring factual knowledge, but the notion that the main delivery mode is through videos (Davies 2013) is contested by our findings. A reason for the extended availability of constructivist teaching modes in medical MOOCs could also be the aim of educators to innovate (Haywood et al. 2015; Goldberg and Crocombe 2017), or the financial freedom to include educational specialists in the development phase of the MOOC. Another possibility is that many of the courses in our sample aim to further develop clinical reasoning skills in their learners, which is reflected in the percentage of courses (55%) offering activities for this goal. As clinical reasoning is a higher order skill, it requires the use of constructivist teaching modes. Thus in this regard, content and learning goals might also be stimulators for focusing on specific epistemological dimensions.

The MOOCs in our sample seem to be oriented towards individual learning for both objectivist and constructivist teaching modes, which might be related to the asynchronous nature of this type of course. Prior research found that when learning online, student's perceived learning and student delivery medium satisfaction are highest in objectivist-group settings, followed by constructivist-group settings (Arbaugh and Benbunan-Finch 2006). It is suggested that structure is most abundant in objectivist-group settings, as it is offered by both teacher and peers. Additionally, isolated online learning increases the likelihood that learners perceive the medium negatively and drop out (Willging and Johnson 2004). The medical MOOCs might need to shift more toward group learning, which would be much more in line with the original idea of the first MOOCs: to connect and create knowledge in networks of people (Anders 2015). Our findings support the description of a shift from MOOCs as more innovative, informal learning environments in their initial stage to more formal and traditional online courses nowadays, at least in the sense of the social dimension (Bradshaw et al. 2017). For connectivist learning to be implemented, medical MOOC instructors might still need more time for conceptual changes in their understanding, and so do students (Masters 2011). Discussion boards are a component that is left from the original MOOCs but they do not seem to really fit into the pattern of formal learning yet, as campus students seem to hold back in posting on discussion boards of integrated MOOCs (Dandache et al. 2017; Swinnerton et al. 2017). Group learning is appropriate for more difficult tasks or working difficult problems and so fostering this teaching mode is desirable (Kirschner et al. 2008). Although we have found discussion boards to be more diverse in terms of use of prompts than previously described, participating in interaction in many cases is not compulsory, which means that only a few students interact with their peers. Discussion boards can be seen as informal and in many cases unstructured learning spaces, which are placed in a formal setting when integrated (Bradshaw et al. 2017). Accordingly, students might need more guidance and structure to use the discussion boards, for example in the form of specific prompts to introduce oneself or to respond to one or two posts of peers. However, a recent study found that viewing MOOC discussion board posts of other learners was most positively associated with course scores and entered peer reviews, even more so than posting (Chiu and Hew 2018).

When integrating MOOCs, or parts of MOOCs, in campus teaching, epistemological and social dimensions matter and can offer guidelines. As previously mentioned, individual-objectivist teaching modes are effective for transfer of factual knowledge, for example, epidemiological findings of diseases that might in a later stage support clinical reasoning. For more difficult concepts, for example the physiological concept of cardiac preload, group-objectivist teaching modes where students can work together on structured problems, are more appropriate. Objectivist teaching modes are frequently employed in formal medical educational settings. For learners and teachers both, this orientation might be most comfortable as learning is quite structured and both learner and teacher have specific, more traditional roles: teachers teach and learners learn (Bradshaw et al. 2017). Switching to constructivist teaching modes is not only useful, but sometimes even mandatory when higher-order thinking skills are aimed at, as is the case with, for example, complex clinical reasoning problems. In many professional settings, combining information from multiple sources to construct a diagnosis is an individual task, but, conferring with peers might support learning to do so. Constructivist teaching modes require some more advanced skills of the learner. They need to be able to assess the quality of different information sources (Huang 2002), and to be able to navigate in less-structured teaching activities and self-regulate (Anders 2015; Bradshaw et al. 2017). Teachers need to be able to dedicate the time and energy that evaluations of constructivist learning demand and need to be capable to take the role of facilitator (Huang 2002).

It needs to be noted that there is a difference between MOOC design (and desired behavior) and learner behavior as learners do not always use MOOCs the way they are designed (Littlejohn et al. 2016). An example of this is the possibility of pausing a MOOC video and discussing emerged questions regarding the subject matter with a peer. The designed activity of watching a video is very much individual-objectivistic, but through the learner's behavior, it has become a constructivist-group activity. In the current study, we have coded the design. This means the categorization of teaching modes into dimensions should be seen as a starting point or guideline. It also means that both additional instructions and student behavior can lead to a change in dimension, which might be very useful for integration purposes.

Future research

For the use of MOOCs in medical education and especially in campus teaching many questions still exist. Future research can be focused on at least three directions. First, ways have to be found to efficiently locate suitable MOOCs and to assess their quality. Identifying suitable MOOCs can be done by subject for example, through online databases

such as class-central.com or MOOC platform search tools. This can be time-consuming, however, as not all courses offer a clear overview of learning goals and or content on their information page. One has to enroll to access this information and depending on the starting date of the MOOC some content might still be unavailable. Additionally, when an MOOC has been selected for integration, one needs to account for quality (Clark et al. 2017). Research is needed to devise effective and efficient ways of selecting suitable, qualitatively sound MOOCs.

Second, expertise needs to be cultivated on how to integrate MOOCs optimally. Many different options exist in terms of integrating as a mandatory or optional component, blended or fully online course, and integrating as a replacement for existing activities or as additional materials. Some universal "rules" for effective integration might arise from future research, but successful integration might also be dependent on context. Future research thus requires describing context extensively, including an overview of the teaching modes profile of the MOOC under investigation.

Finally, MOOCs have been found to be successful learning environments for mainly self-regulated learners (Littlejohn et al. 2016; Kizilcec et al. 2017). It is no wonder that in an online setting with little tutor support certain skills are needed. For MOOC integration into medical campus teaching two questions then arise: How well are medical students equipped to learn in MOOCs in various integration settings, for example, flipped classroom or fully online settings? And if they need support, how can we best assist them? Prior research has found medical students can have strong emotional responses when obstacles with e-learning materials are encountered, which might be counterproductive for learning (Reid et al. 2016) and so this topic requires our investigative attention. Research in these three directions should assist in effectively using medical MOOCs in formal medical education settings in the future.

Conclusions

Medical MOOCs contain a rich variety of teaching modes of which videos, discussion boards, and multiple choice questions are used regularly. Prior research has indicated that MOOC teaching approaches focus mostly on objectivist views of knowledge; this study shows that in medical MOOCs constructivist approaches are also well represented. In all MOOCs, a focus on individual learning modes was found instead of group learning modes. This study offers direction for future medical MOOC integration practices and research.

Acknowledgments

The authors wish to acknowledge Prof. Friedo W. Dekker for his advice regarding methodology and Franka Luk and members of the NVMO PhD journal club for their helpful comments and suggestions.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

Glossary

Teaching Modes: Modes of instruction, interaction or assessment that are incorporated in a course design to stimulate learning. Examples are: texts, peer-feedback assignments, and multiple choice questions.

Social-Epistemological Dimensions: Dimensions that describe educational characteristics of a teaching mode or course in two areas: the social dimension - If a teaching mode or course is aimed at individual or group learning; and the epistemological dimension - if a teaching mode or course aims to transfer knowledge from teacher to student (objectivist teaching) or aims to have a student construct knowledge from multiple sources (constructivist teaching). This results in four social-epistemological dimensions: individual-objectivist, individual-constructivist, group-objectivist, and group-constructivist.

Arbaugh and Benbunan-Finch (2006).

Notes on contributors

Renée A. Hendriks, MSc, is a PhD candidate at the Center for Innovation in Medical Education of the Leiden University Medical Center. She is passionate about designing high quality evidence based online learning experiences and her research focuses on the facilitation of effective and self-regulated learning in medical MOOCs.

Peter G. M. de Jong, PhD, AFAMEE, is a Staff Adviser and Assistant Professor for Technology Enhanced Learning at the Center for Innovation in Medical Education of the Leiden University Medical Center in Leiden, The Netherlands. His research interest is the integration of online materials into classroom teaching.

Wilfried F. Admiraal, Professor, PhD, is full professor of Educational Sciences and Academic director of Leiden University Graduate School of Teaching. His research interest combines the use of technology in education and social psychology in secondary and higher education.

Marlies E. J. Reinders, Professor, MD, PhD, is a nephrologist at the Leiden University Medical Center in Leiden, The Netherlands. She is involved in organizing the new curriculum and in integrating novel forms of education at the Faculty of Medicine at Leiden University. She developed a MOOC with Coursera (http://www.coursera.org/learn/clinical-kidney-transplantation).

ORCID

Renée A. Hendriks http://orcid.org/0000-0002-1932-6428
Peter G. M. de Jong http://orcid.org/0000-0001-9038-3137
Wilfried F. Admiraal http://orcid.org/0000-0002-1627-3420
Marlies E. J. Reinders http://orcid.org/0000-0001-9543-567X

References

Anders A. 2015. Theories and applications of massive online open courses (MOOCs): the case for hybrid design. IRRODL. 16:39–61.

Arbaugh J, Benbunan-Finch R. 2006. An investigation of epistemological and social dimensions of teaching in online learning environments. AMLE. 5:435–447.

Bradshaw K, Parchoma G, Lock J. 2017. Conceptualizing formal and informal learning in MOOCs as activity systems. Quart Rev Dist Educ. 18:33–92.

Chiu K, Hew K. 2018. Factors influencing peer learning and performance in MOOC asynchronous online discussion forum. AJET. 34: 16–28.

Clark KR, Vealé BL, Watts LK. 2017. A review of the use of Massive Open Online Courses (MOOCs) in medical imaging education. IJAHSP. 15:1–6.

Dandache S, Frenay M, Van Nes M-C, Verschuren F. 2017. A Massive Open Online Course (MOOC) for implementing pedagogical tools in undergraduate respiratory physiology. HAPS Educ. 21:36–42.
Davies E. 2013. Will MOOCs transform medicine? BMJ. 346:f2877.
Doherty I, Sharma N, Harbutt D. 2015. Contemporary and future eLearning trends in medical education. Med Teach. 37:1–3.
Downes S. 2008. Places to go: connectivism & connective knowledge. Innovate. 5:1–6.
Goldberg LR, Crocombe LA. 2017. Advances in medical education and practice: role of massive open online courses. Adv Med Educ Pract. 8:603–609.
Harder B. 2013. Are MOOCs the future of medical education? BMJ. 346:f2666.
Haywood J, Woodgate A, Dewhurst D. 2015. Reflections of an early MOOC provider: achievements and future directions. In: Lee MM, Reeves TC, Reynolds TH, Bonk CJ, editors. MOOCs and open education around the world. London (UK): Routledge; p. 89–101.
Hoy MB. 2014. MOOCs 101: an introduction to massive open online courses. Med Ref Serv Quart. 33:85–91.
Huang HM. 2002. Toward constructivism for adult learners in online learning environments. Br J Educ Technol. 33:27–37.
Kirschner F, Paas F, Kirschner PA. 2008. Individual versus group learning as a function of task complexity: an exploration into the measurement of group cognitive load. In: Zumbach J, Schwartz N, Seufert T, Kester L, editors. Beyond knowledge: the legacy of competence. Dordrecht, Netherlands: Springer; p. 21–28.
Kizilcec RF, Pérez-Sanagustín M, Maldonado JJ. 2017. Self-regulated learning strategies predict learner behavior and goal attainment in Massive Open Online Courses. Comput Educ. 104:18–33.
Littlejohn A, Hood N, Milligan C, Mustain P. 2016. Learning in MOOCs: motivations and self-regulated learning in MOOCs. Internet High Educ. 29:40–48.
Liyanagunawardena TR, Williams SA. 2014. Massive open online courses on health and medicine: review. J Med Internet Res. 16:e191.
Marks L, Meek S. 2018. Blending MOOCs into medical education. MedEdPublish. 7:60–63.
Masters K. 2011. A brief guide to understanding MOOCs. Int J Med Educ. 1:1–6.
Maxwell WD, Fabel PH, Diaz V, Walkow JC, Kwiek NC, Kanchanaraksa S, Wamsley M, Chen A, Bookstaver PB. 2018. Massive open online courses in US healthcare education: practical considerations and lessons learned from implementation. Curr Pharm Teach Learn. 10: 736–741.
Reid HJ, Thomson C, McGlade KJ. 2016. Content and discontent: a qualitative exploration of obstacles to elearning engagement in medical students. BMC Med Educ. 16:188.
Reinders ME, de Jong P. 2016. Innovations in clinical kidney transplant education by a Massive Open Online Course. MedSciEduc. 26:11–12.
Robinson R. 2016. Delivering a medical school elective with massive open online course (MOOC) technology. Peer J. 4:e2343.
Sarkar S, Bharadwaj B. 2015. Adapting massive open online courses for medical education. Int J Adv Med Health Res. 2:68–71.
Sharma N, Doherty I, Harbutt D. 2014. MOOCs and SMOCs: changing the face of medical education? Perspect Med Educ. 3:508–509.
Subhi Y, Andresen K, Bojsen SR, Nilsson PM, Konge L. 2014. Massive open online courses are relevant for postgraduate medical training. Dan Med J. 61:A4923.
Swinnerton BJ, Morris NP, Hotchkiss S, Pickering JD. 2017. The integration of an anatomy massive open online course (MOOC) into a medical anatomy curriculum. Anat Sci Educ. 10:53–67.
Toven-Lindsey B, Rhoads RA, Lozano JB. 2015. Virtually unlimited classrooms: pedagogical practices in massive open online courses. Internet High Educ. 24:1–12.
Willging PA, Johnson SD. 2004. Factors that influence student's decision to drop out of online courses. JALN. 8:105–118.