Finding valuable direction for teaching and learning in campus-integrated Medical Massive Open Online Courses

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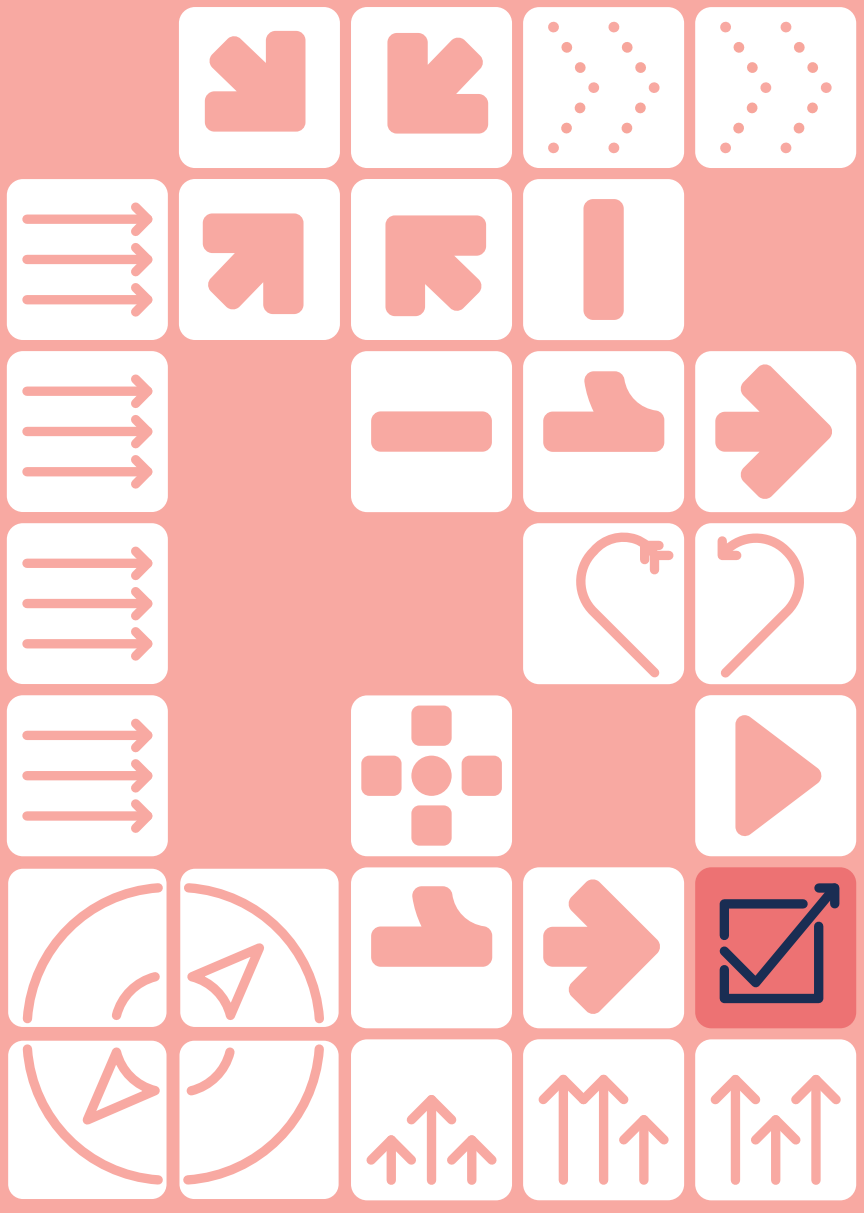
CHAPTER 3



Instructional Design Quality in Medical Massive Open Online Courses for Integration into Campus Education

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Abstract

Medical Massive Open Online Courses (MOOCs) are of interest for campus education. With growing interest in integrating medical MOOCs, their quality must be ensured. This however, has not been studied. We investigated if medical MOOCs meet the instructional design principles: problem-centeredness, activation, demonstration, application, integration, collective knowledge, collaboration, differentiation, authentic resources, feedback and goal-setting.

An overview of medical MOOCs and inclusion criteria were developed. Out of 410 MOOCs 33 were selected. A data collection tool was compiled and calibrated. Investigators enrolled in selected MOOCs and coded presence of instructional design principles after examination of all course pages.

Application, authentic resources, problem-centeredness and goal-setting were found to be present in many of the courses. Activation, collective knowledge, differentiation, and demonstration were present in less than half of the courses. Finally, integration, collaboration, and expert feedback were present in less than 15% of the courses.

Medical MOOCs meet these principles in varying degree. Certain principles might be scarcely present due to a problematic fit with the MOOC concept or a need for further development in online settings. Assessment of instructional design quality is desired before integrating so that MOOC quality can be considered in relation to the quality of existing campus education.

Introduction

Massive Open Online Courses (MOOCs) are believed to offer a new model for online learning in higher education (Cormier & Siemens, 2010; Masters, 2011). They provide learners with multiple modes of instruction, such as videos, readings and podcasts; interaction, such as discussion boards and peer assignments; and assessment, such as multiple choice questions and automatically, self-, or peer-assessed essays (Hendriks et al., 2019). Additionally, MOOCs are open to anyone, mostly free to use, and accessible 24/7.

MOOCs were originally designed for learners not necessarily affiliated with the university. However, because substantial investments are involved and MOOCs produce materials with a high quality look and feel, interest in integration of medical MOOCs into campus education is rising (de Jong et al., 2019). A number of universities are already experimenting with this integration (Clark et al., 2017; Dandache et al., 2017; Marks & Meek, 2018; Maxwell et al., 2018; Pickering & Swinnerton, 2017; Reinders & de Jong, 2016; Robinson, 2016; Swinnerton et al., 2017) and large-scale exchange projects are being organized, where consortia of universities offer each other's MOOCs to their students (Virtual Exchange 2018). Newly produced MOOCs may even be designed with possibilities for integration into campus education already in mind (Pickering et al., 2017).

Many advantages of integrating medical MOOCs have been described, for example creating a course once and delivering it multiple times without extra effort or cost, reusing 'exemplar' teaching materials from experts in their field instead of each university making their own, and offering topics that are not regularly addressed in the curriculum (Doherty et al., 2015; Sharma et al., 2014). In a recent paper concerning medical MOOCs, we have found higher diversity in teaching modes than previously described, making MOOCs rich sources for integration (Hendriks et al., 2019). Additionally, the investigated courses offered many constructivist teaching modes, aimed at knowledge construction by the student rather than knowledge transfer from teacher to student. So, for medical education settings that still rely on more traditional 'transfer' teaching modes such as lectures, integration of the constructivist teaching modes offer an opportunity for educational innovation (Hendriks et al., 2019).

Through integration in campus teaching, the quality of medical MOOCs will influence the quality of the curriculum and should therefore be assured (Clark et al., 2017). When measuring the quality of MOOCs, one has to take into account their non-obligatory nature (Hood & Littlejohn, 2016). In this sense, the learner experience is related to the personal goals of each learner, which means that a MOOC is of high quality as long as learners have learned what they wanted. This might mean that some learners do not complete a course. Thus accessible learning outcomes such as completion rates are in that case not the best measure for quality. When MOOCs are integrated in formalized learning environments such

as campus teaching however, learning goals are set and learning outcomes can be used as valid quality indicators. As it is desirable to discern the quality of a MOOC before integrating, other indicators are needed. In this regard, learning process variables such as instructional design can offer considerable insight into educational quality. Where face to face courses leave room for different versions of performance or execution, in online courses the designed curriculum resembles the taught curriculum to great extent as online courses tend to follow their prescribed structure (Lowenthal & Hodges, 2015).

Research into the instructional design quality of 76 randomly selected (mostly non-medical) MOOCs has found that 'although they scored high on organization and presentation, instructional design quality is low' (Margaryan et al., 2015). Other researchers found that none of the six science-, technology-, engineering- and mathematics-focused MOOCs they investigated would have passed an established instructional quality review for higher education (Lowenthal & Hodges, 2015). Literature about the quality of medical MOOCs show ambiguous claims, with some articles stating that they are pedagogically deficient (Doherty et al., 2015) and others that they are of high academic standard (Subhi et al., 2014), however no systematic investigations have been done. In this study we therefore investigated the quality of the instructional design of medical MOOCs that are eligible for integration in formal campus education.

Instructional Design Quality

Merrill (2002) has identified five First Principles of Instruction for learning activities, that are common to various instructional design theories. These five principles are: problem-centeredness, activation, demonstration, application and integration. These principles state that learning is promoted when: students are engaged in solving real world problems; prior knowledge is activated; new knowledge is demonstrated to the student; new knowledge is applied by the student; and new knowledge is integrated into the student's perceptions and experiences. Margaryan et al. (2015) have added to the first five, a set of principles that focus on learning resources and learning support to form a ten-principle framework to evaluate the instructional design quality of online courses. These additional principles are: collective knowledge, collaboration, differentiation, authentic resources and feedback. These principles assume learning is supported when students: contribute to collective knowledge; cooperate; receive learning avenues based on their different needs; work with authentic resources; and receive feedback from experts about their performance.

Additionally, to learn effectively in an online setting with little to no tutor support, certain skills are needed. In this regard, multiple studies have emphasized the importance of promoting self-regulated learning skills in online learning environments and each of these studies emphasizes the importance of focusing on course goals and personal goals in designing online learning environments (Kizilcec et al., 2017; Littlejohn & Milligan, 2015).

We have therefore added one final goal-setting principle based on Goal-Setting Theory (Littlejohn & Milligan, 2015; Locke, 1996). In Table 1 the eleven principles are summarized.

Method

Case selection

This investigation was the second of two studies into medical MOOCs that qualify for integration in campus education and the same case selection procedure and cases were included (Hendriks et al., 2019), as described below.

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 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 ten different platforms and offered by two health organizations, three partnerships of institutions and 26 different universities, with three courses from the same university. A list of the included MOOCs can be found in Appendix B.

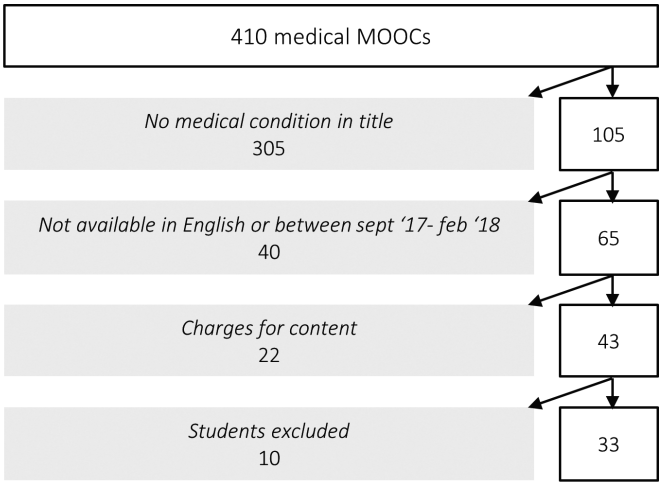

Figure 1. MOOC inclusion process (Hendriks et al., 2019).

Materials

For coding the instructional design quality principles, an extended version of the *Course Scan* tool (Appendix C) was used (Margaryan et al., 2015). *Course Scan* consists of a set of questions specifically created for the purpose of evaluating MOOCs. For each of the ten principles of the framework one or more questions are answered. Some questions consider whether a principle applies and some questions consider to what extent a principle applies. For the first type of questions yes or no can be answered, resulting in 1 or 0 points. For the second type of questions possible answers are:

1. *none*, when the course does not reflect a given principle at all, for 0 points;
2. *to some extent*, when serious gaps were found, the course reflects a given principle in less than 50% of the included teaching modes, for 1 point;
3. *to large extent*, when the course reflects a given principle mostly sufficient, in 51% to 80% of included teaching modes, for 2 points;
4. *to very large extent*, when the course reflects a given principle to complete satisfaction, in 81% to 100% of included teaching modes, for 3 points;
5. *not applicable*, when an item is absent, for example when group work is absent in a course, all questions regarding the composition of the group are not applicable, for 0 points;
6. *no information,* when no information is available to determine if a given principle is reflected in the course, for 0 points.

A similar set of 6 type-one and -two questions has been developed to extend *Course Scan,* based on the relevant key findings of Goal Setting Theory, as stated in Table 1.

The items regarding the instructional design principles are preceded by five questions about the organization of course materials and presentation of course information to form an overall picture of each course. A total of 78 points could be scored per MOOC for full saturation of all principles.

Table 1. Relevant principles used in in investigated MOOCs. 1 Merrill, 2002; 2 Margaryan et al., 2015; 3 Locke, 1996; Latham and Seijts, 2016.

Principle	Learning is promoted when:
Problem-centered[1]	'learners are engaged in solving real-world problems'
Activation[1]	'existing knowledge is activated as a foundation for new knowledge'
Demonstration[1]	'new knowledge is demonstrated to the learner'
Application[1]	'new knowledge is applied by the learner'
Integration[1]	'new knowledge is integrated into the learner's world'
Collective knowledge[2]	'learners contribute to the collective knowledge'
Collaboration[2]	'learners collaborate with others'
Differentiation[2]	'different learners are provided with different avenues of learning, according to their need'
Authentic resources[2]	'learning resources are drawn from real-world settings'
Feedback[2]	'learners are given expert feedback on their performance'
Goal-Setting[3]	working on/setting measurable, difficult long-term goals, chunked into short-term goals. Committing to a goal and considering obstacles is essential.

Procedure

Data collection consisted of the first author enrolling in the selected MOOCs and answering the questions after thorough examination of all course materials. All tool-questions have been validated by calibration of answers for four randomly selected MOOCs with the second author, of which a log was kept. Full agreement on each answer was reached. The remainder of the MOOCs was scored by the first author, who consulted both the log and second author when necessary. For descriptive statistics we used IBM SPSS Statistics version 23.

Results

The investigation of the 33 MOOCs provided total scores between 12 and 34, with an average of 20.1 and a standard deviation of 6.4. All MOOCs scored well on organization and presentation of the course, as showed in Table 2. In 79% (26) of the MOOCs the target group was described. Requirements to complete the course were stated in 73% (24) of the courses, and requirements to participate such as prior knowledge, were described in 36% (12). In 33% (11) of the MOOCs, an improvement in specific skills as a result of participation was predicted.

Principles for Learning Activities

For *problem-centeredness,* in all MOOCs activities built on each other to have learners work on content that increases in difficulty, as showed in Table 3. In 61% (20) of the MOOCs relevant workplace problems were incorporated in activities, such as clinical patient cases. In addition, 33% (11) of the MOOCs had learning objectives based on real-world tasks, for example on developing conversational skills to talk about cancer with patients in the MOOC 'Talking about Cancer'. Problems in 33% (11) of the MOOCs were typical of learners' real-world challenges. In 15% (5) of the courses complex or ill-structured problems with multiple solutions were present and 12% (4) of the courses incorporated a variety of different problems, for example for the treatment of patients in different types of addiction such as alcohol and drug addictions, in a MOOC about managing addiction. Prior knowledge was *activated* in 48% (16) of the MOOCs, by summarizing content from previous activities or by referring to real-life experiences learners might have had, for example heartburn after eating fatty foods. In 33% (11) of the courses new knowledge or skills were *demonstrated* to the learner, with 9% (3) of the MOOCs showing both good and bad examples to illustrate how to gain wanted outcomes such as successful conversations with a patient. In 97% (32) of the MOOCs learners had to actively *apply* their newly developed knowledge or skills during course activities, which means they had to demonstrate, illustrate or use relevant content in an assignment. In 6% (2) of the MOOCs learners were encouraged to *integrate* their new knowledge or skills into daily life. For example, one MOOC about organ donation had learners make a plan for getting personally involved to help organ donation in their local context.

Table 2. Scores for organisation and presentation in investigated MOOCs.

Organisation and presentation	Present in (%)	Max score	Mean score
The course materials are well organised	100	3	2,82 (n=33)
The course description is clear	100	1	1,00 (n=33)
The learner population that will engage in the course is specified	79	1	1,00 (n=26)
The course completion requirements are outlined clearly	73	1	1,00 (n=24)
The course enrolment requirements are outlined clearly	36	1	1,00 (n=12)
The change that needs to be promoted in the skill set of the learner population is specified	33	1	1,00 (n=11)

Principles for Learning Support

Learners could work on *collective knowledge* by learning from each other, by building on each other's input, and contributing additional knowledge or resources, in respectively 27% (9), 39% (13), and 45% (15) of the MOOCs. In 3% (1) of the MOOCs it was required that learners *collaborate* to some extent, in this case with others outside the course. Learners had to find people willing to help them practice their skills for conversating with aphasia-patients.

Avenues for learning were *differentiated* in 39% (13) of the courses, some courses offering honours content for learners craving more challenge, and others offering in-course links to short courses covering content necessary before starting the current MOOC. One course about aphasia offered distinct tracks for patients and medical professionals. Learners worked with *authentic resources* in 97% (32) of the MOOCs, including real patients describing their experiences, videos of operations, and open access research articles. *Feedback* was present in 97% (32), and largely automated or by peers, not by experts. In 18% (6) of the MOOCs, it was clearly explained how feedback would be provided to the learners, for example what criteria would be considered and who would be providing feedback.

Principles for Self-Regulated Learning: Goal-Setting

Learning goals were explicated in 82% (27) of the MOOCs, 76% (25) being measurable, meaning they had incorporated an assessable verb in the goal, for example: clarify, summarize, predict or give examples (Krathwohl, 2002). In 40% (13) of the courses only long-term goals were present, 21% (7) of the courses offered only short-term goals and 21% (7) offered both. In 24% (8) of the courses, learners were explicitly encouraged to formulate personal goals, which were not necessarily learning goals, but could also be performance goals, like gaining the certificate. Obstacles to attain learning goals were considered in 3% (1) of the MOOCs by pointing out difficulties one can have when learning online and directing learners to a YouTube video about time management. No encouragements were found to commit to ones goals by, for example, stating them to another learner on the forum.

Table 3. Presence of instructional design principles and their mean scores for investigated MOOCs.

Principles of instruction and related components	Present in (%)	Max score	Mean score
Problem-centred			
The activities build upon each other	100	3	2,21 (n=33)
The activities in the course relate to the participants' real workplace problems	61	3	2,10 (n=20)
The course objectives are relevant to real-world problems	33	3	2,91 (n=11)
The problems in the course are typical of those learners will encounter in the real world	33	3	1,91 (n=11)
The problems are ill-structured – have more than one correct solution	15	3	1,40 (n=5)
The problems are divergent from one another	12	3	1,25 (n=4)
Activation			
The activities attempt to activate learners' relevant prior knowledge or experience	48	3	1,56 (n=16)
Demonstration			
There are examples of problem solutions	33	1	1,00 (n=11)
Solutions represent a range of quality from excellent examples to poor examples	9	3	1,00 (n=3)
Application			
The activities require learners to apply their newly acquired knowledge or skill	97	3	1,28 (n=32)
Integration			
The activities require learners to integrate the new knowledge or skill into their everyday work	6	3	1,00 (n=2)
Collective knowledge			
The activities require contributing to the collective knowledge, rather than merely consuming	45	3	1,00 (n=15)
The activities require learners to build on other participants' submissions	39	3	1,00 (n=13)
The activities require participants to learn from each other	27	3	1,00 (n=9)
Collaboration			
Activities require participants to collaborate with other course participants	0	3	-
Activities require participants to collaborate with others outside the course	3	3	1,00 (n=1)
Activities require peer-interaction groups with individuals with different backgrounds, opinions, and skills	0	3	-
The individual contribution of each learner in the group can be clearly identified	0	3	-
Peer-interaction groups are given specific directions for interaction	0	1	-
Each member of a peer-interaction group has a specific role to play	0	1	-
Differentiation			
There are activity options for participants with various learning needs	39	3	1,31 (n=13)
Authentic resources			
The resources are reused from real-world settings	97	3	1,22 (n=32)
Feedback			
There is feedback on activities by the instructor(s) in this course	97	1	1,00 (n=32)
If there is feedback, the way feedback will be provided, is clearly explained to the participants	18	1	1,00 (n=6)

Goal-setting			
Goals are measurable	76	3	2,64 (n=25)
Course contains distal goals	61	1	1,00 (n=20)
Course contains proximal goals	42	1	1,00 (n=14)
Personal goals are incorporated	24	1	1,00 (n=8)
Obstacles to attain goals are considered	3	1	1,00 (n=1)
Commitment statement about goals is required	0	1	-

Discussion

The current study shows that the included medical MOOCs eligible for integration in campus education, meet the instructional design principles to varying degree. The medical MOOCs from this study received higher scores than MOOCs on various topics from previous research (Margaryan et al., 2015). A*pplication*, *authentic resources,* and some items of *problem-centeredness* and *goal-setting* were found to be present in many of the investigated courses. An explanation might be that instructors and designers frequently use these principles in campus-based medical education, and that therefore these principles are also more implemented in MOOCs. *Activation*, *collective knowledge*, *differentiation*, and *demonstration* were made explicit in less than half of the courses as were typical and relevant *problems*, and short-term and personal *goals.* Finally, *integration*, *collaboration*, ill-structured and divergent *problems*, and consideration of obstacles and commitment to reach *goals* were present in less than 15% of the courses. Although *feedback* was found in many of the courses, it was only provided by peers or in automated form, and expert feedback was absent.

Some instructional design principles may be difficult to implement in the MOOC concept, while others might be easily incorporated. The lowest score was found for the principle *collaboration*. While collaboration between learners perfectly fits the original MOOC concept of learning together (Cormier & Siemens, 2010), participants in the included medical MOOCs were not required to work together. The investigated courses focus on discussion or peer feedback to deepen *collective knowledge*, however no examples of learners being a part of a group to work on a collective task or goal were found, which is at the core of *collaboration*. This finding is in line with our previous work, where we found medical MOOCs mainly focus on teaching modes for individual learning (Hendriks et al., 2019), and literature from other domains (Margaryan et al., 2015; Wen, 2016). An explanation for the absence of collaboration might be that it is problematic to organize synchronous collaboration among participants because of the non-committal and asynchronous character of MOOCs (Sanz Martínez et al., 2016). Four issues that hinder teamwork in MOOCs have previously been identified: 1) learners might need to be prepared for collaborative work (Wen, 2016); 2) collaborative team formation and maintenance require ample planning and support (Staubitz & Meinel, 2017; Wen, 2016); 3) teams need to be able to edit task related documents together in addition to communication tools; and 4) teams need to be able to hand in assignments as a group to allow

assessment (Staubitz & Meinel, 2017). In this regard, some obstacles are easier to overcome than others and the first support tools for some of the issues are available or in development (Sanz Martínez et al., 2016; Staubitz & Meinel, 2017; Wen, 2016). However, seemingly none of these tools have made their way into the instructional designs of medical MOOCs yet, and it might be a while before collaboration in MOOCs is similar to collaborating in face to face education or in other online learning applications.

Another principle that seems difficult to implement is *expert feedback*. Although we have found nearly all courses to offer feedback, this consisted mostly of automated quiz feedback or peer feedback. Expert feedback is highly desirable in courses that involve work that is too open-ended for automated assessment, but too complex and high-stakes to rely only on peer evaluations for grades and formative assessment (Joyner, 2017). Because of the massiveness of MOOCs it is very difficult to provide each learner with qualitative expert feedback. Endeavours to upscale expert feedback have been described, for example by hiring freelance project reviewers, online teaching assistants, or by automated essay scoring, where a scoring algorithm is developed based the scores an expert has inserted on a hundred essays (Balfour, 2013; Joyner, 2017). However, previous research found no expert feedback present in MOOCs and our findings show that if present, qualitative feedback in MOOCs can only be obtained from peers. Although the feedback process is beneficial for the learner who is giving feedback (Li et al., 2010), in an online environment such as a MOOC where peers do not know each other as they do in campus settings, authority of peers and credibility of their feedback might hamper desired effects for the learner who is receiving feedback. Additionally, giving peer feedback is a skill that needs to be developed. We found little guidance is provided to learners when they are to give feedback to their MOOC peers. Clear explanations of what is and can be expected in peer feedback activities are important and can be done, for example by offering rubrics (Ashton & Davies, 2015). Research has found that in university campus settings, feedback from multiple peers could significantly improve the quality of a written essay in comparison with expert feedback, but the feedback of a single peer could not (Cho & MacArthur, 2010). Until differences in value between expert and peer feedback in online courses have been discerned, adding expert feedback is desirable in integrated credit-bearing MOOCs, and solutions will have to be further explored.

Some instructional design principles are currently subject of online education research and their application may be rapidly advancing. Our findings for the principles of *differentiation* and *goal-setting* might have been affected by the early stage of development of these principles. Personalized online learning and adaptive online courses are the next level of *differentiation*. At present, models are being built and tested to create adaptive MOOC platforms where learners are offered or recommended differentiated learning paths, based on their prior learning activities and the vast amount of data that online learners produce in a course (Wang & Jiang, 2018; Xi et al., 2018). In this regard, technological advances seem to push the

development of quality education, as adaptive differentiation on a personal level is extremely difficult to organize in face to face education. Similarly, self-regulated online learning and goal-setting have gained the interest of the MOOC research community. Recent reviews of tools to support self-regulation while learning in a MOOC, and literature about self-regulated learning in MOOCs found respectively 23 tools and 82 articles describing design strategies to include self-regulated learning support in MOOCs and other online courses (Pérez-Álvarez et al., 2018; Wong et al., 2018). However, these studies also found that the literature rarely reported on the impact of the tool or design on the self-regulated learning strategies or learning outcomes of the learner. We expect rapid development of self-regulated learning support and the presence of the goal-setting principle in MOOCs to be quite likely in the near future.

A few of the principles that we consider very well fit for MOOC designs, we found to be scarcely to moderately present, namely: *integration*, *collective knowledge, activation, demonstration*, and some items of *problem-centeredness*. For these principles and their subitems, Margaryan et al. (2014) also found similar low scores and they have described the following potential causes: 1) MOOC instructors and designers may lack knowledge of the contemporary instructional design principles or learning theories; 2) instructor and designers might be well aware and practice these in their classroom teaching but not in their MOOCs; 3) institutional marketing considerations rather than pedagogic concerns may drive instructors when offering MOOCs.

The instructional design quality score of a MOOC should not be considered as an absolute score but as relative scores when deciding if the MOOC or its content is suitable for integration purposes. For integration, medical MOOC instructional quality should be as good or better than the instructional design quality of learning activities in the regular face-to-face on campus courses in order to improve the quality of the course as a whole. Quality of education should always be considered, however expectations for online education should be realistic. When instructional design quality is comparable or better, online education offers major organizational benefits (Lowenthal & Hodges, 2015). In addition, when integrating MOOCs the opportunity rises to add certain face-to-face components in order to accommodate desired principles that were not already incorporated in the course. *Collaboration* and *expert feedback* can be organized more easily face-to-face, for example with a group essay, linked to participation in the MOOC. So, although we found overall average total scores for instructional quality for medical MOOCs, they remain valuable resources for integration in formal classroom education.

Our findings strongly indicate that it is desirable to consider the quality of MOOCs before integrating them into classroom teaching. However, in a previous study we have found medical MOOCs to differ distinctly in their teaching mode profile, and we found quality assessment of MOOCs being time consuming, and demanding an experienced assessor (Hendriks et al.,

2019). As an alternative for each teacher assessing MOOCs individually, more concentrated efforts might be more effective, for example, centrally screening all MOOCs of exchanging universities within a consortium. As this would still be time consuming, we advocate the addition of metadata to each course, to have characteristics of MOOCs more commonly available, as an educational map provided by MOOC instructors. Information about the design principles that were considered, combined with an overview of included instruction, interaction, and assessment modes, would be a valuable resource to teachers that are interested in integrating. We do propose teachers explicitly describe how quality principles were integrated in their course instead of just listing their favoured principles. In this way, accuracy of quality principle integration can be traced.

Future research

According to our findings we propose future research in two areas: 1) practical quality assessment methods, and 2) further defining quality. For the first area, research can focus on the development and implementation of a designated area or metadata for integration information on MOOC platforms, and more efficient and effective tools for teachers to investigate quality. Second, we have added goal-setting to the list of relevant principles based on the literature to further define quality, and similarly other principles might be important to consider. Another avenue for acknowledging instructional design quality is to investigate constructive alignment of course goals, activities and assessment (Biggs, 1996). Especially when integrating MOOCs as a whole, cohesiveness of the course deserves investigation. So far, we have not come across literature that describes assessment of constructive alignment in MOOCs. In addition to instructional design, other criteria for MOOC quality might be considered as well, for example the quality of use of technology, or the quality of the information that is represented in a course (Hood & Littlejohn, 2016).

Limitations

For twenty of the items in Table 3, mean scores give insight into the extent to which the instructional design principles were present in the MOOCs. Low mean scores for principles that are present in few MOOCs can be explained by the causes as described above for low presence scores. Another reason for not finding many high scores is that some of the items are to be considered per activity instead of on course level. *Activation*, for example, is assessed for each activity and the percentage of activities that indeed activate prior knowledge define the total course score. This makes it hard to gain high scores as maybe not all activities in a course should represent all of the principles. One could even argue that if each activity would activate prior knowledge, and would offer ill-structured and divergent problems, and would demonstrate many options to complete the task or problem, that this activity would be in violation of another item for *problem-centeredness*: to have activities build upon each other to gradually increase difficulty. It is very likely instructors and designers have made choices to have some activities incorporate other principles than

others (Margaryan et al., 2015). Mean scores are still informative however, as per course they can show how principles are distributed across activities and identify imbalances.

Conclusion

This study shows medical MOOCs differ in the way they address various instructional design principles. Some principles may be easier accomplished in campus contexts outside of the online domain. These findings are valuable for curriculum decisions and can inform universities that develop or integrate medical MOOCs.

Practice points

- Medical MOOCs eligible for integration meet instructional design principles in varying degree
- Certain principles might be scarcely present due to a problematic fit with the MOOC concept or a need for further development in online settings
- Assessment of instructional design quality is desired before integrating in campus settings
- For integration, MOOC quality should be considered in relation to the quality of the existing campus education and the finalized integrated course
- More effective and efficient MOOC assessment methods are needed for the purpose of large-scale integration