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

Hendriks, R.A.

FINDING VALUABLE DIRECTION

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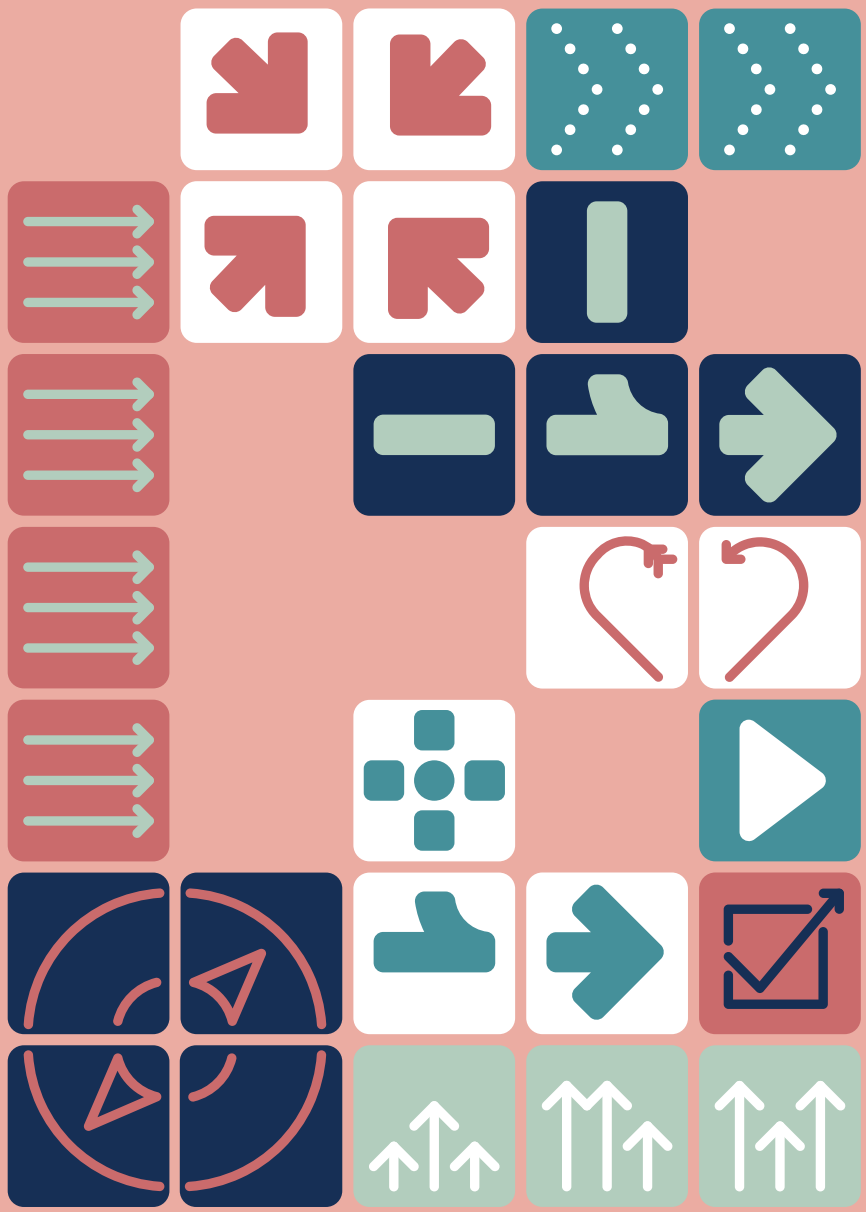

Renée Anne Hendriks

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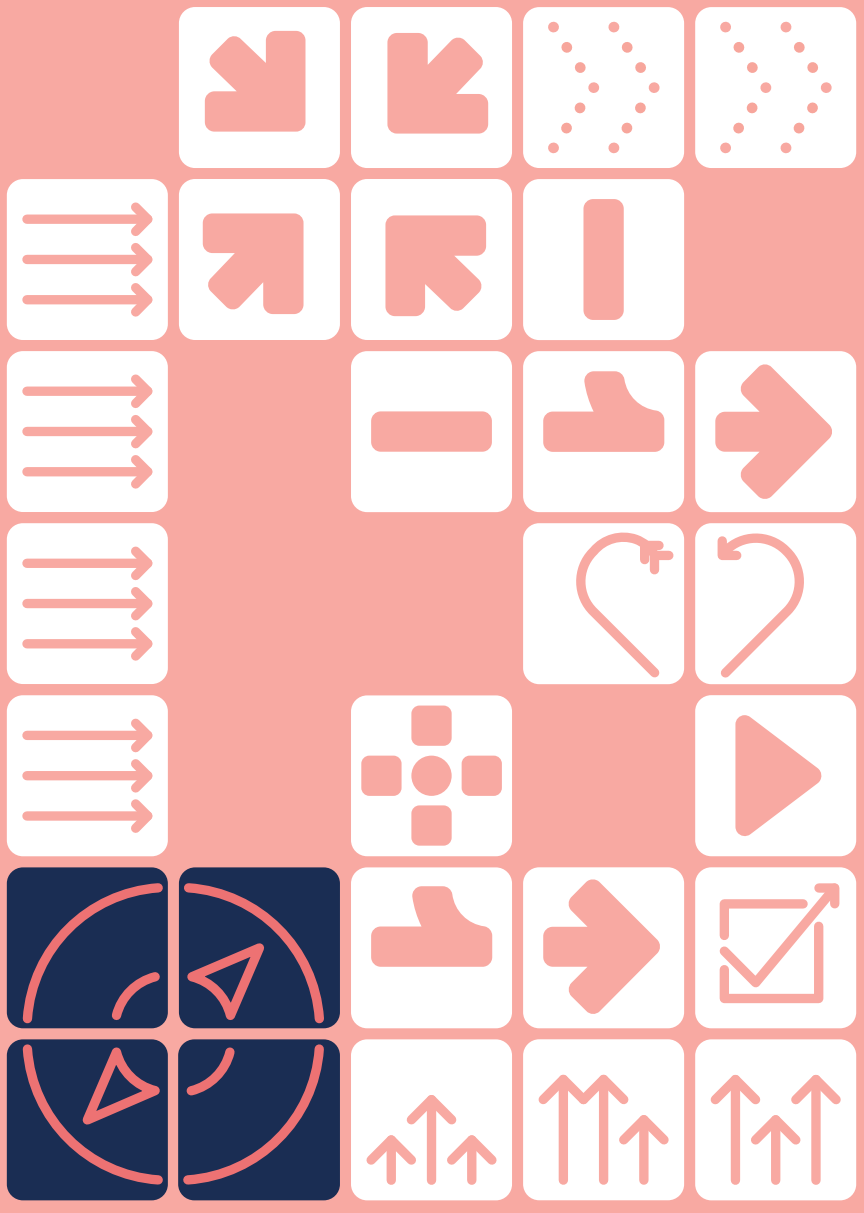
Table of contents

CHAPTER I



General Introduction

Introduction

Massive Open Online Courses (MOOCs) are, as the name suggests, *online* courses that can accommodate *massive* amounts of learners and are *open* to everyone. They are one of the most popular innovations in Technology Enhanced Learning worldwide (Bozkurt, 2021). MOOCs can be created, offered and followed on special MOOC platforms such as Coursera, EdX and Futurelearn. Medical MOOCs specifically are popular with a wide range of learners including (bio)medical students, professionals and patients and have grown in number extensively over the last few years (Berger et al., 2021; Liyanagunawardena & Williams, 2014; Longhini et al., 2021; Pottier et al., 2020). A review study in 2014 (Liyanagunawardena & Williams, 2014) identified 98 MOOCs available on Health and Medicine and a recent superficial search (February 2022) on health and medicine related MOOCs with search engine Class-central revealed 1959 courses available. Early expectations regarding the importance of MOOCs for medical education stated students to be able to 'increasingly complete requirements online' and for medical schools to 'either develop courses to be taken online or license courses from other schools'. More pessimistic predictions included MOOCs to only have small part in medical education as it encompasses more than only 'content delivery' (Harder, 2013). However unexpected, online learning became a critical resort for many (bio)medical teachers and students during the COVID19 pandemic (Kim et al., 2020; Skaggs, 2021; Stojan et al., 2021). With overflowing hospitals that were temporarily inaccessible for medical students and overextended medical professionals, teaching became an extremely challenging task, and consequently so did learning (Ardekani et al., 2021; Motte-Signoret et al., 2021; Stojan et al., 2021). During this period teachers and scholars learned a great deal about online teaching and learning and it is foreseeable that many innovations are here to stay in some form or other, now that we got used to them (Erlich et al., 2021; Furtner et al., 2021; Jiang et al., 2021; Lucey & Johnston, 2020). In this regard, use of MOOCs in formal medical education is likely to last and evolve further, and in need of attention from the research community (Longhini et al., 2021).

In this introduction we will first provide background information about MOOCs and the desire to integrate them into campus settings. This will be followed by a description of the problem we identified while integrating the medical MOOC 'Clinical Kidney, Pancreas and Islet Transplantation', the context we operated in, and the approach we adopted in our contribution to this problem. Then teaching and learning in medical MOOCs are operationalized to introduce the relevant terms for this thesis. This includes the identification of omissions in the literature regarding these terms. Finally, an overview of the research in this thesis is outlined and the adopted paradigm is discussed.

Medical Massive Open Online Courses

The first MOOC was developed to offer a different type of learning: connectivist learning (Siemens, 2004). In connectivism, learning starts when knowledge is activated by learners

connecting to and participating in the learning community. Learning communities are "the clustering of similar areas of interest that allows for interaction, sharing, dialoguing and thinking together" (Siemens, 2004). The idea for the first MOOC was thus that learning paths were not set by the instructors, but learners would, by connecting with each other and the instructors, create questions, answers and content to learn from (Fini, 2009). When learning within and from a community, there is more to learn when more learners join, and so the university course that would be the first MOOC was made *open* to anyone who wanted to join. To make the course accessible to a large number of learners it was *online* and free of charge. When other institutions, including Ivy League universities joined in the creation of MOOCs, the more traditional course format in which the learning path is set by the instructors was transferred to the MOOC context. Teaching was thus based on cognitive-behaviourist theories of learning, however the characteristics of massiveness, openness and absence of a fee were retained (Pilli & Admiraal, 2016). Since then, many different small changes have been made to create different types of courses out of the MOOC concept, for example Small Private Online Courses (SPOCs), however the main categories of the connectivist MOOC (cMOOC), where no path is set for the learner by the instructor, and the cognitive-behaviourist MOOC with a high dose of prescribed activities and structure (xMOOC), are still prevalent.

MOOCs are created by several types of institutions such as government organizations and museums, but mostly by universities. Over the years the concept has been adapted by universities, and MOOCs are created for different reasons than connectivist learning (Haywood et al., 2015). One reason to create MOOCs is to offer education to learners with limited or no access to high quality education, based on the idea that everyone should have access to quality education (Tang & Wang, 2017). For universities, another reason is to reach many potential learners. Universities aim for learners to get excited to join their institute through MOOCs (Howarth et al., 2017; Jansen et al., 2015). A third reason interweaves with the first two: institutions get the opportunity to provide the world with a snapshot of their expertise and improve their reputation, for example regarding innovative teaching (Haywood et al., 2015; Howarth et al., 2016). These reasons make institutions want to offer their best and so, often, MOOCs are heavily invested in. Many MOOCs have been produced by large teams with expertise on learning, technology and the topic to be covered (White & White, 2016; White et al., 2020). In combination with the specifically created MOOC platforms, most available MOOCs have a very high quality look and feel. As MOOCs became expensive to create but did not generate direct income due to their characteristic of being free, many MOOCs now offer a certificate for a minor fee. In addition, increasingly more frequent, MOOCs are offered partly for free, by for example charging a fee for access to the exams or for extended access to the course over time. Another way for universities to harvest from their investments is to reuse MOOCs in the campus curriculum.

Integration in Campus Education

Integration of MOOCS in campus has many advantages, including all advantages of online learning: 1) the possibility to use "exemplar" learning materials from experts in their field instead of each university making their own (Doherty et al., 2015; Sharma et al., 2014), 2) access to topics not normally available in the curriculum(Doherty et al., 2015), 3) access to education from institutions that not all students can travel to (Doherty et al., 2015), 4) enhanced understanding of topics not common to students' resident country (Sharma et al., 2014), 5) the opportunity to remove costs and inconvenience of getting to a single location (Davies, 2013), 6) enhanced communication among international communities of experts and learners, 7) innovative teaching models for student learning (Goldberg & Crocombe, 2017), and 8) the convenience of creating a course once and delivering it multiple times without extra effort or cost (Sarkar & Bharadwaj, 2015).

Many university teachers created a MOOC based on their existing university course, and integrated their complete MOOC or parts of it back into the campus curriculum. Later, MOOCs were even created with this dual purpose in mind (Israel, 2015). In addition MOOCs have been described as Open Educational Resources (OER), meaning whole MOOCs or parts of MOOCs have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions (Jansen et al., 2015; Stracke et al., 2019). Universities have also joined forces to increase this practice by establishing networks of institutions where students can enrol in MOOCs from other universities for credits (Website, 2018). MOOCs have been predicted to be a disruptive innovation, for example by unbundling of the higher education system (Wellen, 2013). Unbundling entails the division of formal higher education degrees into smaller parts, each with their own micro credential, so that students can amass the credentials they or their (future) employer desire (Ralston, 2021). In addition, this would ease career switches and lifelong learning. While unbundled higher education is not widely implemented for now, the idea and attention for it do indicate the impact MOOCs are thought to and may have on formal higher education in the future.

Problem and context description: the added value of medical MOOC integration

MOOC integration poses many exciting opportunities, however, at the start of our project many challenges were uncovered. Mostly, we wanted to explore how we could take advantage and optimally use MOOCs in campus education. For MOOC integration to be truly valuable, we decided, it must contribute to high quality teaching and learning, an opinion that is shared. Our main question at the start of this project was: Can MOOCs be used to offer high quality teaching and facilitate high quality learning in campus, and how?

At Leiden University Medical Center (LUMC), where this project was executed, multiple MOOCs have been created by expert teams. Two are offered live on Coursera since 2016:

Clinical Kidney, Pancreas and Islet Transplantation and *Anatomy of the Abdomen and Pelvis; a journey from basis to clinic*. Since 2019 multiple MOOCs on Population Health have also been created. Within LUMC these first two MOOCs were already being reused partly or as full courses, in different types of education including undergraduate, graduate and professional education. It quickly became apparent that within a design for MOOC integration many choices can be made, which could all influence the quality of teaching and learning. Guidelines for specifically medical MOOC integration were thus much needed to accommodate the wish to reuse these popular courses. In this thesis we focus on the integration of MOOCs for undergraduate students.

Although many previous studies had focused on MOOCs outside of formal learning, MOOC integration research was somewhat uncharted territory when this research project started in 2016. Mainly enthusiastic case descriptions from early adopters of MOOC integration existed, without uniformity on what information was relayed about the MOOC or the integration design (Israel, 2015; Robinson, 2016; Sarkar & Bharadwaj, 2015; Subhi et al., 2014). While experimenting with introducing MOOCs to campus students, many studies measured student satisfaction, pass rates or final scores (Israel, 2015), however how teaching was impacted was not examined and the impact on learning was only investigated as perceived by students (Swinnerton et al., 2017). In addition, MOOCs were described to always contain video lectures, discussion forums and quizzes (Dandache et al., 2017; Hoy, 2014; Robinson, 2016), however if and what other activities were available in medical MOOCs for integration was unclear. We set out to do groundwork, needed to make informed decisions about MOOC integration to support high quality teaching and learning.

High quality teaching with integrated medical MOOCs: instructional design

High quality teaching can mean different things in different contexts, however most experts would agree that for a high quality course the *instructional design* must make sense (Stracke & Trisolini, 2021; Van Merriënboer & Kirschner, 2001). The instructional design of a course can be summated as the blueprint for all the activities in a course and the order they are to be completed in. Logically there must be an idea underlying the activities and their linked accumulation, one that promotes learning for the desired outcomes ((Kirschner & Van Merriënboer, 2008). Especially in xMOOCs the designed curriculum resembles the taught curriculum to great extent as online courses tend to follow their prescribed structure and there is little room for different versions of performance or execution, as opposed to face to face courses (Lowenthal & Hodges, 2015). Additionally, as examining the instructional design can be done before integration, this is more desirable than evaluating course outcomes: students do not have to be exposed to a potentially ineffective course. In researching what medical MOOCs have to offer for high quality teaching we focused on four topics: 1) the offered teaching modes of the activities, 2) the social and epistemological dimensions of these modes, 3) relevant instructional design principles and 4) the practical side of coordinating MOOC integration.

Teaching modes represent the way the instructor or instructional designer has chosen to shape the activities in which the desired knowledge, skills and attitudes are taught and learned. They have previously been divided into modes of instruction, such as lectures or readings, modes of interaction, such as a discussion forum or a chat-box, and modes of assessment, such as multiple choice quizzes (Toven-Lindsey et al., 2015). If instructors want to integrate their own or another institution's MOOC content into formal on-campus teaching, it is important to know what teaching modes are offered, so that the incorporation into campus can be aligned with the desired outcomes. Characteristically medical MOOCs feature videos, forums, and multiple-choice questions (Dandache et al., 2017; Hoy, 2014; Robinson, 2016), but their teaching methods have not been systematically studied.

In addition to identifying the teaching modes available for each course, it is also important to consider their *social and epistemological dimensions*. When setting up a MOOC or its materials in a specific context it is important whether approaches are aimed at individual or group learning and whether knowledge is transmitted or constructed: these dimensions need to fit the difficulty level of the task and the learning skills of the student (Lou et al., 2001; Vrasidas, 2000). Arbaugh and Benbunan-Finch (2006) characterized these social and epistemological dimensions in their Teaching Approach Framework: teaching methods can be distinguished socially, as individual or group-oriented, and epistemologically, as objectivist or constructivist. These dimensions result in four possible combinations: 1) objectivist-individual; knowledge transfer from teacher to learner, 2) objectivist-group; knowledge transfer from teacher to group, 3) constructivist-individual; knowledge construction by a learner, and 4) constructivist-group; knowledge construction by a group. Toven-Lindsey et al. (2015) found that most of the educational strategies they studied, were associated with an objectivist view of knowledge, which was also the case for the single medical MOOC they included. This made them doubt if MOOCs really are revolutionary for higher education. As no other studies had been conducted regarding teaching characteristics in medical MOOCs specifically, it was unclear if the findings from Toven-Lindsey et al. (2015) were representative.

The quality of the curriculum will be influenced by the quality of medical MOOCs through integration in campus teaching, therefore MOOC quality should be assured (Clark et al., 2017). In total we selected eleven *instructional design principles* that are relevant, to assess quality before MOOC integration. Each of the eleven principles we consider are summarized in table 1. Five First Principles of Instruction for learning activities were identified by Merrill (2002). These principles are common to the various instructional design theories. A ten-principle framework to evaluate the instructional design quality of online courses was created when Margaryan et al. (2015) added a set of five principles focused on learning resources and learning support. Finally, as multiple studies emphasized the importance of promoting self-regulated learning skills in e-learning environments and each of these studies highlighted the importance of

focusing on course goals and personal goals in designing online learning environments, we added an eleventh principle based on Goal Setting Theory (Kizilcec et al., 2017; Latham & Seijts, 2016; Locke, 1996; Milligan & Littlejohn, 2016).

Table 1. Relevant principles. 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.

Prior research into the quality of instructional design of MOOCs on various topics found that 'although they scored highly 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 showed 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 had been done.

Although literature contained some information on how to create a MOOC (Demaree et al., 2014; Kellogg, 2013; Pickering et al., 2017), the *practical side of medical MOOC integration* had not been described. Through our practical and research experiences regarding MOOC integration we ourselves were on a steep learning curve. We found MOOC integration to encompass several steps, and to require specific knowledge. Practical information regarding MOOC integration was needed to help the community of teachers interested in and motivated for MOOC integration. Furthermore, in progressing the movement of MOOC integration, MOOC integration research could benefit as well. In this regard, we wanted to share our experiences.

High quality learning in integrated MOOCs

High quality teaching is pointless without high quality learning. Indicators of high quality learning can be defined in multiple ways: deep learning, prolonged retention, engagement, acquiring higher order thinking skills; the idea is that students truly understand and can use what they have learned for an extended period of time. This can regard knowledge, skills or attitude. Important factors for high quality learning, especially online, are motivation, self-regulated learning strategies and the act in which they overlap: goal-setting (Broadbent & Poon, 2015; Hartnett, 2016; Kawachi, 2003; Wong et al., 2019).

The relationship between *motivation* and learning outcomes has been substantiated in higher education, and medical education specifically (Dickinson, 1995; Hustinx et al., 2009; Kusurkar et al., 2011; Vansteenkiste et al., 2004). In short it can be said that highly motivated students often show higher engagement and more active learning strategies. However not only quantity matters, quality of motivation might be even more important. In this regard Self-Determination Theory distinguishes between quantity of motivation and quality of motivation (Ryan & Deci, 2000). One can be highly motivated, but when this motivation is only externally regulated, or controlled, it is considered low quality motivation (Vansteenkiste et al., 2009). Autonomous motivation is more internally regulated, and is associated with well-being, enjoyment, and academic achievement (Reeve et al., 2008; Ryan & Deci, 2000). The quantity is the sum of autonomous motivation and controlled motivation, while the quality of motivation regards the ratio between autonomous motivation and controlled motivation: low autonomous ang high controlled motivation equals low quality motivation and high autonomous and low controlled motivation equals high quality motivation (Vansteenkiste et al., 2009). Self-Determination Theory also postulates that in order to acquire autonomous motivation, a sense of autonomy, competence, and connection to others is psychologically required (Ryan & Deci, 2000). In educational contexts, these psychological needs can be satisfied or frustrated, thereby satisfying or frustrating autonomous motivation, which in turn affects the overall quality of motivation (Reeve et al., 2008; Vanasupa et al., 2010). Motivation to learn in integrated MOOC settings is thus a relevant outcome measure, even more so as in campus education extrinsic motivation is bound to be present as well, as it is more structured and compulsory (Bradshaw et al., 2017; Wellington, 1990). A review of the literature regarding motivation to learn in online settings concluded there is a 'need for research that explores motivation from a contemporary situated perspective, in 'real-life' online settings that includes consideration of a broad range of social and contextual influences' (Hartnett, 2016). For MOOC learning in informal settings motivation has been studied (Zhu et al., 2018), however as integration offers a very different context it unlikely that findings regarding motivation to learn in informal MOOCs can be generalized to formally integrated MOOCs.

In addition to the profits of enjoyment, well-being and academic achievement, autonomous motivation is thought to enhance *Self-Regulated Learning* (SRL) (Reeve et al., 2008). SRL is described by several models, however most agree on it being a set of metacognitive activities to 1) plan, 2) monitor, and 3) reflect on one's own learning (Panadero, 2017). It is generally agreed that more SRL strategies are required for online learning, as there is usually no teacher, tutor or mentor present (Kizilcec et al., 2017). Much research has focused on what processes are involved in SRL, followed by strategies to teach successful execution of SRL. Recent literature reviews suggest that many SRL processes including goal setting, monitoring, and evaluation during the planning phase can be supported by adding SRL prompts, feedback, or a combination of the two (Pérez-Álvarez et al., 2018; Wong et al., 2019). While SRL skills can also be successfully obtained online, this may not be enough for students to truly self-regulate their learning when using SRL strategies is no longer supported. Prominent motivation researchers suggested a two-tier condition for students to self-regulate: they must know how to, and they must want to do it for themselves (Reeve et al., 2008). This relationship has not been tested however. Recent literature suggests that efforts to support SRL in MOOCs focus on providing support for execution of self-regulated learning, rather than autonomous motivation to implement the learned skills (Pérez-Álvarez et al., 2018; Wong et al., 2019).

Goal setting is an important part of the planning phase of SRL and is described as an essential skill for MOOC learning (Kizilcec et al., 2017). It is thought to drive all other phases of SRL (Panadero, 2017). Students who personally set their learning goals are motivated more autonomously, set more ambitious goals, exhibit higher commitment and show greater affect when accomplishing or not accomplishing a goal (Latham & Seijts, 2016). Although goal-setting is preferably done by the person pursuing the goals, this is not always theoretically desirable or practically possible. First, goal setting requires skills, as set goals are best when articulated as measurable, difficult, long-term goals, which are then specified into short-term goals. Commitment to a goal and consideration of obstacles are essential (Latham & Seijts, 2016). Second, novice learners often do not know enough about a subject they are going to learn about to gauge what knowledge, skills and attitudes are essential, and thus what goals are relevant (Farrell, Bourgeois-Law, Buydens, & Regher, 2019). Third, giving direction to one's own learning also requires some maturity (Jossberger et al., 2010; Saks & Leijen, 2014). In practice this leaves joint goal setting and consultation of students about goals, if you want them involved in setting their own goals, which are very time consuming for a teacher and often nearly unattainable. Especially for larger numbers of student, as subsequent study activities and assessment need to be constructed in alignment with the learning goals (Biggs & Tang, 2011). In scenario's where primarily teachers are involved in setting the goals, acceptance by the student of the assigned goals is key (Erez & Kanfer, 1983). Difficulties with assigned learning goals and co-creating learning goals have been described in multiple studies in clinical learning contexts (Farrell, Bourgeois-Law, Buydens,

& Regher, 2019; Larsen et al., 2017), but we have not come across literature that describes learning goal acceptance in online learning. As courses where teachers decide the learning goals are plentiful, MOOCs as well as regular in campus courses, the acceptance of learning goals by students needs to be studied.

Research outline

This thesis focuses on what MOOC integration offers for high quality medical education and on challenges for learning that arise with integrating MOOCs. The aim of this thesis is to provide answers to the following questions:

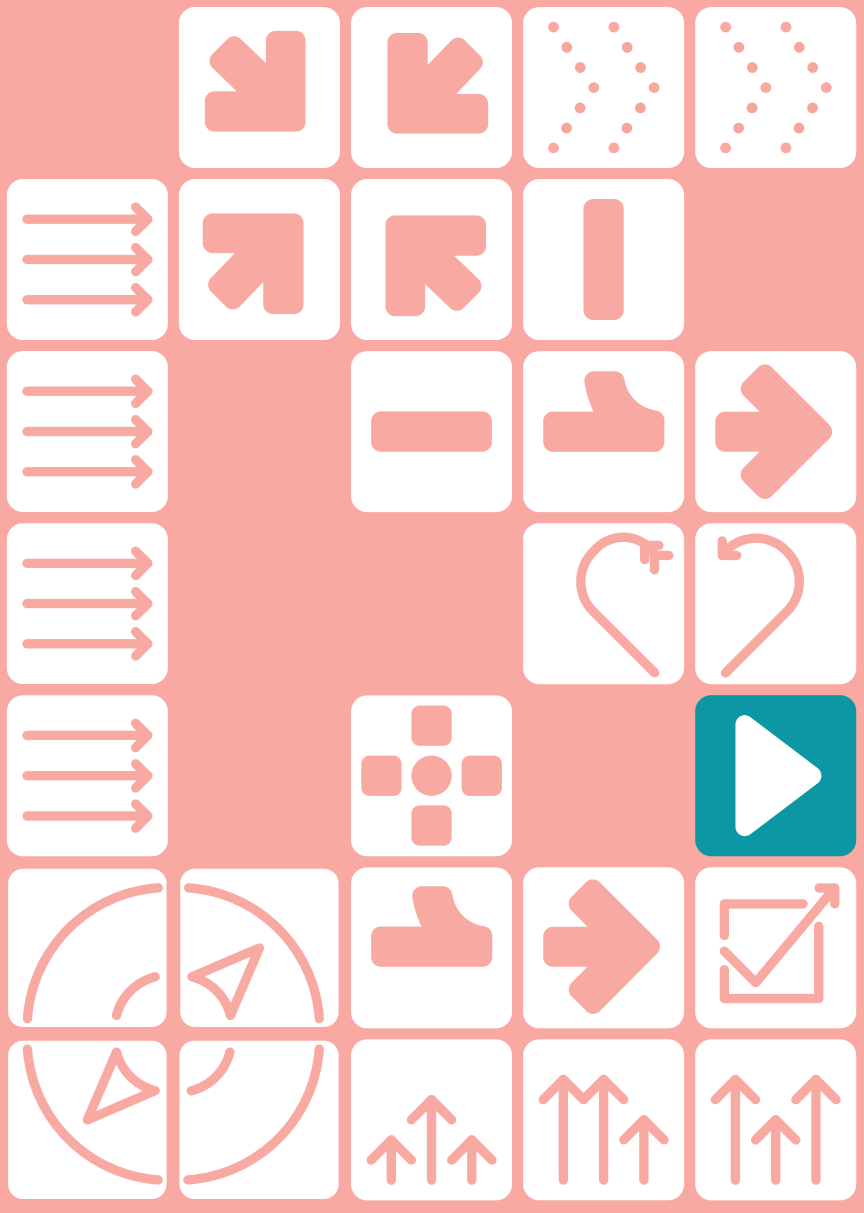
1. What do medical MOOCs have to offer for integration? (Chapters 2 and 3)
2. What does creating and integrating a medical MOOC entail? (Chapters 4 and 5)
3. How can learning in integrated MOOCs be supported? (Chapters 6, 7 and 8)

In table 2 an overview of the conducted research can be found, including research questions and aims, research methods, and analyses for each chapter. The research in this thesis was conducted within the pragmatic research paradigm, meaning that two systems of philosophy and reality were implemented. Depending on what fitted the research question, constructivist or post-positivist stances were adopted, leading to qualitative, quantitative and mixed methods designs.

Table 2. Overview of included research aims/questions, methods and analyses.

Chapter	Research aim or question(s)	Research method	Analyses
2	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?	Document Analysis	Template analysis, descriptive statistics
3	To what extent do medical MOOCs meet the instructional design principles: problem-centeredness, activation, demonstration, application, integration, collective knowledge, collaboration, differentiation, authentic resources, feedback, and goal-setting?	Document Analysis	Template analysis, descriptive statistics
4	1. What are our experiences with developing a medical MOOC and integrating it into campus education? 2. How was the MOOC (integration) received by learners?	Case Report	Descriptive statistics
5	What steps are essential in integrating medical MOOCs into campus education?	Twelve Tips Article: practical tips based on theory, previous research, and own experiences	n.a.
6	1. Describe motivation profiles of medical students that learn in integrated MOOCs, and discern if motivation profiles are associated with specific MOOC integration designs; 2. Investigate how psychological needs of medical students are satisfied or frustrated in different MOOC integration designs; 3. Investigate the relationship between autonomous motivation to learn and use of SRL skills in an integrated MOOC; 4. Uncover processes that are involved in goal acceptance or rejection of medical students in integrated medical MOOC designs with assigned learning goals; 5. Identify obstacles medical students encounter when learning with assigned learning goals in integrated medical MOOCs.	Research proposal (mixed methods)	n.a.
7	1. What are motivation profiles of (bio)medical students in three different MOOC integration designs? 2. Do the three MOOC integration designs differ in students' motivation profiles? 3. How are psychological needs of students satisfied or frustrated in different MOOC integration designs?	Student Surveys (cross-sectional)	Twostep cluster analysis, multivariate analysis of variance, Chi square test
8	What processes are involved in goal acceptance or rejection of undergraduate students in integrated MOOC designs with assigned learning goals?	Interviews	Grounded theory approach: open, axial and selective coding

CHAPTER 2



Teaching Modes and Social-epistemological Dimensions in Medical Massive Open Online Courses: Lessons for Integration in Campus Education

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Medical Teacher, 2019

Abstract

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.

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 analysed teaching modes after examination of all course pages. Teaching modes were categorised in social-epistemological dimensions according to the Teaching Approach Framework.

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.

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 enrol. 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 & Williams, 2014); in 2017, 511 courses were found in a similar search (Goldberg & 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 (Doherty et al., 2015; Sharma et al., 2014), (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 & Crocombe, 2017), and (h) the convenience of creating a course once and delivering it multiple times without extra effort or cost (Sarkar & Bharadwaj, 2015).

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 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 (Dandache et al., 2017; Marks & Meek, 2018; Maxwell et al., 2018; Reinders & de Jong, 2016; Robinson, 2016; Swinnerton et al., 2017). 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 a 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 (Dandache et al., 2017; Hoy, 2014; Robinson, 2016), 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-Fich (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 analysed. 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 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 A.

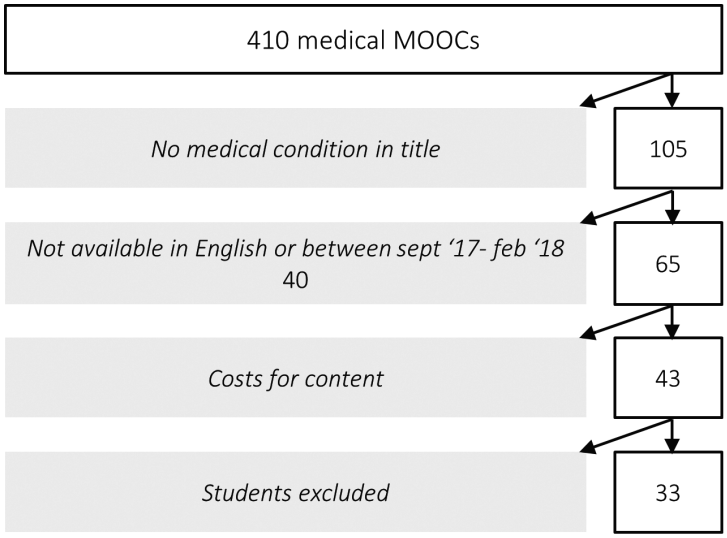


Figure 1. MOOC inclusion process.

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 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, 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 re-examined 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 & Benbunan-Finch, 2006) was utilized to categorise all teaching approaches as *Objectivist-Individual*, *Objectivist-Group, Constructivist-Individual* or *Constructivist-Group*. Categorisations 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 categorised 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 considerable 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 via 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 fifteen of these courses, staff or instructor 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 figure 2 and 3. Formal assessment structures, or assessments that had to be concluded for graduation of the course were found in 88% (29).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 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. 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.

Table 1A. Presence of teaching modes in investigated MOOCs.

MOOC no.	Instruction modes												Interaction modes					Assessment modes				Multifunctional modes		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
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				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 1B. Specification for designations in table 1A.

Instruction modes	**A**	Digital text or textbook
	B	Recorded traditional lecture
	C	Independent activities related to content
	D	Links to external online resources
	E	Prompts to use external links
	F	Video of instructor talking to camera*
	G	PPTslideswith voiceover
	H	Audiofiles
	I	Flashcards
	J	PPT slides
	K	Illustrations or simulations
	L	Thoughttrees or word clouds
Interaction modes	**M**	Discussionboards for asking questions
	N	Discussionboard answering questions prompted
	O	Discussion boards for discussing course materials
	P	Prompts to respond to peers
	Q	Discussion board prompt to introduce oneself
Assessment modes	**R**	Multiple Choice Questions
	S	Open ended question with short answer
	T	Open ended question peer reviewed
	U	Open ended question with long answer
Multifunctional modes	**V**	Virtual patient cases
	W	Virtual microscope activities
	X	Games

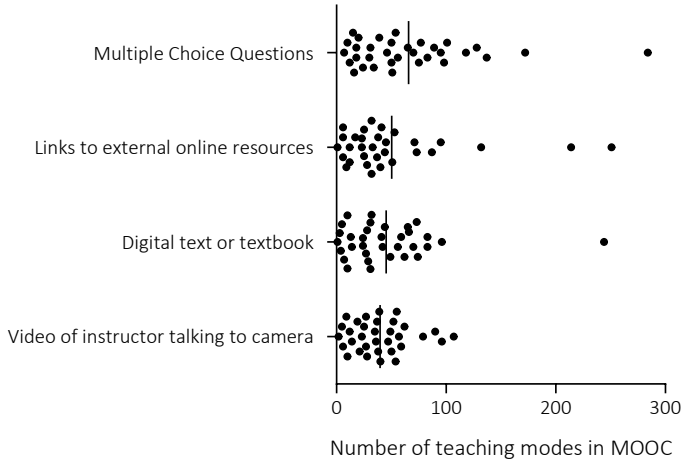


Figure 2. Wide distribution of number of teaching modes.

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 categorisation by Toven-Lindsey et al. (2015), fifteen teaching modes were categorised into social-epistemological dimensions (table 2). Including the modes previously categorised, of 29 teaching modes, 45% (13) were categorised as Objectivist-Individual, 3% (1) as Objectivist-Group, 31% (9) as Constructivist-Individual and 21% (6) as Constructivist-Group. Of the investigated courses 6% (2) only included teaching modes that are in the Objectivist-Individual and 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 favoured individual teaching modes, with a maximum of 100% and a minimum of 60% of the course teaching modes being individually oriented.

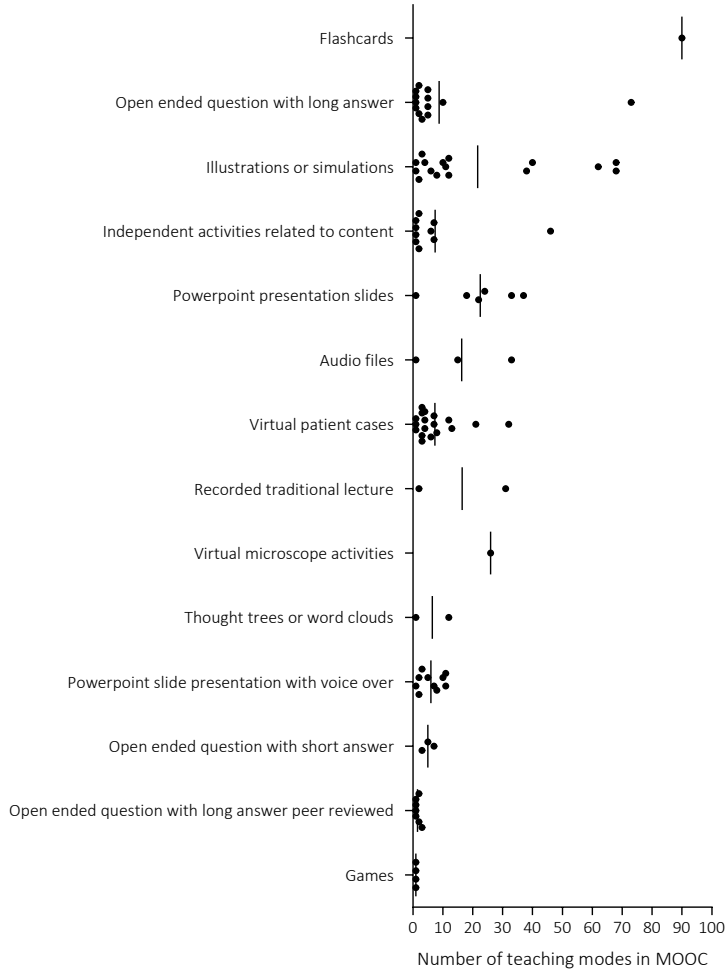


Figure 3. More narrow distribution of number of teaching modes.

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

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 dialogue				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

differs in variety and amount of teaching modes. Many of the investigated courses focus on constructivist teaching modes and few focus on group learning. Implications for 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 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 adapters' 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 three 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 into 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 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 & Crocombe, 2017). Medical MOOCs have also been said to be mostly 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 (Goldberg & Crocombe, 2017; Haywood et al., 2015), 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 focussing on specific epistemological dimensions.

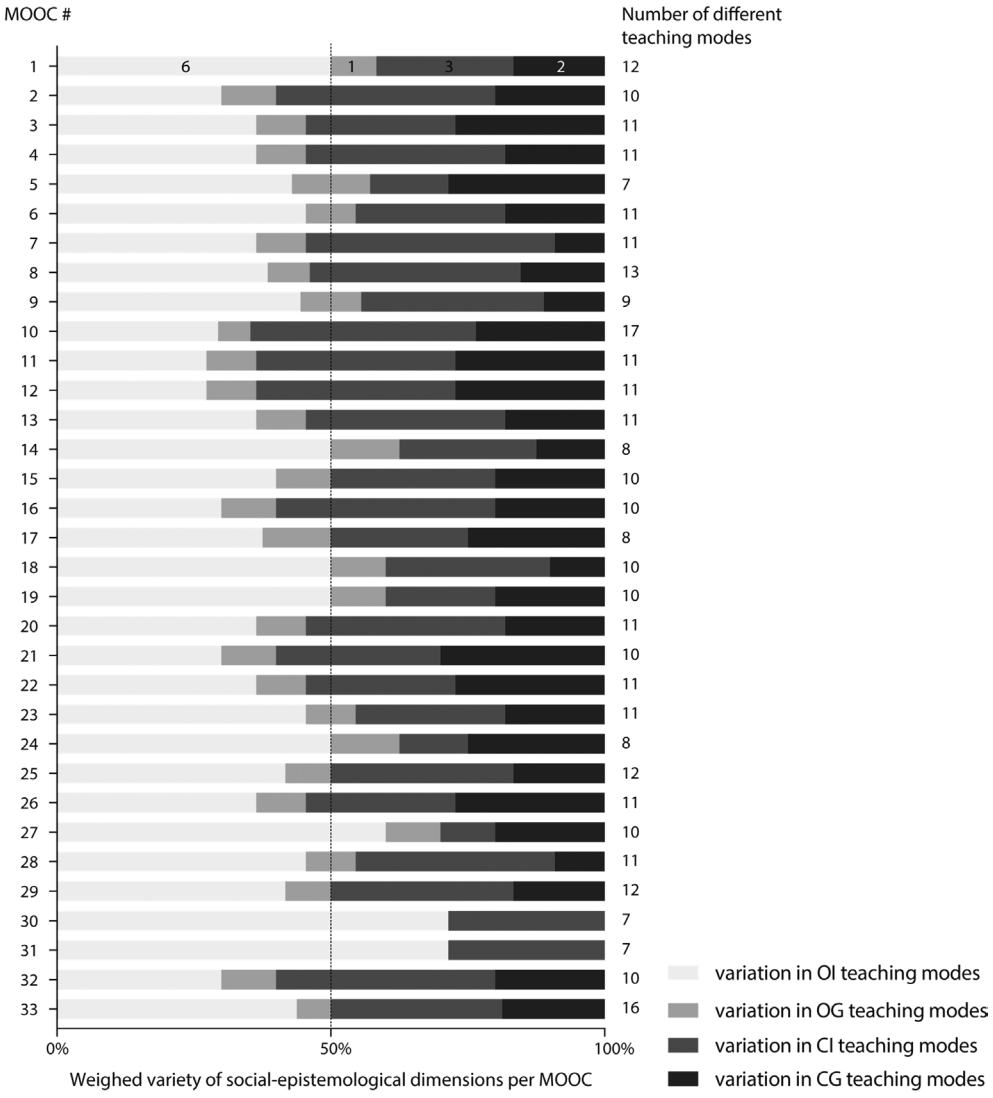


Figure 4. Weighed variety of social-epistemological dimensions.

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 & 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 & Johnson, 2009). 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 & 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 about 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 behaviour) and learner behaviour 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 behaviour is has become a constructivist-group activity. In the current study, we have coded the design. This means the categorisation of teaching modes into dimensions should be seen as a starting point or guideline. It also means that both additional instructions and student behaviour 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 in 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 enrol to access this information, and depending of the starting date of the MOOC some content might still be unavailable. Additionally, when a 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 of 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 (Kizilcec et al., 2017; Littlejohn et al., 2016). 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.

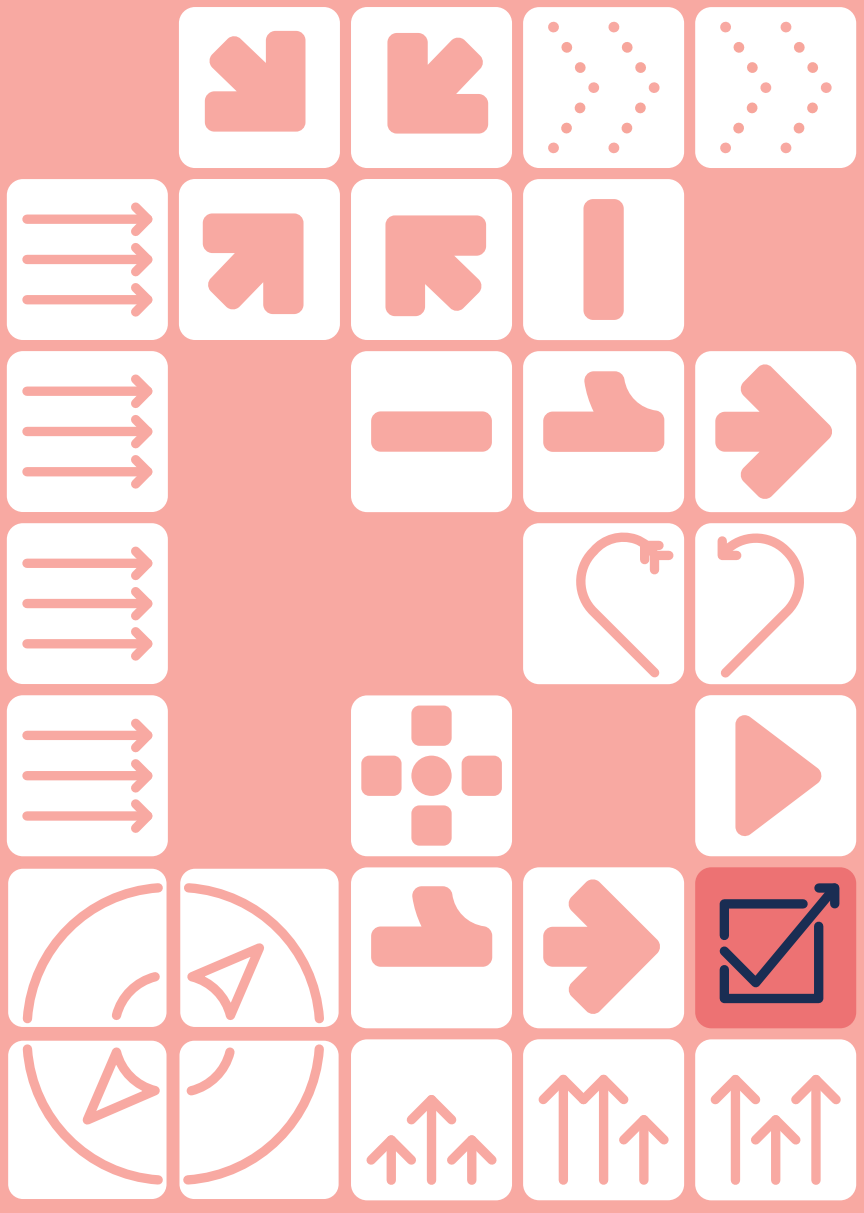
Conclusion

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.

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.

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.

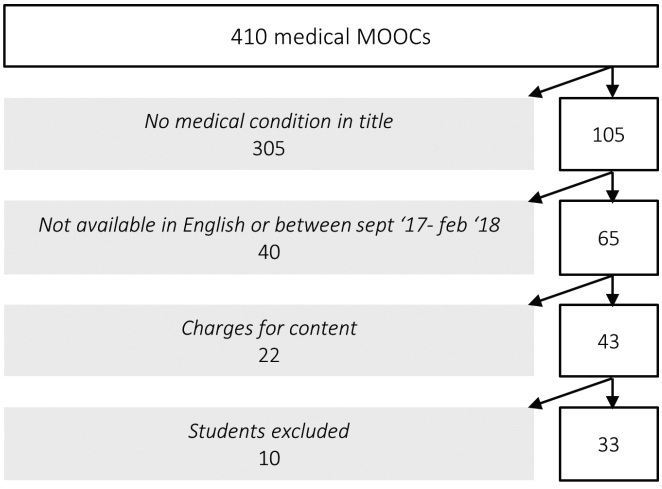


Figure 1. MOOC inclusion process (Hendriks et al., 2019).

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.

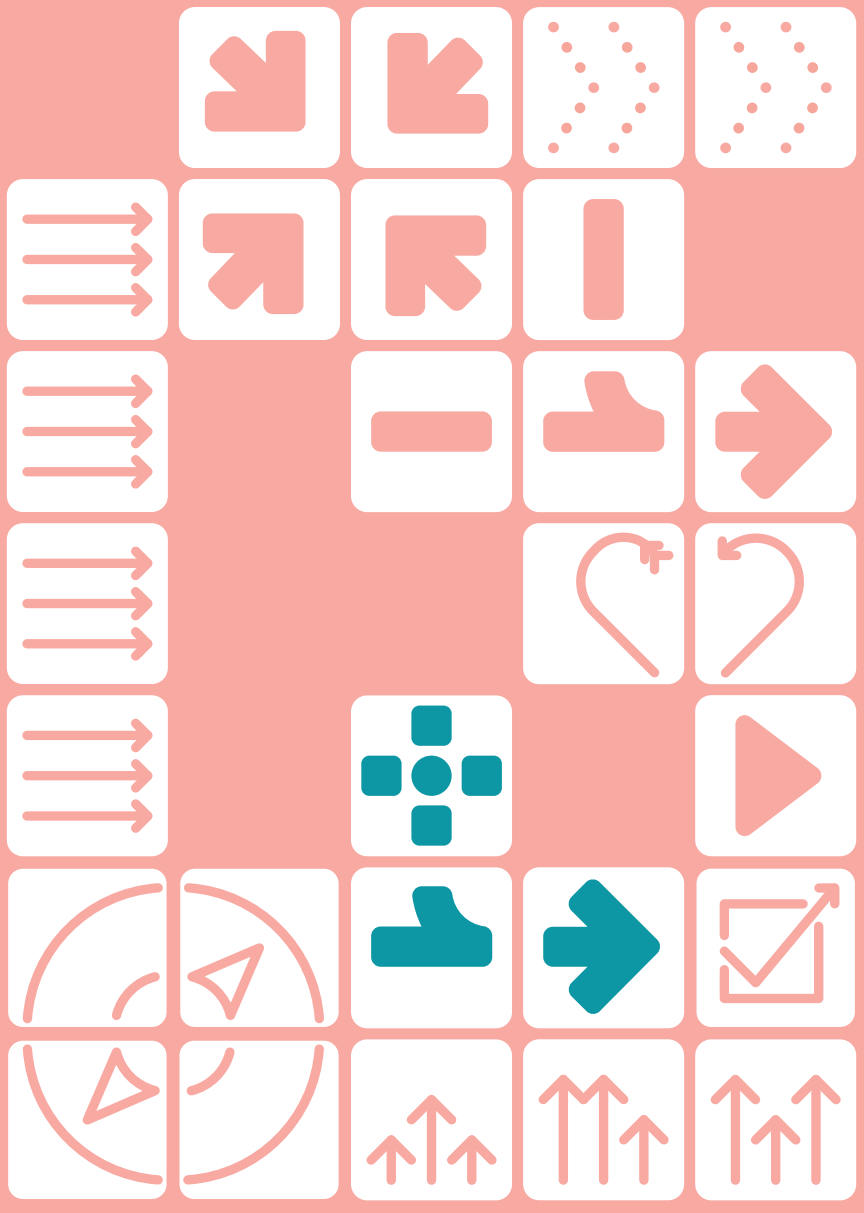
Conclusion

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

CHAPTER 4



Development and Application of a Massive Open Online Course to Deliver Innovative Transplant Education

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Abstract

Massive Open Online Courses (MOOCs) offer an entirely new course concept for delivering content and engaging learners. This method of teaching has huge potential for the field of transplant education. In this study we describe the development and implementation of the MOOC “Clinical Kidney, Pancreas and Islet Transplantation”. Three and a half years after the introduction of the course, the learning demographics have been analysed. The majority of learners were from Europe, North America and Asia. The course has been offered at several different stages of education at Leiden University Medical Center from undergraduate to continuous medical education. The level of engagement with the content was associated with the background and motivations of the learners. 74% had a bachelor’s degree or higher. 48% of the undergraduate students participated in other content than instructed. Learners reported having liked the design of the course. Personal growth was the main motivation for 93% of worldwide learners. 69% considered the content of the MOOC to be relevant to their job. In general student’s intentions focused more on reasons of personal growth, general interest, and relevance to school or degree program. Overall the integration of the MOOC in different settings of formal transplant education offered an added value to the on-campus program.

Introduction

Medical education has evolved enormously over the last decade. Following this trend, the field of nephrology and transplantation has also experienced several educational innovations resulting in the development and implementation of new technologies (Woods & Rosenberg, 2016). One of the new interesting technologies for transplant professionals are Massive Open Online Courses (MOOCs) (Harder, 2013; Reinders & de Jong, 2016; Yuan & Powell, 2013). MOOCs are online courses, mostly created by universities and institutions from around the globe, that are often accessible without any costs or pre-requisites. Medical MOOCs offer health care professionals across different disciplines the opportunity to study the latest developments in their field in a place and time-independent way. Although the number of medical MOOCs available worldwide is quite high, early 2020, only 4 MOOCs are being offered in the specific field of organ transplantation and donation (Table 1).

Table 1. An overview of available MOOCs on the topic of transplantation and donation as of January 31, 2020.

Title	University	Platform	Length
Clinical Kidney, Pancreas and Islet Transplantation	Leiden University, Netherlands	Coursera	4 weeks
Liver Transplant: the Ins and Outs	University of Birmingham, UK	FutureLearn	3 weeks
Trasplante de órganos - desafíos éticos y jurídicos | Organ Transplantation - Ethical and Legal Challenges	Universidad Autónoma de Madrid, Spain	edX	9 weeks
Organ Donation: From Death to Life	University of Cape Town, South Africa	Coursera	4 weeks

Source: classcentral.com search engine for free online courses.

In addition to using MOOCs as informal transplant education for interested learners worldwide, the freely available courses can also be used in formal curricula for medical students or professionals. Using MOOCs from other institutions offers several advantages including the possibility to use “exemplar” learning materials made by external experts in the field without the need for developing any new teaching materials. Research shows that MOOCs offer a rich variety of teaching modes for instruction, interaction, and assessment, and because of that may contribute to innovative ways of teaching and addressing the personal learning profiles of students. (Doherty et al., 2015; Hendriks et al., 2019; Pickering et al., 2017; Sarkar & Bharadwaj, 2015; Sharma et al., 2014). For students, it offers them access to materials outside of their university’s curriculum without having to travel abroad or incurring any expenses, while they can still communicate with international communities of clinicians and student clinicians active in the course. For institutions that are interested in hosting their own courses, once a MOOC has been created it can be used multiple times without extra effort or costs.

With these considerations in mind, in 2016 a team of transplant professionals at Leiden University Medical Center (LUMC) together with the Centre for Innovation of Leiden University in the Netherlands launched a MOOC entitled "Clinical Kidney, Pancreas and Islet Transplantation" as part of a university-wide program to develop MOOCs on the Coursera platform (Reinders & de Jong, 2016). The MOOC content has been developed in collaboration with medical, educational and technological experts and is being offered worldwide as well as an integrated part of the local curriculum. In this article, we provide an overview of the development of the course and the different ways in which we employ the course at several different stages of education at LUMC including undergraduate, graduate, resident and continuous medical education. We present socio-demographic data, user feedback and an insight in the intentions of our learners to engage with the MOOC materials.

Materials and methods

Development of the MOOC

The MOOC on kidney, pancreas and islet transplantation was developed to target health care professionals who work in the preclinical and clinical transplant field as well as medical students and biomedical research students (Reinders & de Jong, 2016). A large multidisciplinary team of transplant professionals, educationalists and instructional design professionals worked together for almost one year to develop and create the course content. The E-tivities framework by Salmon was used to create online activities enabling active and participative learning to develop clinical reasoning skills (Salmon, 2013). The final result was hosted on the Coursera online learning platform that offers massive open online courses and fully online degree courses worldwide. At its launch, the course was endorsed by various professional organizations, including the European Society of Organ Transplantation, the Transplantation Society, the International Society of Nephrology and the European Society of Pathology and the European Federation for immunogenetics (EFI). In 2018 the MOOC has been accredited for Continuing Medical Education (CME) for health care professionals as part of their requirement to obtain a certain amount of CME-credit hours to maintain their licenses.

Delivery to the world

Starting January 2016, the MOOC is being offered to interested learners worldwide free of charge. After completion of the course, learners are invited to share their learner stories online on the MOOC platform, and an optional certificate of completion is available at a modest fee. Data from January 2016 until October 2019 offered by the Coursera platform analytics dashboard have been collected to determine key socio-demographic characteristics of the learners like gender, age-group, countries and regions, continents, and their highest education level. Enrolment intentions of learners for this course were assessed with the

Online Learning Enrolment Intentions (OLEI) scale as published by Kizilcec and Schneider (2015). Learner stories posted by the learners have been collected.

Integration in the curriculum

Besides informal use in graduate, resident and continuous medical education at LUMC, the MOOC has also been offered in the formal curricula of the second year of medical school, the Leiden University Honours program, and the international Leiden Oxford Transplantation Summer School (LOTS) (Fig. 1) (Leiden University Website 2019a). In the second year course "Chest and Kidney" (CK) various videos, the discussion forum, and a clinical patient case assignment in the MOOC are used as optional learning materials, while in the "Mechanisms of Disease" course (MOD) two chapters of the MOOC actually replace several days of traditional classroom teaching (compulsory materials). For the Honours program, designed as an additional program for ambitious and inquisitive Bachelor students, the learners need to complete the regular MOOC, and they need to complete the additional in-depth insight MOOC-assignments that were designed for the Honours track, to obtain the basic plus Honours course certificate. Additionally, these students need to work on an individual reflective assignment where they summarize what they have learned, which is graded by the course instructors.

For LOTS the MOOC is a mandatory preparation activity and submitting the course certificate as proof of completion is a requirement to be admitted to the on-campus part of the program. This annual summer school is designed for biomedical and medical students where 20 international students interested in transplantation and clinical research are admitted after selection. Student's satisfaction with the materials was assessed with an anonymous questionnaire using a 5-point Likert scale, and their enrolment intentions for the course were measured with the OLEI scale.

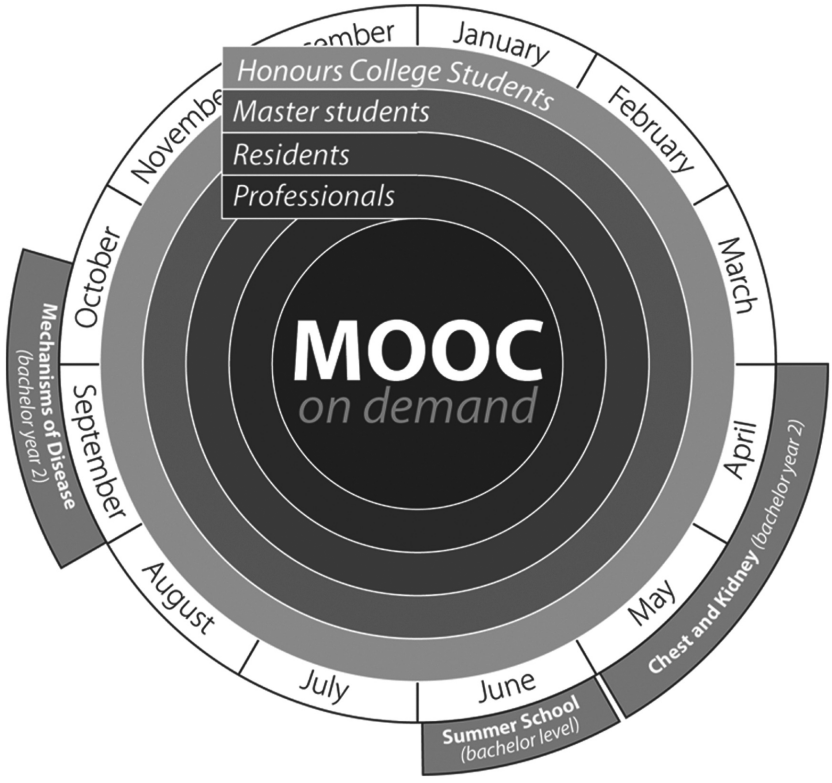


Figure 1. Integration of the MOOC on "Clinical Kidney, Pancreas and Islet Transplantation" into the local curriculum. In the formal medical school curriculum of LUMC, the MOOC has been integrated in two regular courses, "Chest and Kidney" (CK) and "Mechanisms of Disease" (MOD), and as mandatory preparation for the annual summer school (LOTS). Additionally, the complete MOOC is being offered with credits as an elective course for Leiden University Honours students, for students from participating universities worldwide in the Virtual Exchange program, and for residents and professionals as part of their requirement to obtain CME-credit.

Results

The layout of the MOOC

The course contains 4 separate 1-week modules addressing 1) before trans-plantation, including different aspects of the immune system; 2) the surgical procedures and the challenged patient, including patients with diabetes, highly immunized and elderly patients; 3) early challenges after transplantation including surgical complications and acute rejection; and 4) late challenges after transplantation including infections, malignancies and fibrosis of the kidney and tolerance. Each weekly module is extended with an Honours track offering additional in-depth insights into specialist subjects with extra assignments for those students who wish to obtain advanced knowledge on transplantation beyond the general learning objectives of the course. Every module offers a range of instructional tools

in the areas of instruction, interaction and assessment (Fig. 2A). Innovative teaching modes such as virtual patients, serious games, 3D animations and virtual reality 360° videos of the operating theatre were added to the course to engage students in their learning process (Fig. 2B-2E).

A

Teaching mode profile	MODULE 1 Before the transplant		MODULE 2 The procedure and the challenged patient		MODULE 3 Early challenges in transplantation		MODULE 4 Late challenges in transplantation		TOTAL COURSE
Instruction	*Amount*	*Amount HC*	*Amount*	*Amount HC*	*Amount*	*Amount HC*	*Amount*	*Amount HC*	*Amount*
Digital text or textbook	11	2	3	3	5	3	3	2	32
Independent activities related to content	-	-	1	-	1	-	-	-	2
Video of instructor talking to camera	11	1	12	2	10	2	10	2	50
PowerPoint presentation slides	6		7		4		6	1	24
Illustrations or simulations	1	1	-	1	2	3	2	3	13
Links to external online resources	19	10	27	23	54	13	60	12	218
Prompts to use external link for activities in the course									✔
Virtual reality 360° video			2						2
Interaction									
Discussion boards available for freely asking questions									✔
Discussion board posts answering questions prompted	1	1	2	1	3	1	3	1	✔
Discussion boards available for discussing course materials									✔
Prompts to respond to peers	2	1	2	1	3	1	3	1	✔
Discussion board prompt to introduce oneself	1								✔
Assessment									
Multiple Choice Questions	13	5	12	5	16	5	47	14	117
Peer reviewed open ended question with long answer	-	1	1	-	1	-	-	1	4
Open ended question with long answer		1	3	2	1	2	7	1	17
Multifunctional									
Virtual patient cases	2	1	5	3	4	1	6	1	23
Games	-	-	1	-	1	-	-	-	2

HC = optional Honors Content

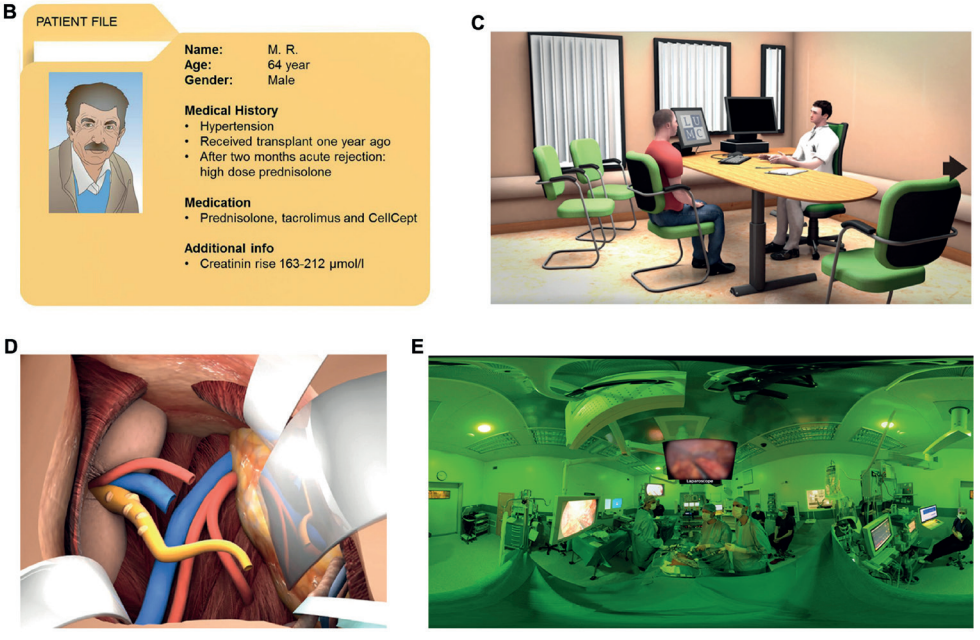


Figure 2. Different teaching modes in the MOOC on "Clinical Kidney, Pancreas and Islet Transplantation". Different teaching modes in the MOOC are listed per module (A). For every module, the teaching modes are divided into the standard module and the optional Honours track. Examples of teaching modes such as virtual patients (B), serious games (C), 3D animations (D) and virtual reality 360° videos of the operating theatre (E) are available in the MOOC.

Usage in the worldwide track

Since its launch until October 1, 2020, 14,996 unique learners worldwide enrolled in the course, of which 9959 actually started the course (66%). In total 1189 learners (7.9%) passed all assessments and were issued a course certificate. For 10,716 users, socio-demographic data were available by subtracting them from Coursera's platform-wide demographic survey and learners' user profiles. Regarding socio-demographic characteristics, while the majority of learners of our MOOC live in Europe, followed by North America and Asia, participants originated from over 90 countries (Fig. 3A). Seventy percent of our learners were between 18 and 34 years of age (Fig. 3B). The majority of the learners (74%) had a bachelor degree or higher, compared to 70% with Coursera in general (Fig. 3C). Between June and December 2017, 29 OLEI surveys were completed by learners worldwide. Their enrolment intentions are shown in Fig. 3D. Worldwide learners score high on the topics of personal growth and enrichment, general interest in the topic, prestigious university/professor, and relevance to job or school/degree program.

112 learner stories posted from January 2016 until February 2020 have been collected and coded into the global domains of learning goals, the achievement of goals, design and format of the course, and gratitude to the teaching staff. In these stories, 14% of the learners specifically mentioned that they liked the design and format of this MOOC. 30% of the learners stated their personal learning goal(s) for taking the course, and 74% of those learners confirmed reaching their learning goal(s) upon finishing the MOOC. The majority of the learners (75%) expressed gratefulness towards the staff for making the course available. Many of these learners stated that their country or hospital lacked transplantation centres and thus lacked opportunities for them to study this subject.

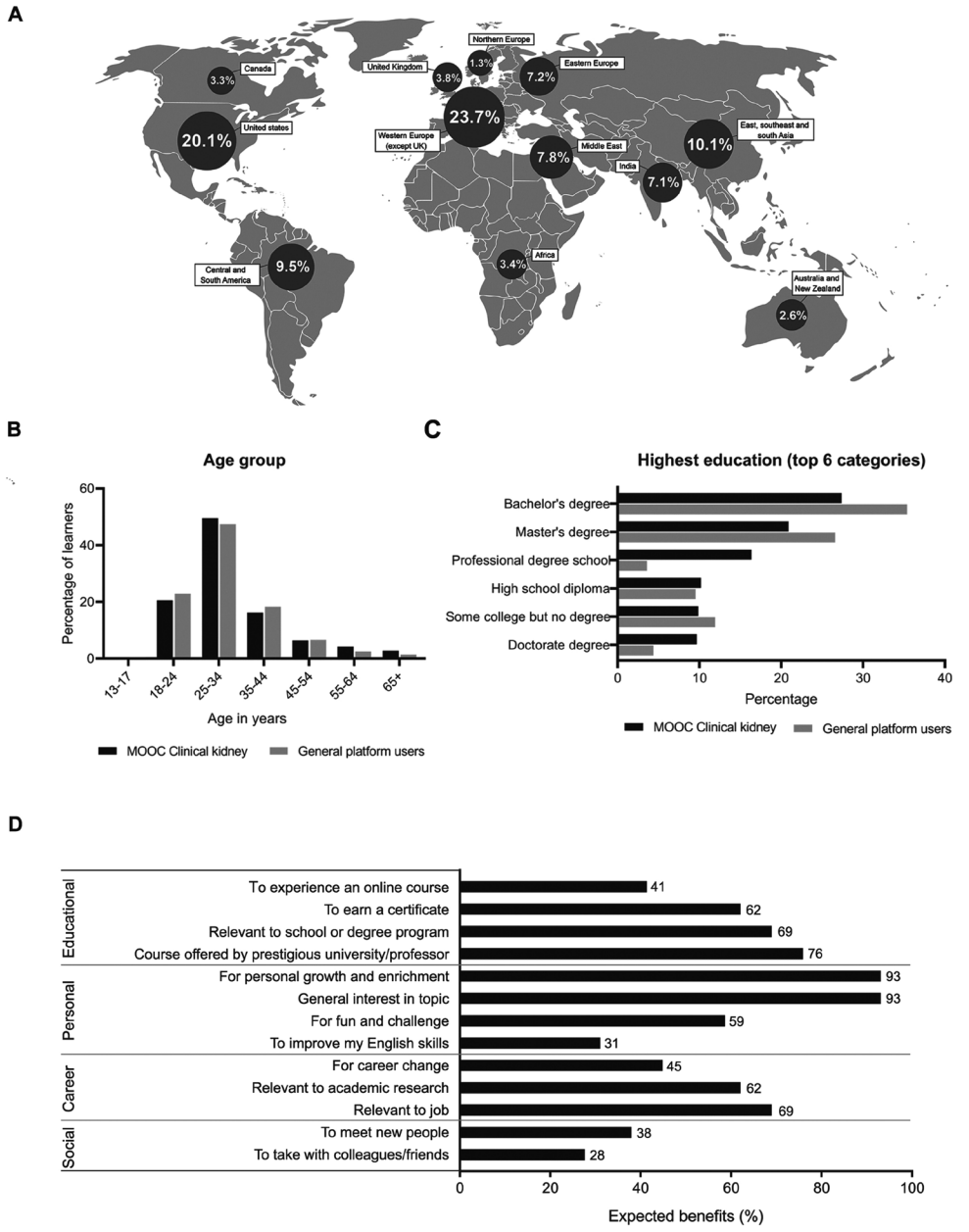


Figure 3. Socio-demographic characteristics in the MOOC on "Clinical Kidney, Pancreas and Islet Transplantation". Data from 10,716 individual learners were subtracted from the Coursera's platform-wide demographic survey and the learners' user profiles. Learners' current countries of residence were demographically depicted (A). The age (B) and educational status (C) of learners from the MOOC on "Clinical Kidney, Pancreas and Islet Transplantation" were compared to learners from all the courses available at the Coursera platform. Using the OLEI scale enrolment, intentions of worldwide learners were assessed (D).

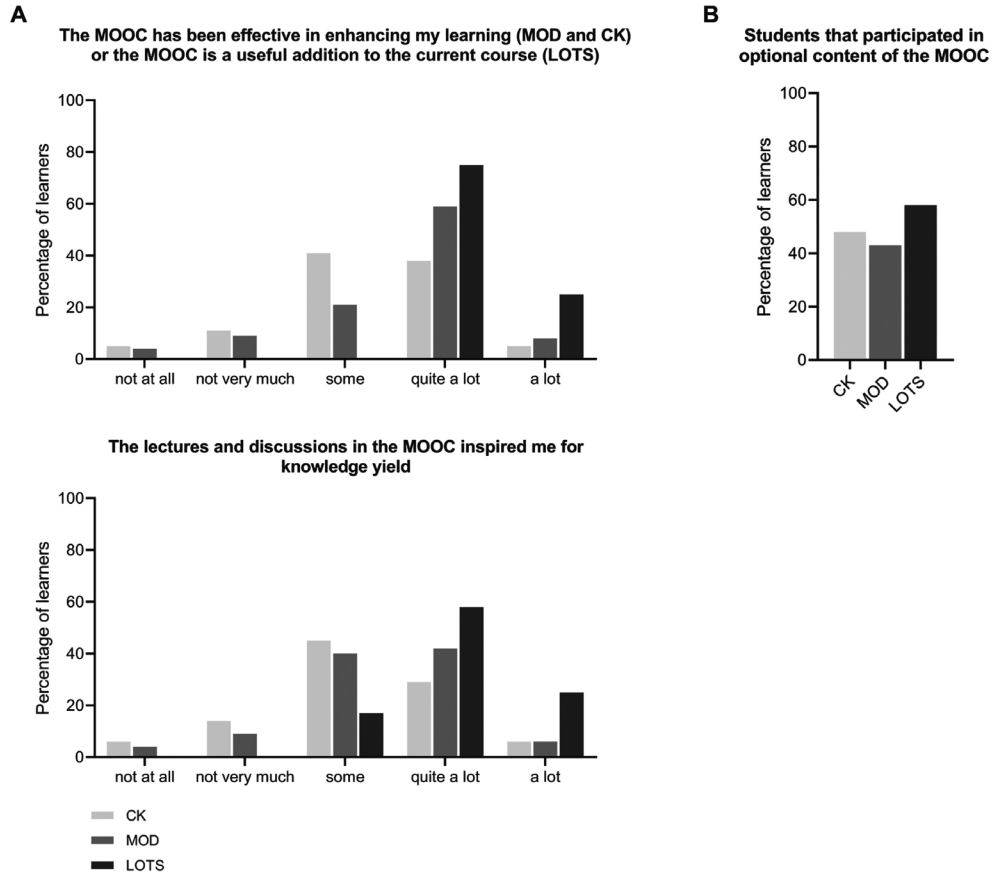


Figure 4. Student engagement of local curriculum students within the MOOC. Student engagement within the MOOC was assessed using an online questionnaire. (A) shows student responses to the question if the MOOC was effective in enhancing their learning (MOD and CK students) or if the MOOC was a useful addition to the current course (LOTS students). (B) shows student responses to the question if the MOOC content inspired them for knowledge yield. (C) shows the response to the question if students participated in extra content of the MOOC alongside the mandatory content.

Usage in the in-campus tracks

In the academic year 2016–2017, 325 students were enrolled in the CK and MOD courses and 20 students were admitted to LOTS. Student's satisfaction with the materials was assessed with a questionnaire, to which 50 students in CK (15%) and 53 students in MOD responded (16%). For LOTS 12 responses were received (60%). The survey focused on three topics: was the MOOC a useful addition/enhancement for learning; did the content of the MOOC inspire the students; and did students participate in more content than instructed. Respondents indicated that the MOOC elements were an interesting addition to the face to face curriculum and that the online lectures and discussion forums were inspiring (Fig. 4A-B). Of the undergraduate students in CK and MOD, approximately 46% explored to some extent parts of the MOOC

other than those that were mentioned in the assignments, while 58% of the LOTS students indicated they did (Fig. 4C). Between June and December 2017, a total of 52 OLEI surveys were completed by LOTS participants (16) and medical students in the MOD course (36). MOD students scored high on the topics general interest in the topic, relevance to school or degree program, and personal growth and enrichment. LOTS students scored high on general interest in the topic, relevance to school or degree program, relevance for academic research, personal growth and enrichment, and fun and challenge (Fig. 5).

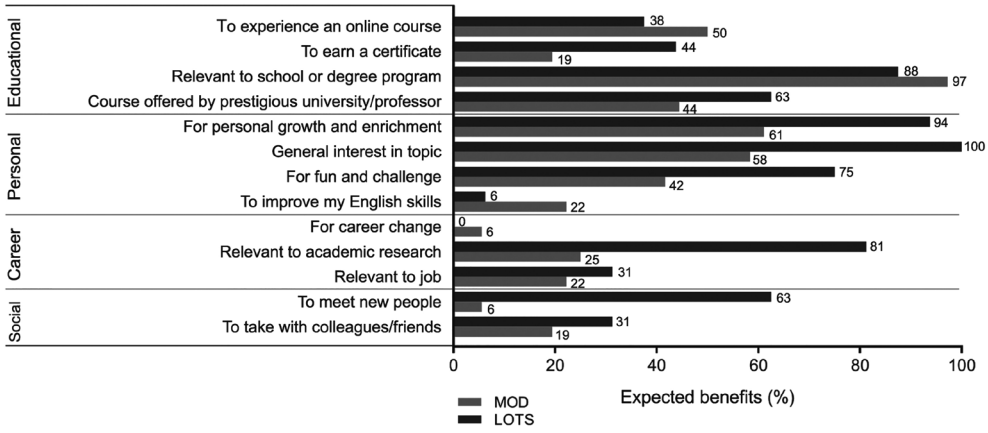


Figure. 5. Student intentions for enrolment in the MOOC. 36 MOD course students, 16 summer school participants and 29 worldwide learners sent in their intentions for enrolment in the MOOC course. Learners could select multiple options.

Discussion

In the last few years, MOOCs have become very popular in higher education. The first MOOC was launched in 2008 and tended to be focused on exploration and discussion rather than instructor-provided content, but over the years the course design has evolved into many different formats each with their own dynamics (Downes, 2008; Pilli & Admiraal, 2016). Regardless of the differences between these formats, all MOOCs have several powerful concepts in common, such as accessibility for students worldwide without traveling abroad or extra costs, time and place independent learning, and opportunities for learners to communicate with international medical students and specialists. Obviously, MOOC technology offers learners in under-resourced countries with a unique possibility to access information otherwise unreachable.

MOOCs are of interest to students and transplant professionals as our learner distributions and evaluations show. Learners can study at a convenient place and time by watching short video lectures, taking interactive quizzes and completing games and assessments. They

also have the ability to study at one's own pace depending on pre-existing knowledge and experience, and to follow a self-determined path through the materials offered. In the online environment, learners can actively engage with a large group of intrinsically motivated peers, fellow learners as well as instructors, involved in the online discussions and assignments. It is known that such group learning activities promote deeper learning (Hendriks et al., 2019; Kirschner et al., 2008; Merrill, 2002). The wide diversity of our learners regarding age and professional background, and the explicit acknowledgements of learners in the learner stories indicate that the MOOC clearly meets the needs of many transplant learners worldwide. The online course offers professionals from around the world a convenient way to stay informed of the latest developments in the field.

Our findings show that MOOCs are not only useful as stand-alone professional development resources in transplant medicine but can also be effective as integrated materials in a wide range of educational contexts from undergraduate to post-graduate teaching. Initially, this practical use of MOOCs as a learning tool in regular classroom teaching was under discussion (Bateman & Davies, 2014; Mehta et al., 2013; Prober & Heath, 2012; Reich, 2015). And although MOOCs originally have been designed for learners in the world outside of university, nowadays more and more institutions explore ways to integrate online courses into medical school curricula (Prober & Heath, 2012; Robinson, 2016; Swinnerton et al., 2017), in continuing professional development programs (Gandhi, 2014; Murphy & Munk, 2013; Pickering et al., 2017; Power & Coulson, 2015; Subhi et al., 2014), and in inter-professional education (Kirch & Ast, 2015). We experienced that integrating an online course in the second year courses CK and MOD offered interesting assets such as time and place independence, exposure to high-quality materials, activating teaching modes, and online connections with peers, inspiring some of the students to dig deeper in the field of transplantation medicine. Although not assessed in this study, the educators in the LOTS program experienced a noticeable increase in the prior knowledge level of students on entering the program since the introduction of the online course as a mandatory preparation activity. While in the past the first day of the classroom program was entirely spent on bringing all participants to the same knowledge level, now the students come in well prepared and the on-campus activities can immediately address more detailed and engaging content which is very satisfying for the students as well as the teachers.

Our results show that learners have different intentions for participating in online education. For undergraduate students, it is often mandatory to enrol in the course as part of the curriculum. It is understandable that these students focus more on the relevance to school or degree program and are often not motivated to do anything more than required. On the contrary, summer school students and professionals in the worldwide track show different enrolment intentions related to a job, career, research relevance, connections and personal growth. In our study, the engagement of the LOTS students with the online materials and participation in discussion forums was clearly higher compared to the medical students.

Although this outcome is not surprising, it is extremely important to know the audience well before integrating online resources into classroom teaching. Depending on the intentions and motivations of the learners involved, one might select a different strategy to integrate.

Although the integration of online content from courses such as MOOCs is being more and more explored in medical education, it still is not an easy process. To successfully integrate MOOC content into a classroom setting, several conditions need to be met (de Jong et al., 2019). The content needs to be on the right educational level, of sufficient educational quality as well as scientific quality, the course needs to be accessible at the time of teaching, appropriate teaching modes need to be available and the learning goals and the social-epistemological dimensions of the course need to be brought into alignment with the classroom activities (Hendriks et al., 2020a). Several reports in the literature show that this is very well doable, but it is of great importance that the educator is aware of these aspects before integration is implemented.

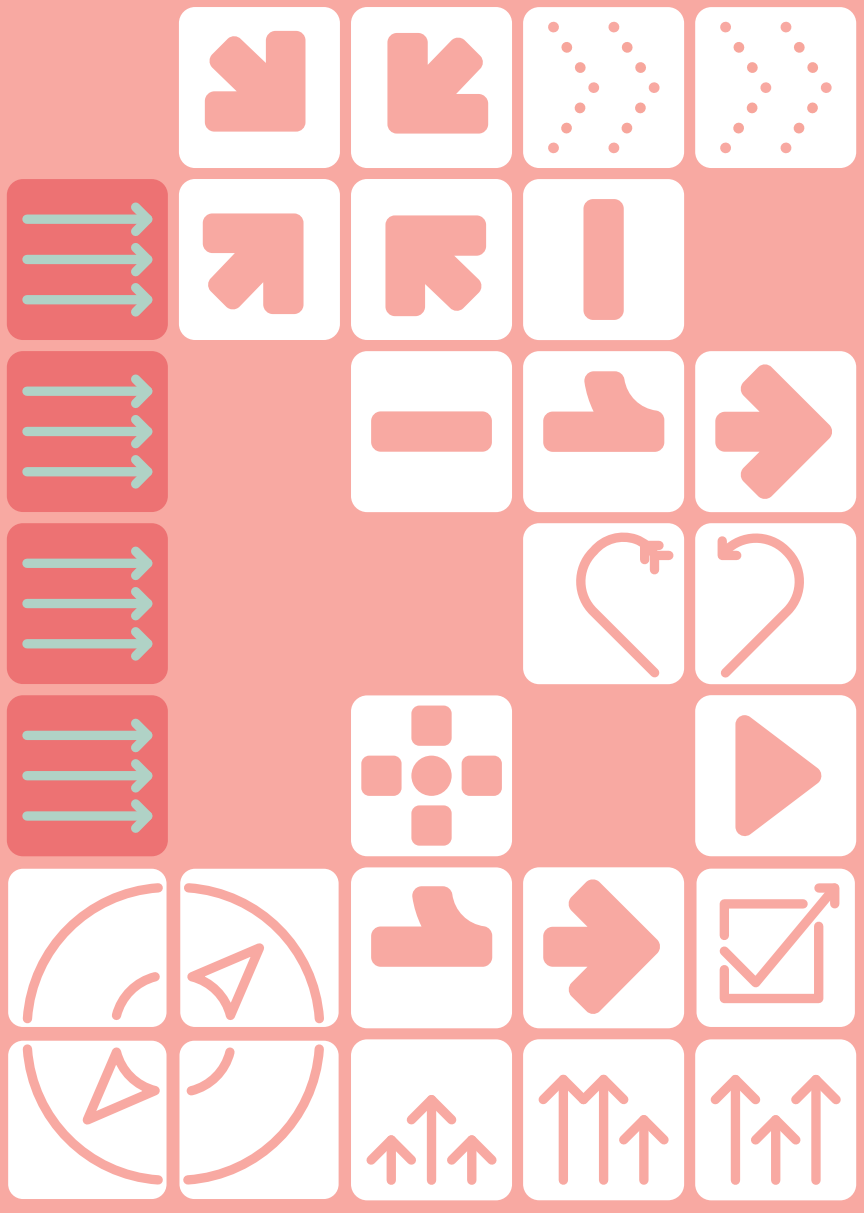
Overall, creating a new MOOC is a time-consuming activity and requires lots of resources, financial as well as faculty time (Pickering et al., 2017). To better utilize the wealth of available learning resources, schools worldwide are forming consortia in which students can follow online courses from another institution while being awarded the official educational study credits for it at their home institution. Leiden University started such a 'Virtual Exchange' program with 11 other universities worldwide, in which the MOOC on kidney transplantation has been included (Leiden University Website 2019b).

The Massive Open Online Course on Clinical Kidney, Pancreas and Islet Trans-plantation has successfully been integrated into different settings of formal transplant education, including on-campus classroom teaching as well as distance education. The materials, interactivity and online discussions offer added value to the on-campus program according to students. The level of engagement with the online content seems associated with the background and motivations of the learners. Further research is needed to identify the motivation profiles of the different groups of learners and to develop ways in which all students can be more encouraged to gain as much as possible from the content-rich resources in the MOOC.

Ethical considerations

The evaluation of course feedback provided by Coursera was conducted in accordance with the Coursera Privacy Policy. Survey results were collected strictly anonymous. The study and manuscript have been reviewed and approved by the Institutional Educational Research Review Board of the Leiden University Medical Center (reference: OEC/ERRB/20200310/1).

CHAPTER 5



Twelve Tips for Integrating Massive Open Online Courses Content into Classroom Teaching

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Medical Teacher, 2019

Abstract

Massive open online courses (MOOCs) are a novel and emerging mode of online learning. They offer the advantages of online learning and provide content including short video lectures, digital readings, interactive assignments, discussion fora, and quizzes. Besides stand-alone use, universities are also trying to integrate MOOC content into the regular curriculum creating blended learning programs. In this 12 tips article, we aim to provide guidelines for readers to integrate MOOC content from their own or from other institutions into regular classroom teaching based on the literature and our own experiences. We provide advice on how to select the right content, how to assess its quality and usefulness, and how to actually create a blend within your existing course.

Introduction

More and more massive open online courses (MOOCs) are becoming available in the field of medical education. MOOCs are a new way of delivering interactive learning activities to large numbers of participants worldwide. They offer the advantages of online learning and provide content including short video lectures, digital readings, interactive assignments, discussion fora, and quizzes. Creating a MOOC is a time consuming and resource expensive process which contains multiple steps (Pickering & Swinnerton, 2017). Although MOOCs originally have been developed for stand-alone delivery to students outside of the regular curriculum, schools around the world have started to integrate MOOC content from their own or from other institutions into the curriculum (Bralić & Divjak, 2018; Robinson, 2016; Swinnerton et al., 2017), with students indicating high satisfaction with the online materials provided as an inspiring addition to the traditional course materials (Aboshady et al., 2015). The use of open materials offers the educator opportunities for reforming and innovating regular face-to-face programs with easily available high-quality materials offered by other institutions. However effective integration of such resources is not an easy process. This article offers 12 tips for educators to consider before starting integrating MOOC content into their own teaching. Although we focus on MOOC content in particular, many of these tips are also relevant to integrating on-line material in general.

Tip 1. Clearly define what content you want to include in your course

Before you even start looking for MOOC content, it is important to have a clear view of what you are looking for. For many educators, this is already “in their head” which makes it very tempting to skip this first step but in order to make the following steps efficient it is advisable to define the scope in detail. What are the topics that lack in your teaching and which you want to supplement with outside resources? What kind of online activities do you envision your students to do? Is it more focused on reading materials or watching videos, or do you want your students to self-explore resources and discuss and collaborate with peers? For this, create a one-page detailed description of the integration you are looking to establish.

Tip 2. Determine the way you like to use the online materials

The second step is to determine in which way you envisage integrating the MOOC content you are going to find into your classroom course. The most basic way to use parts of the online course is to offer small elements like a reading or a video clip as additional learning materials to your face-to-face teaching. In this scenario, the student only enters the MOOC to study this particular element. A more intensive way to use a MOOC is to replace one or several teaching sessions in the classroom with some specific MOOC materials or sections, like one or two entire activities. A MOOC can also be offered in full, where participation in and completion of the course is conditional to enter a face-to-face training program. Finally, the MOOC can also be offered as a stand-alone online course, of which completion will be

rewarded by educational credits for the students. It is important to think the integration model through carefully, as it determines which kind of materials you need to select in a later phase and how to align these materials with the classroom teaching activities (see Tip 9). In selecting a scenario, take also into consideration that engagement of students with the online materials and the level of participation in discussion fora often seems to be higher in compulsory scenarios than in voluntary ones.

Tip 3. Search for MOOCs on the selected topic

Medical MOOCs can be found through MOOC search engines such as Class Central and MOOC List or through the platform websites themselves such as Coursera, EdX, Futurelearn, Udacity, or Canvas Network (Liyanagunawardena & Williams, 2014). Perform your search in medicine but also explore health or life sciences related categories. Often searches can be performed on content keywords, language, start date, level of the learner, skills that are taught, offering institution, or the availability of a certificate. Searches yield information about the course, specifically the objectives, target audience, course outline, number of study hours per week, number of weeks to complete the course and the associated costs. Take into account that search engines do not use the same databases and that search results may differ, with specific platforms only showing their own offerings. We, therefore, advise you to browse multiple engines and platforms when looking for a MOOC on your desired topic. The number of results you find might be high; already 511 medical courses were identified in 2017 through Class Central alone and the number keeps growing (Goldberg & Crocombe, 2017).

Tip 4. Determine the availability of the specific MOOC and its contents

Having selected the MOOC, understanding its accessibility in terms of availability and duration are essential for effective integration, especially if you want to tightly synchronize your classroom learning with the MOOC discussion fora or the presence of online moderators. The availability of courses varies from monthly to annually or biannually, and others being solely one-off events. The duration of courses varies from short 1-week courses to 6, 7, or 8 weeks being common. These course characteristics will largely be out of your control unless you are integrating a MOOC from your own institution into your teaching. To overcome timetabling restrictions there are a few solutions. First, most MOOC platforms allow users to continue accessing the course for several weeks after the official end date as long as they have enrolled onto the course during the relevant enrolment window. Second, some platforms like Coursera offer the option of “private sessions” to be created by the owner of the course, which can have tailored start and end dates and exclusively is focused on your students. Finally, most MOOC providers allow users to download content that can be repackaged and released to your students on your institutional learning management system. The main issue with all of these approaches is the loss of discussion with external peer students or moderators.

Tip 5. Gauge the credibility of the MOOC before deciding to integrate

Before you start doing more research into the complimentary availability of the MOOC (Tip 6) and making an assessment of its educational quality and key attributes (Tips 7 and 8), it is helpful to get a quick first impression of the credibility of the course. An easy way to do that is to rate the institution and instructors who developed and teach the course. Many MOOCs are being led by prominent scientists or leaders in their field and offered by leading international institutions. These "house-hold" names bring a level of credibility to the course. Realize that MOOCs are subject to a huge exposure from the outside world, and those individuals and schools will not hazard their reputation by delivering poor content. The credibility of the MOOC is particularly important for your students to offer them a high level of academic worth from participating in the course. If you really want to evaluate a course in more depth, there are many more variables to consider (Chapman et al., 2016). But, from our experience, we feel assessing the credibility is enough at this stage to move forward.

Tip 6. Ensure the MOOC content is freely available to your students

A key aspect of MOOCs is their openness regarding prerequisite qualifications, personal background, age, country of residence, and very little, if any, financial costs associated with participation. The only requirement is having a digital device and connection to the internet. It is, therefore, reasonable to encourage your students to enrol and utilize the open content alongside your existing course or program. However, caution is needed. Some aspects of the MOOC experience are being placed behind a pay wall. There is a financial cost attached to obtaining a certificate showing how much of the course has been completed including details about performance on assessments. Some MOOCs are also now credit-bearing, and obtaining these credits has a financial cost attached. More recently, some platforms have started to charge to allow longer-term access to the MOOC and its resources for more than a few weeks after the MOOC end-point, whereas previously enrolment on a MOOC generally allowed unlimited future access. Therefore, it is useful to check the access rules for the MOOC you are interested in, as they vary per course and per platform. Also, for each of the resources that you choose to use, you should identify the Creative Commons (CC) license attached to it, which specifies how you can use, edit, and share the material, and for what purposes. You should retain that license when you use the resource. If the resource does not have a CC license or copyright details specified, then it is good practice to check with the content providers that it can be shared.

Tip 7. Determine if the MOOC contains the desired teaching modes

Now you have identified one or more MOOCs you are interested in, check the courses for their availability of specific teaching modes by simply enrolling in the course as a student to find out what options are available. When browsing the course, it might be helpful to distinguish between instructional modes, interaction modes, and assessment modes

(Toven-Lindsey et al., 2015). Most MOOCs offer all of the three modes; however, some courses do so more abundantly than others. For instruction, materials like short videos, digital texts, illustrations, PowerPoint slides, audio clips, and links to external websites can be found. These instructional materials are generally information dense (Harder, 2013) and are well suited for students to prepare. For interaction, most courses offer discussion fora to introduce oneself, to ask questions or to discuss content-related topics. Interactions within MOOCs are extremely powerful due to the interesting audience of peer learners (Reinders & de Jong, 2016). A diversity of peer medical students, medical specialists, other health professionals, and even patients and their families from all over the world contribute to discussion fora of different kind (Goldberg & Crocombe, 2017). This offers an opportunity to learn about medical concepts from different perspectives, cultures, and religions. Most medical MOOCs include assessments consisting of automatically graded multiple choice quizzes and exams, automated or peer-assessed short open-ended questions, and open question that require a long answer such as a reflection or an essay (Reilly et al., 2014). Also, virtual patients and educational games are being used for assessing learners on clinical reasoning skills (Berman et al., 2017; Reinders & de Jong, 2016; Stathakarou et al., 2014; Subhi et al., 2014). Formal MOOC assessments usually include a combination of assessment modes, and for the integration into your course it is up to you if the MOOC assessment of your choice counts as a high or low stake assessment.

Tip 8. Determine the social-epistemological dimensions of the course

Teaching materials can be categorized into different social and epistemological dimensions of learning (Toven-Lindsey et al., 2015). When integrating MOOC materials, it is important to use materials in the appropriate dimensions relative to the rest of your course. For the social dimension, learning activities can be designed to either focus on learning individually or learning in a group. One of the basic tenets of the first MOOCs is that knowledge is something that exists in networks of people instead of in individuals and many MOOCs are, therefore, aimed at group learning (Bradshaw et al., 2017). As MOOCs have evolved, more traditional individual e-learning components have been implemented. Studies have described that campus students tend to not use the online interaction options when they also have access to their fellow students in other ways (Dandache et al., 2017; Swinnerton et al., 2017). Epistemologically, teaching can be focused on more objectivist or constructivist views on learning. Objectivist teachers consider reality to exist independently from the human mind, so teaching is essentially the transmission of known facts about reality (Arbaugh & Benbunan-Finch, 2006). Constructivist teachers consider reality to be located in the human mind, it is constructed as we experience it and thus multiple realities exist in multiple minds. Teaching is the cultivation of the constructing mind (Vrasidas, 2000). In general, objectivist approaches are more structured and thus might be more appropriate for novice learners while constructivist approaches rely on engagement with content and demand some maturity in task skills from the learners. To categorize teaching modes into

dimensions, the Teaching Approach Framework can be consulted which combines social and epistemological dimensions (Arbaugh & Benbunan-Finch, 2006; Toven-Lindsey et al., 2015).

Tip 9. Make sure you align the goals, the teaching activities, and the assessments

For integration of MOOC content in class, the challenge is to develop an integral concept in which the overall learning goals are aligned with the teaching activities and the assessment in which the students will show to have mastered the learning goals. The main theoretical model of constructive alignment is provided by Biggs and Tang (2011). As the integration of MOOC content in class will contain content from the MOOC and from your class, you should make a plan how to align goals, learning activities, and assessments of the chosen education material. Unfortunately, in many MOOCs goals are not well communicated. The study of Margaryan and colleagues (2015) demonstrated that in many MOOCs neither learning objectives nor learning outcomes were specified, and if they were specified they were largely not measurable. Thus, designing your own intended learning outcomes is necessary and learning goals should be made as measurable as possible. Assessment criteria should be designed which meet the intended learning outcomes. Assessments might be fully offered outside of the MOOC or (partly) within the MOOC using the assessments available. Ideally, all assessments, whether used in the MOOC or class should be bespoke (Pickering et al., 2017). However, although this feedback would be possible in the online environment of the MOOC, it is probably easier and more effective to offer the feedback outside the MOOC in class, as there is direct interaction with the students and alignment with your curriculum aims can be made clear.

Tip 10. Provide clear instructions to students on how to enrol onto the MOOC

With a MOOC or its content forming part of your classroom course you will need to inform your student cohort how to access this material and also why this approach is being taken. Traditional strategies, such as teaching guides, announcements, and institutional emails, will usually suffice, but it is important to get the specifics correct. If the MOOC you are integrating is running concurrently with your course you will need to clearly disseminate the URL and to let the students know when they must register by and that they will need to create a personal account with the host platform. As this is likely to be external from your own LMS, you will need to clearly disseminate the URL and perhaps provide detailed support to ensure the students are enrolled. This is particularly important if the MOOC content is to be undertaken during timetabled sessions.

Tip 11. Provide clear instructions to students on how to utilize the MOOC and its resources

A clear dialog with the student cohort will need to include the rationale for including this content, how you intend to use the resources, and what you expect the students to achieve. Are the resources supplementary to be used for consolidation or is the MOOC content standalone and covers specific learning objectives from the overarching course? And is

engagement with the content voluntary or compulsory? It is often needed to help students to understand their responsibilities in the online course as that differs from traditional classroom learning. Guide their new independence in learning by providing a list of tips on how to make the most out of such a massive and open learning environment and how to use the different content types offered most efficiently (Griffiths 2013). For example, watching the online lectures as part of a daily routine works better than trying to sit down and watch a week's worth of lecture videos in one sitting, or students watching videos together during class time and then discussing and absorbing important concepts together. Consider discussion activities from an inquiry perspective and ensure they encourage students to move from awareness to knowledge construction and finally to application (Garrison & Vaughan, 2008). A blended course with a MOOC requires students to learn in new ways in a probably unfamiliar online environment. If your group's size allows, it would be beneficial to facilitate the familiarization process by holding the first session face-to-face in a computer lab to show students how to navigate the MOOC.

Tip 12. Determine the success of MOOC integration

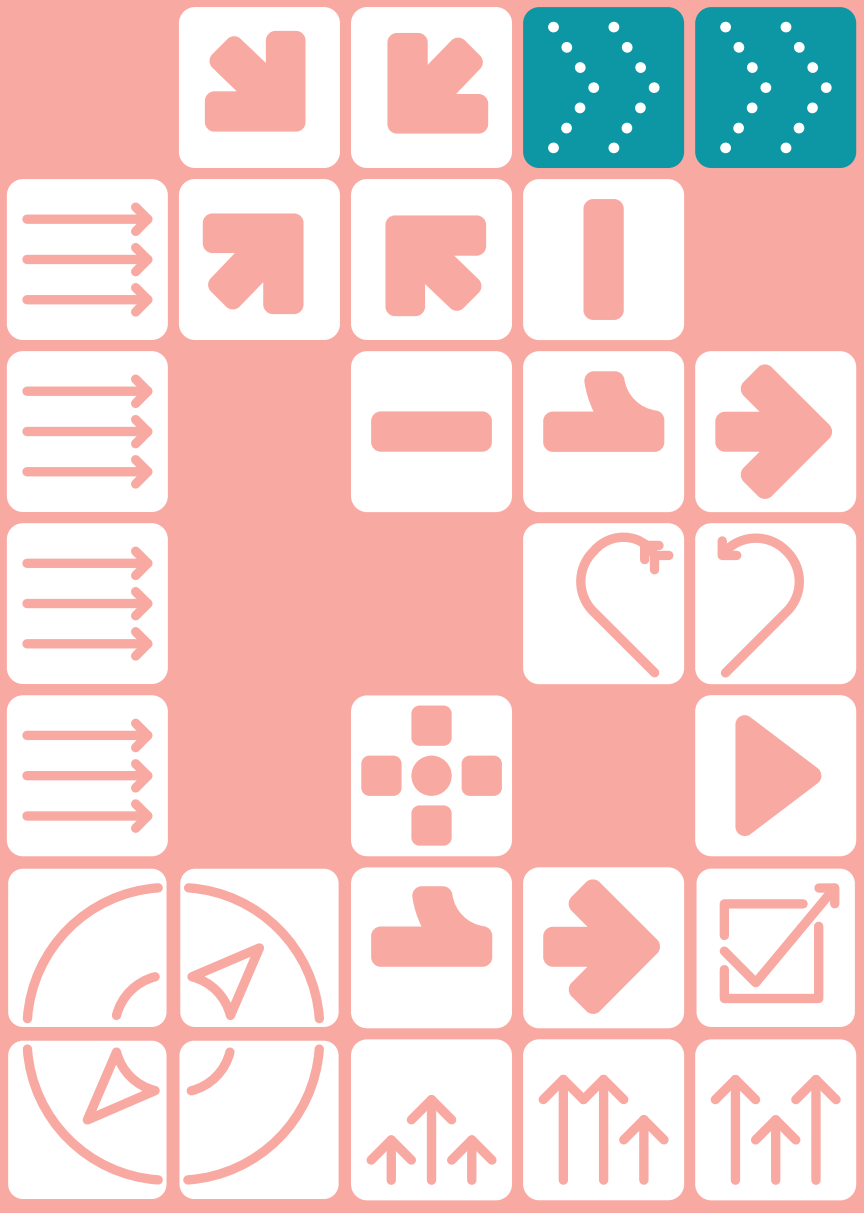
The integration of online digital content into campus-based courses is not uncommon (Swinnerton et al., 2017) however, the role of MOOCs as content providers is still nascent. It is therefore important to evaluate the impact the MOOC has made on the cohort of students who received the integration. Early research focused on the perceived success of MOOCs using platform-derived quantitative measures of participation, included the proportion of the MOOC accessed, time before drop-out, and completion rates (Deng & Benckendorff, 2017; Veletsianos & Shepherdson, 2016). Increasingly recent evaluations have focused on more nuanced quantitative approaches and qualitative analyses that aim to understand learner behaviour across a range of performance indicators. To evaluate the impact of MOOCs, you can use a range of research methodologies, such as a survey asking for your students' opinions about the MOOC and its value, an assessment which tests their knowledge gain, or activities where you can monitor and assess whether you think the activity is having the desired outcomes. If you are connected to the MOOC and the developing institution, you may be able to access log file data to explore your students' participation in more detail, and evaluate their engagement both quantitatively and qualitatively. In both cases, in order to assess the impact of the MOOC, you must have a clear rationale for why you chose this approach and what you hoped to achieve.

Conclusions

Effective integration of open materials offered from MOOCs into regular classroom teaching is not an easy process. By establishing a clear rationale on the topics you want to include in your teaching, the way in which you want to do that, the social-epistemological dimensions

you want to use most in the online teaching part, and the way you are going to instruct the students on how to engage with the materials, the process of integrating MOOC materials into classroom teaching becomes more efficient and effective.

CHAPTER 6



Uncovering Motivation and Self-Regulated Learning Skills in Integrated Medical MOOC Learning: a Mixed Methods Research Protocol

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Abstract

Introduction: Massive Open Online Courses (MOOCs) are informal learning environments. Since a few years, MOOCs are being reused and integrated in formal medical education. However, what constitutes optimal integration is still unclear. In this mixed methods study protocol we describe how we will investigate three MOOC integration designs using the same MOOC.

This study holds multiple objectives: 1) describe motivation profiles in medical students that learn in integrated MOOCs, and discern if motivation profiles are associated with specific MOOC integration designs; 2) investigate how psychological needs of medical students are satisfied or frustrated in different MOOC integration designs; 3) investigate the relationship between autonomous motivation to learn in an integrated MOOC and use of SRL skills in that MOOC; 4) uncover processes that are involved in goal acceptance or rejection of medical students in integrated medical MOOC designs with assigned learning goals; and 5) identify obstacles medical students encounter when learning with assigned learning goals in integrated medical MOOCs.

Methods and Analysis: Objective 1 and 2 will be pursued with a cross-sectional study design, objective 3 with a observational cohort study design, and objective 4 and 5 with a qualitative interview study design. All medical students in one of three MOOC integration designs at Leiden University Medical Center (LUMC) will be invited to participate. Primary endpoints for objective 1 and 2 are motivation profiles, and variety in need satisfaction and frustration. For objective 3 the primary endpoints are autonomous motivation and Self-Regulated Online Learning. For objective 4 and 5 primary endpoints are process themes regarding goal acceptance or rejection, and perceived obstacles when working with assigned online learning goals.

Ethics and dissemination: This study has been approved by the Educational Research Review Board of the LUMC. Planned dissemination of findings include three presentations at (inter) national conferences and three research articles.

Strengths and limitations of this study:

+ The used MOOC is open for integration in other institutions, the teaching modes profile will be disclosed, and integration designs are described extensively, increasing replicability to a high extent.
+ By comparing integration designs utilizing the same MOOC, we maximize the validity of the findings regarding differences between integration designs.
+ This study uses three data collection points in time for each participant to answer a total of five research questions, minimizing the participants' time investment.
+ Specific efforts have been made and described to optimize the quality of both quantitative and qualitative methods.
- As only one MOOC is investigated, future research has to decide on generalizability to integration of MOOCs with different teaching mode profiles.

Introduction and rationale

Massive Open Online Courses (MOOCs) are informal learning environments that are mostly created by universities. In MOOCs, learners from all over the world are free to choose any topic, at any place and any time to learn, usually with little or no financial commitment needed. In addition to this traditional MOOC format, many other MOOC forms now exist, ranging on scale, openness, and costs for learning (Pilli & Admiraal, 2016). Since a few years, MOOCs are being integrated in formal campus education (Israel, 2015), with many examples of integration in the medical domain because of the advantage integration offers: (a) the convenience of creating a course once and delivering it multiple times without extra effort or cost (Sarkar & Bharadwaj, 2015), (b) access to education from institutions that not all students can travel to (Doherty et al., 2015), (c) the opportunity to remove costs and inconvenience of getting to a single location (Davies, 2013), (d) access to topics not normally available in the curriculum (Doherty et al., 2015), (e) the possibility to use 'exemplar' learning materials from experts in their field instead of each university making their own (Doherty et al., 2015; Sharma et al., 2014), (f) enhanced understanding of pathology not common to students' resident country (Sharma et al., 2014), (g) enhanced communication among international communities of clinicians and student clinicians (Goldberg & Crocombe, 2017; Hendriks et al., 2019), (h) access to a wide variety in available teaching modes (Hendriks et al., 2019), and (i) access to innovative teaching models for student learning (Goldberg & Crocombe, 2017; Hendriks et al., 2019).

Many studies have described the way a MOOC was integrated into the campus context (Reinders & de Jong, 2016), sometimes accompanied by outcome measures such as student satisfaction (Dandache et al., 2017; Robinson, 2016; Swinnerton et al., 2017), or effectiveness for learning (Marks & Meek, 2018), and in 2019, an article describing twelve tips for integrating medical MOOCs into campus education was published, based on the experiences of early adapters and researchers of MOOC integration (de Jong et al., 2019). However, what constitutes optimal integration is still largely unclear, as most studies only describe one case of integration while integration contexts differ significantly between cases. MOOC integration designs can be characterized by choices of 1) level of education, 2) degree of obligation, 3) ratio of online versus face-to-face teaching, 4) replacing or adding MOOC content to formal courses, and 5) level of contact with other online learners in the MOOC. A MOOC integration design is thus a combination of choices in each of these five areas. We see this distinction between designs as a first step towards practical insights into what works when and why. In this proposal, we present a mixed methods study that investigates three MOOC integration designs using the same MOOC, and explore motivation to learn and Self-Regulated Learning (SRL) skills in this context. We have outlined our three directions for research below, which are all exploratory and descriptive, and function to form hypotheses for future research. In short, we seek to discern

1. how medical students are motivated to learn in three different MOOC integration designs,
2. if autonomous motivation is needed for self-regulation when learning in an integrated MOOC, and
3. what processes and obstacles are involved in working with assigned learning goals while learning in an integrated MOOC setting.

These directions give form to a total of five research questions, of which the rationales will be described below.

1: Theoretical Framework for RQ1 and RQ2: Motivation in different MOOC integration designs

Self-Determination Theory distinguishes between quantity of motivation and quality of motivation (Ryan & Deci, 2000). One can be highly motivated, but when this motivation is only externally regulated, or controlled, it is considered low quality motivation (Vansteenkiste et al., 2009). High quality, autonomous motivation is more internally regulated, and is associated with well-being, enjoyment, and academic achievement (Reeve et al., 2008; Ryan & Deci, 2000). Self-Determination Theory also postulates that in order to be autonomously motivated, there is a psychological need for feelings of autonomy, feelings of competence and feelings of relatedness to others. In educational settings, these feelings can be satisfied or frustrated, which satisfies or frustrates autonomous motivation, which in turn influences the quality of motivation (Reeve et al., 2008; Vanasupa et al., 2010). Motivation to learn in integrated MOOC settings is a relevant and understudied outcome measure. To gain insight in the quality of motivation in medical students in integrated MOOCs, we aim to answer the following research questions:

RQ1: What are motivation profiles of medical students in three different MOOC integration designs, and do the three integrated MOOC designs differ in students' motivation profiles?

RQ2: How are psychological needs of medical students satisfied or frustrated in different MOOC integration designs?

2: Theoretical Framework for RQ3: Autonomous motivation and use of Self-regulated Learning skills

In addition to the benefits of well-being, enjoyment and academic achievement, autonomous motivation is thought to stimulate Self-Regulated Learning (SRL) (Reeve et al., 2008). It is widely accepted that online learning demands more SRL strategies, as usually no teacher, tutor, or mentor is present (Kizilcec et al., 2017). Many studies have focused on what processes are involved in SRL, and subsequently strategies were developed to teach successful execution of SRL. Recent literature reviews suggest that SRL processes can be

supported by adding SRL prompts, feedback, or a combination of the two for many of the SRL processes, including goal-setting, monitoring, and evaluating. However, although SRL strategies may be successfully acquired, even online, this might not be enough to make students actually self-regulate their learning when it is no longer supported. In the book Motivation and Self-Regulated Learning by Schunk and Zimmerman (2008), Reeve et al. state:

"We believe that developing such skills is important for students' regulating their learning activities effectively. However, we also suggest that for students to put the skills to use and take greater responsibility for their learning, they will need to develop autonomous motivation for doing so."

- Reeve, Ryan, Deci and Jang, page 239

The authors suggest a two-tier condition for students to self-regulate: they must know how to, and they must want to do it for themselves. Recent literature suggests that efforts to support SRL in MOOCs focus on offering support for how to self-regulate, and not on autonomous motivation for doing so. If Reeve et al. are right, efforts will also have to be directed at supporting autonomous motivation in integrated MOOC designs. As we have found no studies to test this relationship in online learning settings we seek to investigate their assumption. Findings can inform research efforts to support SRL in MOOCs, and can offer guidelines for future MOOC integration designs. The related research question is:

RQ3: What is the relationship between autonomous motivation to learn in an integrated MOOC and self-regulated learning in that MOOC?

3: Theoretical Framework for RQ4 and RQ5: Goal setting processes surrounding assigned online learning goals

Goal setting is an important part of SRL and it has been described as an essential skill for learning in MOOCs (Kizilcec et al., 2017). Students that set their own learning goals are more autonomously motivated, set more difficult goals, show higher commitment and greater affect when attaining or not attaining a goal (Latham & Seijts, 2016). When possible, self-set goals are to be preferred over assigned goals (Latham & Seijts, 2016). However, in most medical MOOCs, like in most other courses, learning goals are still assigned. As we strive to have more self-regulated students, this goal assignment might pose a problem. A possible solution for this problem is to set goals with student and teacher together, as is posed by goal-setting theory (Locke, 1996) and the social-cognitive path to self-regulatory skills (Zimmerman & Kitsantas, 2005). However this requires individual attention of the teacher for each student. This might be hard to achieve in MOOCs, with few teachers and many learners, and with predetermined learning activities and assessments that might

not fit the new learning goals. Latham et al. (1988) have suggested acceptance of a goal is more important than its' origin, that is, the student or the teacher. In this line of thought, student acceptance and internalization of assigned learning goals might offer the solution that is needed for autonomous motivation to learn. Difficulties with assigned learning goals and co-creating learning goals have been described in multiple studies in clinical learning contexts (Farrell, Bourgeois-Law, Buydens, & Regehr, 2019; Larsen et al., 2017), but we have not come across literature that describes learning goal acceptance in online learning settings. For this reason we seek to gain insight in the processes that are involved around goal acceptance of medical students in integrated MOOC designs with assigned learning goals. Related research questions are:

RQ4: What processes are involved in goal acceptance or rejection of medical students in integrated MOOC designs with assigned learning goals?

RQ5: What difficulties do students perceive in working with the assigned goals, and what helps them when working with assigned goals?

Objectives

To summarize, in our study the following objectives are pursued:

- → 1: Establish motivation profiles of medical students in integrated MOOCs, and discern if motivation profiles are associated with specific MOOC integration designs.
- → 2: Determine how psychological needs of medical students are satisfied or frustrated in different MOOC integration designs.
- → 3: Identify the relationship between autonomous motivation to learn in an integrated MOOC and self-regulated learning skills in that MOOC.
- → 4: Uncover processes that are involved in goal acceptance or rejection of medical students in integrated medical MOOC designs with assigned learning goals.
- → 5: Identify obstacles and promoting factors that medical students encounter when learning with assigned learning goals in integrated medical MOOCs.

Study design

Context description

Students in three medical MOOC integration designs will be invited to participate in our study. In each of the integration designs the MOOC "Clinical kidney, pancreas, and islet transplantation" was integrated in undergraduate courses at Leiden University Medical Center (LUMC) in the Netherlands. The LUMC is a public academic hospital in a highly urbanised region. About 320 students start their bachelor studies in the faculty of medicine each year. An overview of the characteristics of the MOOC can be found in figure 1.

- Integration design A consists of completing the MOOC before joining the three and a half day undergraduate level 'Leiden Oxford Transplantation Summer School' (LOTS) which runs yearly in July (Leiden University website 2019a). Joining this course is voluntary and acceptance of students is based on a letter of application. However, once accepted into the course, completing the MOOC is a prerequisite to come to the face-to-face meeting. Since 2017 the MOOC has been added to equalize and enhance the level of prior knowledge among students. Students do not meet before the face-to-face component and have to enrol in the MOOC themselves, where they will learn alongside all online MOOC learners. Approximately 20 students join this course and we strive to include two cohorts of this course in the study.
- Integration design B is an eight-week compulsory second year module called "Mechanisms of disease" (MOD) starting in October in which one week of lectures at the end of the course has been replaced by a part of the activities in the MOOC. In this design, the entire cohort of approximately 300 students has followed undergraduate courses together for a little over a year. Students are enrolled in a separated version of the MOOC course and thus have no contact with MOOC learners outside of their cohort.
- Integration design C is a newly offered elective for undergraduate students that have enrolled in the honours program, and students from universities in the virtual exchange program (Leiden University Website 2019b; Ommering et al., 2018). The honours program is available for students that long for more challenge in their studies. To complete the honours program, students must gather 30 extracurricular study credits. Students can choose the components in their honours program from several lectures, meetings and courses, among which the MOOC. For all students in this integration design the MOOC elective consists of completing the MOOC at any time in their first or second year of undergraduate studies and an additional written assignment. Students do not meet face-to-face with other students as it is an individual online course. Approximately 14-18 students enrol during a study year, which is the period we will include students in. Characteristics of integration designs A, B and C have been summarized in Figure 3, according to the possible integration design choices described above.

MOOC FACT SHEET: Clinical Kidney, Pancreas, and Islet Transplantation

Offered by	Leiden University Medical Center
Platform	Coursera
Level	Intermediate
Time to complete	Approx. 15 hours
Language	English
Rating	4.8 of 5 (205 votes)

4 modules of one week

Teaching mode profile	#
Instruction	
Digital text or textbook	28
Independent activities related to content	1
Video of instructor talking to camera	49
PPT slides	24
Illustrations or simulations	12
Links to external online resources	214
Prompts to use external links	✓
Interaction	
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	✓
Assessment	
Multiple Choice Questions	98
Open ended question peer reviewed	2
Open ended question with long answer	5
Multifunctional	
Virtual patient cases	32
Games	1

Figure 1. MOOC fact sheet including teaching mode profile.

Research Design

Motivation in different MOOC integration designs

For this cross-sectional study, the variety of motivation quality profiles over MOOC integration designs will be calculated to answer RQ1. To answer RQ2, scores for psychological need satisfaction and frustration will be compared between MOOC integration designs.

Autonomous motivation and use of Self-Regulated Learning skills

To answer RQ3, we will use a prospective observational cohort study design. All participants will be handled as one group and autonomous motivation and SRL data will be used in a cross-lagged panel design, to examine the correlations between the levels of autonomous motivation and SRL scores at two points in time: at the start and at the end of the MOOC.

Goal setting processes surrounding assigned online learning goals

RQ 4 is exploratory and a qualitative research design is applied. We want to understand the processes involved in assigned learning goal acceptance or rejection in integrated MOOC learning from the perspective of the students through interviews. Although some research has pried into goal acceptance, and Self Determination theory could inform discussion about internalization of assigned goals, to our knowledge, no theory is known regarding this subject

and so we opt for a grounded theory approach analysis. For RQ 5 we seek to map obstacles and difficulties that students encounter while learning with assigned goals in integrated MOOC. We deem Cultural Historical Activity Theory (CHAT) an appropriate lens (Jonassen & Rohrer-Murphy, 1999) to interpret the wide variety of difficulties and promoting factors that can arise in such a complex learning setting.

Study population

Population

Medical students that have enrolled in one of three described MOOC integration designs at the LUMC will be invited to participate. This includes students from other universities that have enrolled as exchange students. Students will approximately be between 18 and 23 years of age.

Inclusion and exclusion criteria

In order to be eligible to participate in this study, a subject must meet all of the following criteria. For the first 3 research questions, all medical students who have enrolled in one of three described MOOC integration designs at the LUMC will be invited to participate. For research question 4 and 5 students will be purposively sampled, based on motivation profiles, SRL scores, and integration design, as we aim to have a variety of participants on relevant characteristics to yield insights from various angles. There are no specific criteria for exclusion.

Sample size calculation

We will approach all students in the three cohorts (expected n=20 for A, n=300 for B, and n=18 for C) and expect a response rate of at least 80% for quantitative data collection of RQ1, RQ2 and RQ3, resulting in 16, 240, and 14 participants per design respectively. For qualitative data collection of RQ4 and RQ5, we will strive to include participants from all three integration designs, and aim to have a diversity in motivation profiles and SRL scores. We anticipate data saturation for both qualitative RQ's to be reached with a minimum of 8 interviews and a maximum of 16 interviews. We deem the chances of students participating quite high as previously students in these courses have been open to fill in evaluation forms. In addition, other medical education studies that have been performed in the LUMC with medical students have gained highly satisfying response rates.

Methods

Study parameters/endpoints and materials

For each research question the primary study parameters, materials and analyses are described. A summary can be found in Table 1.

- *RQ1:* What are motivation profiles of medical students in three different MOOC integration designs, and do the three integrated MOOC designs differ in students' motivation profiles?

Parameters: Motivation profiles and association between motivation profiles and integration designs.
Materials: Participants will complete the Learning Self-Regulation Questionnaire (Black & Deci, 2000), adapted to MOOC learning, with statements on controlled and autonomous motivation. The reported Cronbach's α is .80 for autonomous and .75 for controlled motivation. To discern motivational profiles we will use a twostep cluster analysis. A double-split cross-validation procedure will be used to examine the stability of the cluster solutions, as described by Vansteenkiste et al. (2009).
Analysis: Assuming we will find at least two different motivational profiles, they will be handled as nominal categorical data. As we have three different groups for the independent variable, a chi-square test will be performed to investigate if specific integration designs are associated with certain motivational profiles.

- *RQ2:* How are psychological needs of medical students satisfied or frustrated in different MOOC integration designs?

Parameter: Variety in need satisfaction and frustration between integration designs**.**
Materials: The Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015) will be adapted to MOOC learning and yield scores for satisfaction and frustration of the psychological needs of autonomy, competence, and relatedness for each participant. Cronbach's α's for subscales are between .71 and .88 for the English version of the questionnaire.
Analysis: The 5-point Likert scales yield numerical data, which we assume will be normally distributed; however this will be checked. Here, need satisfaction and frustration are the dependent variables and a one-way ANOVA and post-hoc tests will be performed to investigate the difference between integration designs for average scores of need satisfaction and frustration.

Table 1. Research questions, related study measures, timepoints, data types, potential and expected sample per design, and analyses.

Research question	Measures	Timepoint	Data type	Sample per design (potential, expected)	Analysis
1. What are motivation profiles of medical students in three different MOOC integration designs, and do the three integrated MOOC designs differ in students' motivation profiles?	- MOOC integration design - Motivation profile	T2	Quantitative	LOTS (20, 16) MOD (300, 240) Hons (18, 14) Total (338, 270)	Two-step cluster analysis followed by a chi-square test
2. How are psychological needs of medical students satisfied or frustrated in different MOOC integration designs?	- MOOC integration design - Psychological need satisfaction and frustration	T2	Quantitative	LOTS (20, 16) MOD (300, 240) Hons (18, 14) Total (338, 270)	One-way ANOVA followed by post-hoc tests
3. What is the relationship between autonomous motivation to learn in an integrated MOOC and self-regulated learning in that MOOC?	- Autonomous motivation - Self-regulated online learning	T1 and T2 T1 and T2	Quantitative	LOTS (20, 16) MOD (300, 240) Hons (18, 14) Total (338, 270)	Cross-lagged panel analysis using Pearson's r
4. What processes are involved in goal acceptance or rejection of medical students in integrated MOOC designs with assigned learning goals?	- Goal acceptance or rejection process themes	T3	Qualitative	LOTS (20, 2) MOD (300, 9) Hons (18, 1) Total (338, 12)	Grounded theory iterative analysis (open, axial, and selective coding)
5. What difficulties do students perceive in working with the assigned goals, and what helps them when working with assigned goals?	- Obstacles and promoting factors for working with assigned online learning goals	T3	Qualitative	LOTS (20, 2) MOD (300, 9) Hons (18, 1) Total (338, 12)	Cultural Historical Activity Theory template analysis

- *RQ3:* What is the relationship between autonomous motivation to learn in an integrated MOOC and self-regulated learning in that MOOC?

Parameters: Autonomous motivation *and* self-regulated online learning.
Materials: The Learning Self-Regulation Questionnaire (Black & Deci, 2000) that will also be used to discern motivational profiles, measures autonomous motivation. Participant data from this questionnaire can thus be reused. The Cronbach's α is reported to be .75 for autonomous motivation. The Self-regulated Online Learning Questionnaire Revised (Jansen et al., 2018) will be used to collect participant scores for perceived metacognitive activities before, during, and after learning, and for time management, environmental structuring, persistence, and help seeking. The Cronbach's α are reported to be between .68 and .90 for all subscales.
Analysis: Autonomous motivation and all subscales for SRL are measured with 7-point Likert scales, yielding numerical data which we assume will be normally distributed; however this will be checked. A cross–lagged panel correlation (Tyagi & Singh, 2014) will be performed to find the direction of the relationship. As described by Tyagi and Singh (2014) this analysis necessitates two constructs, X and Y measured at two different points in time, for example time 1 and 2. The two variables and two points in time (lags) generate four variables (X1, X2, Y1, and Y2) and the four variables generate six correlations: two autocorrelations (rX1X2, rY1Y2); two synchronous correlations (rX1Y1, rX2Y2) and two cross–lagged correlations (rX1Y2, rX2Y1). These correlations will be calculated with a Pearson's r correlation test. The cross–lagged differential is calculated: rX1Y2 minus rX2Y1. In general, if the cross–lagged differential is positive, the causal predominance is that of X causing Y, and if the cross–lagged differential is negative, the causal predominance is that of Y causing X. Interpretation of results about causality will be guided by the more specific 'rules' as posed by Soelberg (1967) and Farris (1969) for interpretation of cross-lagged panel design results.

- *RQ4:* What processes are involved in goal acceptance or rejection of medical students in integrated MOOC designs with assigned learning goals?

Parameter: Process themes regarding goal acceptance or rejection.
Materials: Semi-structured interviews using an interview guide (Appendices E and F), and a grounded theory approach analysis will result in qualitative themes with respect to goal acceptance and rejection.
Analysis: Interview data from the first part of the interview will be analyzed in iterative cycles as described in the AMEE guide about grounded theory (Watling & Lingard, 2012). A coding scheme will be developed with a second investigator, starting with open coding, followed by axial coding, and finally selective coding. When the coding scheme is finalized, a third researcher will perform a member check, and the scheme will be applied to all interview data. This process will be facilitated by using qualitative data analysis software (Atlas.ti).

- *RQ5:* What difficulties do students perceive in working with the assigned goals, and what helps them when working with assigned goals?

Parameter: Perceived obstacles when working with assigned online learning goals.
Materials: Semi structured interviews using an interview guide (Appendices E and F), and a template analysis approach using Cultural Historical Activity Theory as a template will result in qualitative themes.
Analysis: The second part of the interview data will be analyzed with a template based on the components described in Cultural Historical Activity Theory: 1) the objective of the activity system, 2) the actor engaged in the activities, 3) the community or social context, 4) the tools used by actors in the system, 5) the division of labor within the system, and 6) rules that shape the system (Engeström, 2014). Problems with regard to an activity system, in our case the student learning online with assigned learning goals, can exist within and between these components, or when components from two activity systems meet. With a second investigator open codes for obstacles or problems will be created and discussed, as will their fit with the template. Emerging codes that do not fit with the template will be open, axially and, selectively coded with the second investigator to form new themes, and existing template themes that are not present in the data will be abandoned. When the coding scheme is finalized, a third researcher will perform a member check, and the scheme will be applied to all interview data. This process will be facilitated by using qualitative data analysis software (Atlas.ti).

Other Study Parameters

- *Identification number.* To be able to link students' within-subject data, an 8 digit identification number will be collected. This will be generated by the students using the first two letters of their first name, the first two letters of their last name, their birth date and month.
- *Sex, age, and university.* Will all be handled as possible confounders or covariates for RQ3, and will inform purposive sampling for interviews for RQ4 and RQ5.

Study Procedures

Data will be collected between July 1st of 2019 when the first LOTS cohort starts and August 31st of 2020 when interviews have been conducted with participants of the second LOTS cohort, as shown in figure 3. When a student enrols in one of the integration designs, we will be notified and receive the student's email address. All students that enrol receive an email with an information letter (Appendix G), an informed consent form (appendix G), and compiled questionnaire 1 (T1), which includes the measures for autonomous motivation and SRL, as can be seen in figure 2. After completing the MOOC component of a MOOC integration design, students will again receive the information letter and consent form, and will be asked to fill in compiled questionnaire 2 (T2), which includes measures for

autonomous and controlled motivation, SRL, and need satisfaction and frustration. According to the MOOC integration design the moments of data collection differ per integration design as can be seen in figure 3.

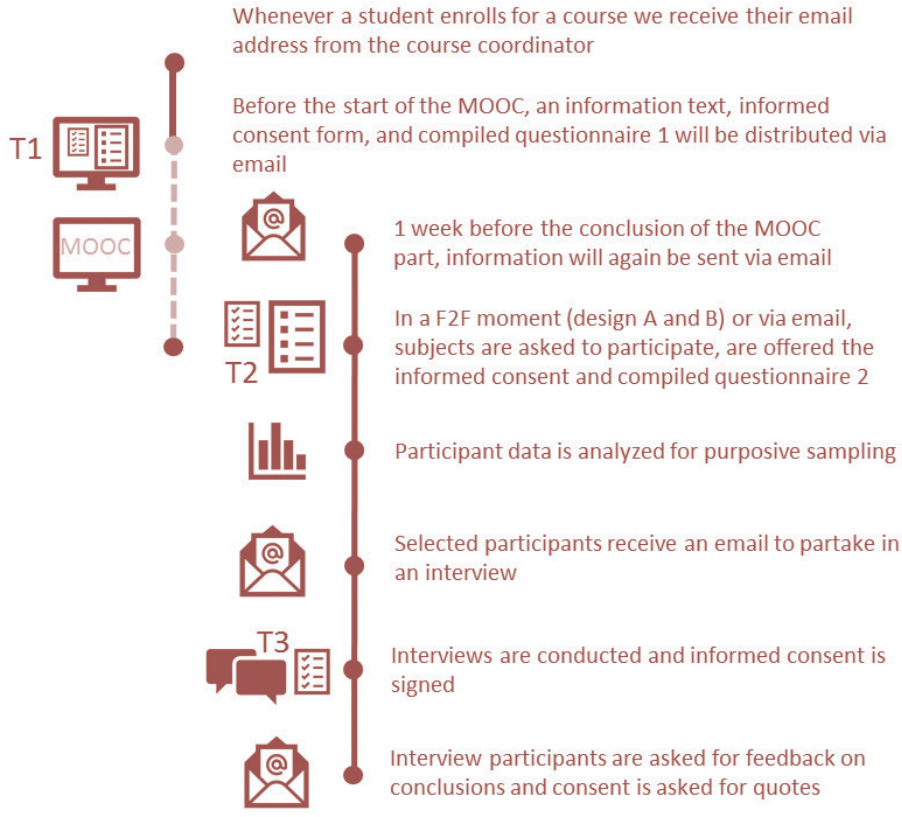


Figure 2. Study procedures.

Based on motivation profiles, SRL scores, integration design, and sex, students will be purposively selected and asked to also participate in interviews. In semi-structured interviews (T3), participants will be asked about 2 topics: 1) the way they work or do not work with assigned learning goals, and 2) problems or obstacles they face in doing so (interview protocol in Appendices E and F). In our view, individual interviews are preferred over group interviews as the processes involved in working with goals and accepting or rejecting them could differ distinctly between students, as may their way of viewing or describing these processes. Students might help each other of thinking about more involved processes in group interviews, but they might also confuse each other. In addition, interviews offer most opportunity for clarifying questions to understand the involved processes. Interviews will take approximately 30 minutes to 1 hour to complete and will be arranged as face-to-face

on a location preferred by the participant, or Skype meetings, depending on the country of residence of the participant. Interviews will be recorded and verbally transcribed.

Integration design	Level of education	Degree of obligation	Online-F2F ratio	Replacement or addition	Contact with other MOOC learners
A (LOTS)	Undergraduate	Compulsory MOOC component in a voluntary course	4 weeks – 3.5 days	Addition	Full access
B (MOD)	Undergraduate	Compulsory MOOC component in a compulsory course	1 week – 7 weeks	Replacement	Separate, private version of the MOOC
C (Hons)	Undergraduate	Voluntary MOOC component in a voluntary course	4 weeks – none	New course	Full access

Figure 3. MOOC integration designs, design choices, and course planning during the year. In design A students can decide when to complete before the face-to-face component in July. In design B students enter the MOOC in October as part of an eight-week course. Design C is continuously available.

Withdrawal of Individual Subjects

Subjects can leave the study at any time for any reason if they wish to do so without any consequences.

Ethical considerations

Regulation statement

This study has been approved by the Educational Research Review Board (ERRB) of the LUMC. This study does not fall under the Dutch Medical Research Involving Human Subjects Act (WMO). However, it is subject to the Dutch General Data Protection Regulation (AVG) and will be conducted according to it.

Recruitment and consent

The first author or another research team member, who has no educational role in relation to the students in these cohorts, will approach students by email to inform them about the opportunity to participate in the study when they have enrolled for the concerned course, but have not started the MOOC part. In addition, a notification will be placed on the Learning Management System (Blackboard). Email addresses will be gathered through the coordinators of each integrated MOOC design course. Students will receive an attachment with extensive information about the research and aspects of their participation (appendix G) and an informed consent form (appendix G). The information letter will include information on the possibility that participants will be approached to also partake in an interview. At

the finalization the MOOC component of each course, students will be contacted face-to-face before or after they have a workgroup or lecture, or after an exam. They receive the information and informed consent again, which in case of participation will be followed by the questionnaire. Permission from the course coordinators will be obtained for the study to take place during the start or end of the workgroup or lecture, or at the end of an exam. When participants for the interview study have been sampled based on abovementioned criteria (section 4.2), they will be contacted via email with information about the interview (Appendix H) and asked to partake. When the interview has been concluded, participants will sign the interview consent form (Appendix I) to use their interview data, as beforehand it will be difficult to have insight into what will be discussed. For the use of quotes, explicit consent will be asked afterwards.

Benefits and risks assessment, group relatedness

No disadvantages or risks are associated with participating in the study, nor are there direct advantages for students, as will be explicitly stated in the information letter. The only burden would be the 15-20 minutes students will have to spend on the compiled questionnaire. It will be possible for students who are interested to obtain information on their motivation profile. Students who also participate in the interviews will additionally spend 30 minutes to 1 hour. Participation may lead to significant findings and implications for future integrated MOOC education. Students can leave the study at any time for any reason if they wish to do so without any consequences for their study progress. The collected data will not be traceable to students' identities after it has been processed.

Incentives

For students that participate in the face-to-face interviews a hot or cold drink and some snacks will be provided.

Administrative aspects, monitoring and publication

Handling and storage of data and documents

The collected data will be processed and coded by the first author using a subject identification code list. Therefore, the research data will not be traceable to an individual student. To ensure data safety, the key file will be stored separately from the anonymized data set on the password-protected personal network storage drive. Only the first author will have access to this document. The anonymized research data will be saved in a SPSS file and stored in a SharePoint Office 365. SharePoint Office 365 is a safe shared Virtual Research Environment within the LUMC according to and recommended by the department of Biomedical Data Sciences. The data set will be accessible only for the research team, mentioned earlier in this proposal. The data will be stored for 10 years for further research purposes according to the 'Dutch Code of Conduct in Scientific Pursuit' of the Association

of Universities in the Netherlands. In case of withdrawal all collected data of a particular subject will be deleted and removed from the analysis.

Monitoring and Quality Assurance

The quality of the study is provided by the following criteria (Frambach et al., 2013):

Quantitative quality

- *Internal validity.* 1) Pilot of questionnaires: All questionnaires have been previously validated. The small changes to accommodate the MOOC context will be piloted in think-aloud sessions with at least three medical students of similar age to ensure students understand the questions. 2) Use of the same MOOC: by comparing integration designs utilizing the same MOOC, we maximize the validity of the findings regarding differences between integration designs. 3) Check of digital data entry: After data entry into a digital file has been completed, every entry will be checked to ensure the digital raw data file contains no errors.
- *External validity.* 1) To increase replicability, efforts have been made to extensively describe the context of the study, as are the methods. The MOOC teaching modes profile will be disclosed and integration designs are described. As this particular MOOC is open to other institutions for integration, replication should be possible to a high extent. 2) By categorizing a MOOC integration design based on a set of relevant characteristics, findings are expected to be more generalizable to other contexts with the same characteristics. The use of a specific MOOC decreases the generalizability to other contexts where other MOOCs will be integrated. As the MOOC teaching mode profile will be disclosed, inferences can be made about similar MOOCs.
- *Reliability.* 1) Internal consistency of instruments will be checked. All questionnaires have been previously validated and Cronbach's α's have been reported above and are all .67 or higher which we deem acceptable. Cronbach's α's will be checked for our sample of participants for each scale when data has been collected.
- *Objectivity.* 1) Participants identities are anonymized, while maintaining the opportunity to link participants results from T1 and T2. 2) The original data will be stored safely to ensure accountability to participants, the research community and the public.

Qualitative quality

- *Credibility.* 1) Respondent feedback will be member checked by communicating preliminary findings to the participants. Consequently, their feedback might generate alternative or new insights. The results will be adjusted accordingly. 2) Researcher triangulation: The interview transcripts will be analysed by at least two researchers independently. (Dis)agreement on emergent findings will be discussed and reported.

- *Transferability.* 1) The learning context and research context will be described in depth to offer meaning to other similar contexts. 2) We will perform purposive sampling in order to obtain a rich diversity in the participant sample and the variety in the interview responses.
- *Dependability*. 1) Data saturation: Saturation is reached if new interviews do not yield any new themes. If saturation is suspected, two more participants will be recruited to verify saturation. 2) Iterative data-collection and analysis: Since this qualitative research comprises of an iterative process, data will continuously be analysed and re-examined. Emerging topics which need further elaboration or clarification will be addressed in subsequent interviews.
- *Confirmability.* 1) Reflexivity: It is likely that many ideas will come up during this study. A lab journal will be kept and serves as a tool for keeping track of reflections (personal perspectives, thoughts and assumptions) during the data collection and analyses. 2) Findings will be discussed with peers and experts at conferences. 3) Literature will be searched for findings that contest and or confirm our findings.

General quality

- *Mixing the methods:* All data together offer in depth insight into effectively using SRL skills in integrated MOOC learning (RQ4 and RQ5), how this is influenced by motivation (RQ3), and how this is influenced by the MOOC integration design (RQ1 and RQ2).
  The methods complement each other also in the following more tangible ways: 1) the quantitative data support the qualitative data collection, as we sample purposively on extremely relevant variables, and 2) the interviews give dept to the motivation profiles that have been created quantitively.
- *Data storage and handling.* According to the Association of Universities in the Netherlands conduct, data will be stored and saved for ten years. Data will be destroyed afterwards. Participants have the right to see their data and to request any changes or deletion of the data. In case of withdrawal all collected data of particular subjects will be deleted and removed from the analysis.

Amendments

Amendments are changes made to the research after a favourable opinion by the accredited ERRB of the LUMC has been given. All amendments will be notified to the ERRB.

Temporary halt and (prematurely) end of study report

The first author will notify the accredited ERRB of the end of the study within a period of 8 weeks. The end of the study is defined as the last moment of data collection, which is most likely to be after saturation is reached and participant feedback has been collected for the qualitative part of the study. Analysis and dissemination of findings will continue

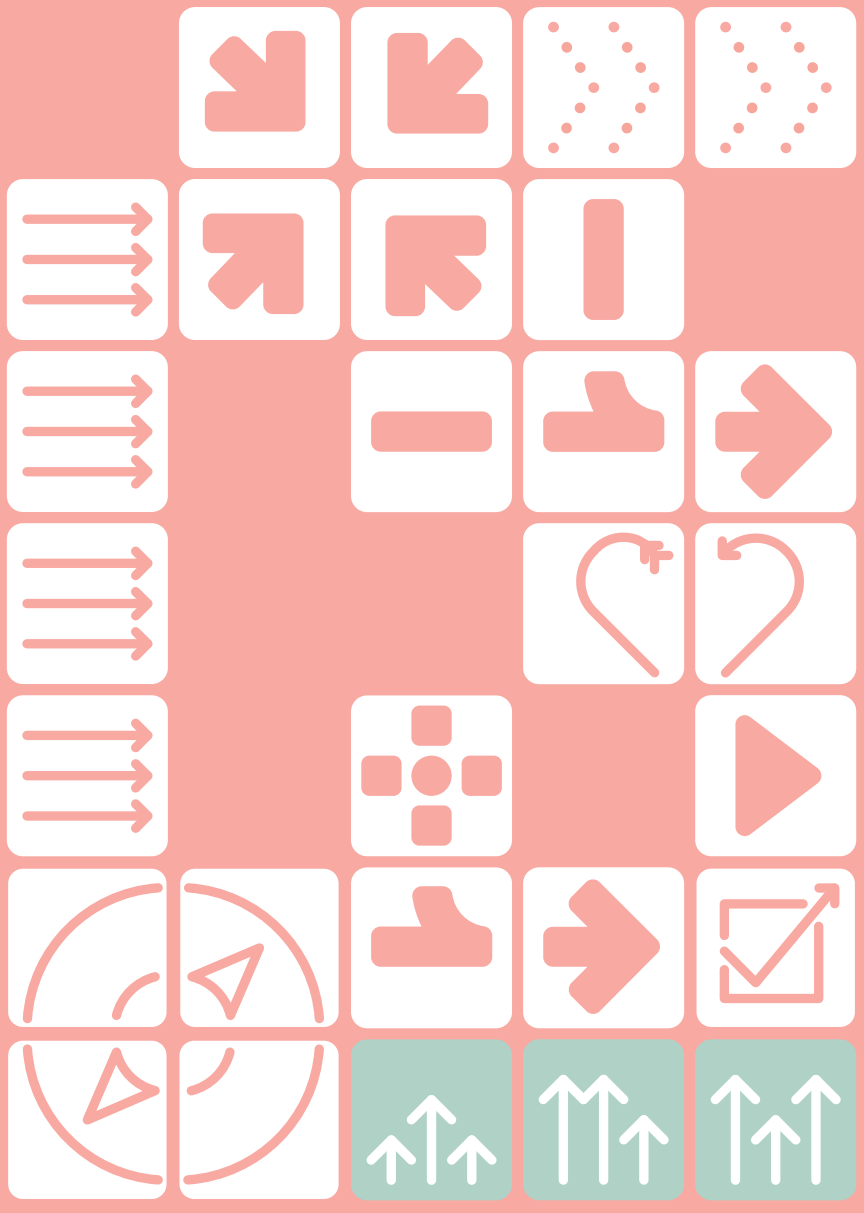
afterwards, however students participation will have ended. The first author will notify the ERRB immediately of a temporary halt of the study, including the reason of such an action.

Public disclosure and publication policy

Planned dissemination of findings include:

- Abstracts for AMEE conference 2020
- Abstracts for EARLI SIG 8 conference 2020
- Abstracts for NVMO conference 2020
- Research article for RQ 1 and 2, preferably open access
- Research article for RQ 3, preferably open access
- Research article for RQ 4 and 5, preferably open access
- Each article will be the basis of a chapter in the thesis of the first author.

CHAPTER 7



Students Learning in MOOC Integration Designs are Self-Determined Learners, Grade Hunters or Teacher Trusters

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Submitted

Abstract

Integration of Massive Open Online Courses (MOOCs) in campus education is rising, in many different forms. In search for optimal integration designs, motivation to learn needs to be considered as it is related to academic achievement and wellbeing among others, and as motivation to learn in informal MOOC learning could be very different to integrated formal MOOC learning. In this study motivation profiles of undergraduate students that learn in three different MOOC integration designs were explored, as was the distribution of profiles among integration designs. Finally, factors that underpin motivation were compared between integration designs. Six motivation profiles were recovered through a twostep cluster analysis: Self-determined learners and highly self-determined learners, grade hunters, and teacher trusters who are moderately, highly or extremely trusting. Proportions of motivation profiles differed significantly between MOOC integration designs, and MOOC integration designs satisfied and frustrated psychological needs significantly different. Future MOOC integration research should enlighten effects of design choices related to degree of obligation and online versus face-to-face ratio. Future MOOC integration practice should aim to monitor motivation and enhance autonomous motivation in obligatory designs specifically.

Introduction

When first introduced, Massive Open Online Courses (MOOCs) were said to be a disruptive innovation that would be able to change the higher education model (Al-Imarah & Shields, 2019; Flynn, 2013). Many universities that created MOOCs have also integrated these courses into their regular campus teaching (Bozkurt, 2021; de Jong et al., 2019). This has many advantages for both teachers and students (Hendriks et al., 2020a; Hendriks et al., 2019). In fact, several institutions are now connected to exchange initiatives to offer students MOOCs from other institutions (Leiden University Website, 2019b). In this respect, MOOCs are indeed changing the higher education model as many different forms of MOOC integration designs are being experimented with worldwide.

MOOC integration designs can be characterised by decisions about '1) level of education, 2) degree of obligation, 3) ratio of online versus face-to-face teaching, 4) replacing or adding MOOC content to formal courses and 5) level of contact with other online learners in the MOOC' as described in Hendriks et al. (2020b). In many case studies, specific approaches to integration have been described (Fair et al., 2017; Mabuan & Ebron, 2018) as have facilitators and barriers for learning (Bralić & Divjak, 2018). Some studies have compared multiple ways of integrating MOOCs, finding that in blended designs student outcomes are equal or improved compared to fully online or traditional face-to-face designs (Cornelius et al., 2019; Larionova et al., 2018). Studies that investigate multiple integration designs are scarce however, while this offers an approach to distinguish what works when.

In finding optimal integration designs, relevant input variables and outcome measures are manifold. Motivation to learn is highly influential for learning and has been studied in depth in informal MOOC settings (Alemayehu & Chen, 2021; Bozkurt, 2021), but not in integration settings, which can be characterized as mainly formal learning (Hendriks et al., 2020b). The important difference between informal and formal MOOC learning is that formal learning implies that external factors also influence motivation to learn, such as grades or expectations from others. As one of the choices in MOOC integration designs regards the degree of obligation to participate in the MOOC, we foresee that design choices could influence motivation to learn and the related outcome measures considerably. The current study aims to contribute to insights on how students' motivation in existing integration settings can be characterized. This characterization will 1) help to understand the effects that MOOC integration can have on motivation to learn in them, 2) offer direction for future intervention studies with integrated MOOCs, and 3) inform efforts to offer more effective and personalized learning experiences with integrated MOOCs.

Overview of the literature

Motivation for learning in informal MOOCs

Over the last few years motivation for learning in MOOCs has been a focal point in MOOC research (Bozkurt, 2021; Zhu et al., 2018), as it has such influence on engagement (Badali et al., 2022; Lai, 2021). Furthermore, it is closely related to self-regulated learning which is essential for learning in MOOCs (Alemayehu & Chen, 2021). Many studies focused on what motivates students to participate in a MOOC or to complete a MOOC (Badali et al., 2022). In this regard Kizilcec et al. (2017) developed the Online Learning Enrolment Intentions scale with thirteen different intentions to enrol in informal MOOCs, including most of the reasons for enrolment found in other studies (Huang & Hew, 2017; Loizzo et al., 2017). In 2019 Luik et al. developed the 'Factors Influencing Enrolment in MOOCs scale'. Reported reasons for participation include 1) interest in a topic, 2) relevance to job, 3) school or academic research, 4) personal growth, 5) career change, 6) fun and challenge, 7) to meet new people, 8) to experience an online course, 9) to earn a certificate, 10) prestige of the university or professor teaching, 11) taking the course with friends or colleagues, and 12) to improve English skills (Luik et al., 2019).

As MOOCs matured, data from many studies showed that MOOC completion is often very low. This prompted researchers to investigate why this happened (Pursel et al., 2016; Zheng et al., 2015), what reasons for persisting to learn in a MOOC (Alemayehu & Chen, 2021; Rizvi et al., 2022) and completion exist (Tang & Chaw, 2019; Zhang et al., 2019), and to discuss the definition of successful learning in MOOCs. The new lens to define successful MOOC learning is based on the notion that informal MOOC learners are often self-directed, meaning they decide their own learning objectives, and when these have been met, completion of the MOOC is unnecessary (Loizzo et al., 2017; Rabin, 2021). Successful informal MOOC learning is thus more defined by learner satisfaction and personal goal attainment than completion, and MOOC platforms have accommodated to this new standard by asking learners for their personal goals when enrolling in a MOOC, and learning analytics are being employed to offer personalized experiences (Rabin, 2021).

While completion is not any longer the sole desired outcome, studies on completion did show that positive motivation was related to positive engagement (Xiong et al., 2015), participation and to the inclination to complete a MOOC (Luik & Lepp, 2021; Tang & Chaw, 2019). In addition, research has been directed to discovering how motivation to learn in a MOOC influences other variables such as retention, self-regulated learning and academic achievement (Zhu et al., 2018). Through a systematic literature review Badali et al. (2022) found that need-based academic motives including intrinsic goal motivation were most important for retention directly and indirectly via self-regulation, performance and engagement among others. In addition, several studies found that intrinsic motivation specifically played an important role and related to better self-regulated Learning (Littlejohn

et al., 2016), performance (de Barba et al., 2016; Moore & Wang, 2021), and participation (Barak et al., 2016; Romero-Frías et al., 2020), which in turn related to completion. Finally attention has been directed at promoting motivation through design measures, although MOOC course design specifically has been understudied (Alemayehu & Chen, 2021; Zhu et al., 2018).

Motivation for learning of university affiliated MOOC learners

Although motivation significantly influences MOOC learning and MOOCs are being integrated in campus learning, only little attention has been dedicated to motivation of university affiliated MOOC learners specifically. Semenova (2020) found that for university affiliated MOOC learners taking the course out of interest and to earn a certificate both positively related to earning a MOOC certificate, and that amotivation negatively related to it. However in this study, the MOOCs had not been integrated into the formal curriculum. Watted and Barak (2018) compared motivation of two groups of MOOC completers: general informally learning participants and university affiliated students. The university students were mostly motivated by earning a certificate and general interest, and the general learners were mostly motivated by general interest and (improving) professional competence. For the university students, a negative relationship was found for the two motivations, students who were highly intrinsically motivated were less extrinsically motivated and vice versa. Finally, Formanek et al. (2018) compared motivation of informal astronomy MOOC learners with motivation of their university students in a similar introductory astronomy course in university and found that the university participants had significantly lower intrinsic motivation, self-efficacy, and self-determination. University learners scored higher on social motivation, grade motivation, and career motivation however.

Theoretical lens: Self-determination Theory

Intrinsic motivation, characterized as important for MOOC participation and completion, is an extreme on the motivation continuum described by Self-determination theory and is related to enjoyment and interest (Ryan & Deci, 2000). It belongs to the act of doing something without external reward or punishment. On the other extreme, amotivation exists, constituting a lack of motivation. In the middle are several forms of extrinsic motivation, which encompass that one is motivated for external reasons. These forms are controlled, introjected, identified and integrated regulation of motivation, which in this order are increasingly more close to personal norms and values and thus intrinsic motivation (Ryan & Deci, 2000). Intrinsic and extrinsic motivation can also be divided differently, into autonomous motivation and controlled motivation, the first including intrinsic motivation and internalized and identified forms of extrinsic motivation, and the second consisting of external and introjected forms of extrinsic motivation (ten Cate et al., 2011). This categorization is important in formal learning contexts as formal learning is rarely purely intrinsically motivated. Often learning in school or university is extrinsically motivated,

however through identification or internalisation of the learning goals, students can feel autonomously motivated. Autonomous motivation has been thoroughly researched in educational contexts and is related to well-being, enjoyment, deep learning strategies and academic achievement (Reeve et al., 2008; Ryan & Deci, 2000).

A meaningful distinction also exists between quantity and quality of motivation (Ryan & Deci, 2000). Quantity of motivation is the sum of autonomous and controlled motivation, quality of motivation can be calculated as autonomous motivation minus controlled motivation. Motivation can be high, however when it is only or highly externally regulated, or controlled, it is considered low quality motivation as the subtraction will result in a low or even negative score (Vansteenkiste et al., 2009). High quality, mostly autonomous motivation is internally regulated to a greater extent, and it is positively associated with deep learning strategies, academic achievement, well-being and enjoyment (Reeve et al., 2008; Ryan & Deci, 2000). In line with this, Vansteenkiste et al. (2009) have found that high quality motivation in students is related to higher academic achievement and Self-Regulated Learning. Thus, high quality motivation, e.g. high autonomous motivation and low controlled motivation, is desired. Furthermore, according to self-determination theory there is a psychological need for feelings of autonomy, competence and relatedness to others in order to be autonomously motivated. In educational settings, these feelings may be satisfied or frustrated. In this way, instructional designs such as MOOC integration designs can influence the amount of autonomous motivation a student experiences, consequently influencing the quality of motivation (Reeve et al., 2008; Vanasupa et al., 2010).

Motivation profiles

When designing for MOOC integration, learning can also be personalised by adjusting pedagogy and online environment according to the motivation of students, to help personal performance (Hegarty, 2011). Grasping the shape of the motivation students feel for learning is therefore essential. This is no easy feat however, as students in online or blended environments are often heterogeneous in their motivation and can have multiple motivations (Vanslambrouck et al., 2018). Profiling can facilitate the design process as it provides a holistic model of learners, offering a tool for informing and justifying MOOC designs (Li & Xiao, 2022). Previously, motivation profiles of university students learning face-to-face, online, or blended have been discerned, describing clusters of students with high quality, high quantity, low quality and low quantity motivation (Vanslambrouck et al., 2018; Vansteenkiste et al., 2009). Motivation profiles of informal MOOC learners have also been determined, resulting in clusters of opportunity motivated, over-motivated, success motivated and interest motivated students (Luik & Lepp, 2021). Profiles of university students formally learning in MOOCs have not been described. To support integrated MOOC learning, motivation profiles could be used to tailor, for example, assessment (Wei et al., 2021). Moreover, targeting students with low quality motivation seems desirable especially, as students with highly controlled motivation tend to engage less with online course materials (Lai, 2021).

Design of informal MOOC learning has been adjusted according to research findings about motivation to learn in them, however research on motivation to learn in formally integrated MOOCs is lacking. Based on our information, no studies have been conducted to characterise or compare motivation of students in multiple integrated MOOC settings. Knowledge of motivation among students in specific MOOC integration designs, and levels of satisfaction and frustration of the underlying psychological needs is necessary to inform future research and practice of MOOC integration.

This study aims to gain insight into the presence of specific motivation profiles and their foundation in different MOOC integration designs, and possible improvements. Moreover, this study reveals motivation to learn in integrated MOOCs based on students' authentic learning experiences, which might indicate potential inconsistencies or agreements between motivation theories and MOOC integration practices to consider.

The research questions of this study are:

1. What are motivation profiles of (bio)medical students in three different MOOC integration designs?
2. Do the three MOOC integration designs differ in students' motivation profiles?
3. How are psychological needs of students satisfied or frustrated in different MOOC integration designs?

Material and methods

Research design

A cross-sectional research design was employed. The variety of motivation profiles was discerned to answer RQ1. To answer RQ2, we calculated the significance of dispersion of motivation profiles over MOOC integration designs. To answer RQ3, we compared scores for psychological need satisfaction and frustration between MOOC integration designs.

Context description and participant selection

The study was conducted at Leiden University Medical Center (LUMC) in the Netherlands. Prospective participants studied MOOC-content between May 2019 and March 2020, before the COVID-19 pandemic spread to the Netherlands. Three MOOC integration designs for undergraduate students using a MOOC on Clinical kidney, pancreas and Islet transplantation (de Jong et al., 2021) were selected for this study and all enrolled students were invited for participation, as previously described and depicted in (Hendriks et al., 2020b). In Figure 1 the MOOC integration designs, the MOOC teaching mode profile and the final teaching mode profiles of the integration designs are summarised.

Integration design	Level of education	Degree of obligation	Online-F2F ratio	Replacement or addition	Contact with other MOOC learners
A (LOTS)	Undergraduate	Compulsory MOOC component in a voluntary course	4 weeks – 3.5 days	Addition	Full access
B (MOD)	Undergraduate	Compulsory MOOC component in a compulsory course	1 week – 7 weeks	Replacement	Separate, private version of the MOOC
C (Hons)	Undergraduate	Voluntary MOOC component in a voluntary course	4 weeks – none	New course	Full access

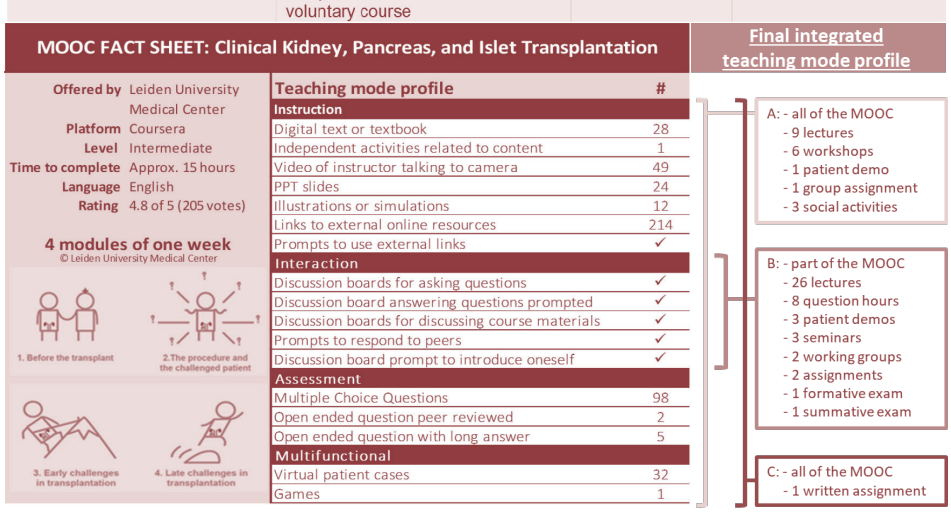


Figure 1. MOOC teaching mode profile and MOOC integration designs.

Integration design A includes completion of a MOOC prior to enrolling in the 3.5-day undergraduate "Leiden Oxford Transplantation Summer School" (LOTS), running every July, except in 2020 due to COVID19 restrictions. Enrolment in this LOTS program is voluntary and student admission is based on an application letter. However, once admitted to the program, completion of the MOOC is a prerequisite for admission to the face-to-face meeting. Students sign up for the MOOC individually and learn with other global MOOC learners. About 20 students take the LOTS program each year.

Integration design B is a compulsory 8-week second year course called "Mechanisms of Disease". At the end of the course a full week of lectures has been replaced by a set of MOOC activities. The entire cohort of about 300 students enrols in a single separate iteration of the MOOC, so there is no connection to MOOC learners outside the cohort.

Integration design C is an elective for undergraduates enrolled in the Leiden University Honours Program (Ommering et al., 2018). The Honours program is designed for students who desire more challenge in their studies. All students in this integrated design must complete the MOOC at any time during their first or second year of undergraduate studies

and must submit additional written assignments. Students will not have face-to-face interactions with other students as this is an individual online course. Between 14 to 18 students participate in this integrated design each year.

Data collection

Email addresses were accumulated through coordinators of the integrated MOOC design courses. The first author contacted students via email to inform them about the study when they enrolled for the selected courses, before commencing the MOOC part. She had no educational role in relation to the students in these cohorts. Furthermore, a notification was placed on the Learning Management System. Students received a document with further information about the study, aspects of their participation and a form regarding informed consent (Appendix G). After finalising the MOOC element of each course, students were approached in person after an exam, or before or after a workgroup or lecture for integration designs A and B, and online for integration design C. They received the information and informed consent again, followed by the questionnaire. All written questionnaires were digitised, and the digital files were checked for mistakes in input.

Measures and materials

To answer our research questions two primary outcome measures were selected: motivation and psychological need satisfaction and psychological need frustration. Instruments were adapted to learning in MOOCs, tested in think-aloud sessions in three iterations with a different student and combined in a questionnaire.

- *Motivation.* The Learning Self-Regulation Questionnaire (Black & Deci, 2000) is comprised of 12 items and constructed to measure autonomous and controlled motivation on a 7 point Likert-scale. Reported Cronbach's α's are 0.80 for autonomous and 0.75 for controlled motivation.
- *Psychological Need Satisfaction and Frustration*. The Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015) is comprised of 24 items on a 5 point Likert-scale. It yields scores for satisfaction and frustration of the psychological needs autonomy, competence and relatedness. The reported Cronbach's α's are between 0.71 and 0.88 for subscales.

Factor analyses and reliability tests

To ascertain the internal validity and reliability of the two instruments, exploratory factor analyses (EFA) were performed using a principal component analysis with an oblique rotation with minimization method, and Cronbach's α were calculated. Factor loading significance was determined according to the sample size thresholds described by Hair (2009).

- *Motivation to learn.* EFA revealed 3 factors in our study instead of the 2 factors predicted by the instrument description. The factors were 1) autonomous motivation, students being motivated to learn in a MOOC because they find it interesting or they want to learn; 2) instructor trusting motivation, students being motivated to learn in a MOOC because they trust their instructor to guide them and to know what's best; and 3) positive image motivation, students being motivated to learn in a MOOC because they want to be perceived positively. Combined the factors explained 61% of the variance. Cronbach's α scores of .836, .705 and .634 were obtained, respectively. The items and factor loadings can be found in Appendix J.

The motivating factors could not all be categorized as strictly autonomous or controlled. However, the recovered factors of instructor trusting motivation and positive image motivation seem similar to motivation factors described in previous informal MOOC research (Luik et al., 2019), and they resonate with findings from a previous qualitative study in this group of students, where we found that "trust in the teacher" is a major driver for learning strategies (Hendriks et al., *submitted*). Furthermore, wanting to be perceived positively certainly fits in the competitive context of (bio)medicine where people want and need to distinguish themselves to secure desired further study or employment positions (Bram et al., 2020; Hill et al., 2018).

- *Psychological need satisfaction and frustration.* The final two principal component analyses with oblique rotation with minimization methods revealed that for psychological need satisfaction, relatedness and autonomy partly loaded together, and that for psychological need frustration, competence and relatedness loaded together, resulting in the following factors: 1) relatedness-autonomy satisfaction, 2) competence satisfaction, autonomy satisfaction, 4) autonomy frustration, and 5) competence-relatedness frustration. The factors of psychological need satisfaction combined explained 60% of the variance, and the factors of psychological need frustration combined explained 51% of the variance. Cronbach's α scores of .819, .794, .456, .836 and .798 were obtained, respectively. As a score of .456 is unacceptable, factor 3: autonomy satisfaction was left out of further analyses. The items and factor loadings can be found in Appendix K.

Analyses

For RQ1, cluster analysis consisted of Ward's hierarchical clustering followed by K-means clustering to form the clusters, a double split cross validation to discern the stability of the cluster solution, and finally a multivariate analysis of variance (MANOVA) to discern to what extent the constituting motivation dimensions contributed to the cluster solution.

Prior to cluster analysis normal distributions were tested and means were calculated for autonomous, teacher trusting and positive image motivation based on the maximum number of items or maximum minus one with a minimum of two, for each scale. This means that autonomous motivation was calculated based on a minimum of five out of six items for each participant. This was followed by finding and discarding multivariate and univariate outliers as these can disturb cluster formation. In total data from ten participants was excluded from further analysis due to missing data (n=6), multivariate outliers (n=1) and univariate outliers (n=2).

Ward's hierarchical clustering was performed forming 2 to 10 clusters, yielding nine different cluster solutions. Sums of squares between groups and within groups for each cluster solution were used to calculate the Variance Ration Criterion (Caliński & Harabasz, 1974) to discern the optimal cluster solution. This is calculated as the optimal ratio between the variance explained by the cluster solution, compared to the total variance (or variance between the clusters), the number of clusters (criterion of parsimony) and the number of units to be clustered. The optimal number of clusters of K=6 was obtained, as can be seen in Appendix L. For the optimal cluster solution, Ward's cluster seeds were recorded to base the non-hierarchical K-means clustering upon. This yielded a final cluster solution and final K-means cluster seeds.

The double split cross validation (Vansteenkiste et al., 2009) was performed by randomly splitting the sample in two and following the cluster-forming steps described above. This yielded final cluster solutions and final K-means cluster seeds for group A and group B. K-means cluster seeds from group A were used to base K-means clustering of group B upon and vice versa. The orders of clusters formed for A and B were then matched to the likeness of the order of the original final cluster solution by hand, so that the K-means cluster seeds of each cluster were similar to each other across the original, group A and group B. Finally Cohen's kappa's were calculated to discern reliability between the original cluster solution and A and B, which informed us of the stability of the cluster solution. The double split cross validation yielded a Cohen's Kappa of .547 for stability of the cluster solution.

For the cluster solution to be acceptable, a minimum of 50% variance should be explained by the constituting motivation factors (Kusurkar et al., 2013; Vansteenkiste et al., 2009). In a MANOVA constituting dimensions of the clusters were added as dependent variables. This was to discern to what extent each type of motivation contributed to the cluster solution. The constituting dimensions included the three forms of motivation found in the factor analysis, and based on literature, quantity of motivation, and quality of motivation A and B. As instructor trusting motivation can consist of both autonomous and controlled forms of regulation, two types of quality of motivation were calculated. Quality of motivation A was calculated as Autonomous motivation and Instructor trusting motivation combined,

minus Positive image motivation. Quality of motivation B was calculated as Autonomous motivation minus Instructor trusting motivation and Positive image motivation. Covariates were not included in the calculation as any difference in age or gender could be important for the composition of the clusters and thus controlling for these covariates was undesirable. As can be seen in Appendix M, constituting dimensions explained 55% of variance or more.

A Chi-squared test was performed to investigate if specific integration designs were associated with specific motivational profiles for RQ2, and a second MANOVA was conducted to discern if student's psychological needs were satisfied and frustrated differently between the different MOOC integration designs for RQ3. This was followed by post-hoc tests.

All analyses were carried out in IBM SPSS statistics 25, except for the Variance Ration Criterion calculations, which were completed in Microsoft Excel.

Ethical considerations

This study was approved by the Educational Research Review Board (ERRB) of the LUMC. It was conducted according to the Dutch General Data Protection Regulation (AVG). Data was anonymized and participants had the right and option to audit the way their data was stored. Participants signed an informed consent form and were aware they were able to withdraw at any moment without consequence. Participants were not offered compensation for partaking, nor were they disadvantaged in any way.

Results

A total of 272 participants filled out the questionnaire, 19 (95%), 240 (67%) and 13 (48%) joined from integration design A, B and C, respectively. Mean age was 19.69 (stdev.= 1.416, data missing from 13 students) and 66,9% were female versus 29,4% male (data missing from 10 students). For Integration design B only students from Leiden University (n=260) participated, for integration design A and C students from eight other universities in Europe and Asia (n=12) also participated.

Typology of student motivation for formal MOOC learning

In Table 1 and Figure 2, we have summarized the six motivation types based on the three underlying motivation dimensions. The K-means clustering algorithm revealed six types of motivation profiles: learners that are 1) Highly self-determined, who are regulated mostly by their autonomous motivation, 9,9% (n=26); 2) Self-determined, who are regulated by their autonomous motivation similarly, but with more emphasis on the other forms of motivation, 14,4% (n=38); 3) Grade hunting or CV building, who are regulated by all three types of motivation, with the highest amount of positive image motivation of all clusters, 23,6% (n=62); 4) Moderately trusting, who are regulated mostly by their autonomous motivation

and instructor trusting motivation, but who have a moderate quantity of motivation, 13,7% (n=36); 5) Highly trusting, who also are regulated mostly by their autonomous motivation and instructor trusting motivation, but who have a high quantity of motivation, 24,7% (n=65); and 6) Extremely trusting, who are regulated mostly by their autonomous motivation and instructor trusting motivation, but who have an extreme quantity of motivation, 13,7% (n=36).

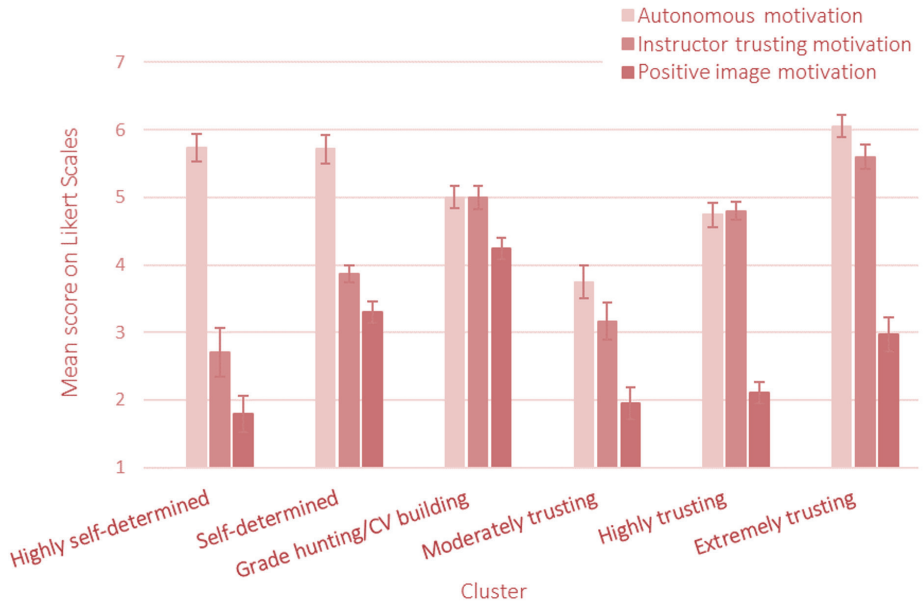


Figure 2. Motivation profiles composed of distinct combinations of the three motivation types, including 95% confidence intervals.

Table 1. The six extracted clusters with mean scores and standard deviations of the constituting dimensions.

	Highly self-directed	Self-directed	Grade Hunters	Moderately trusting	Highly trusting	Extremely trusting
	n = 26 (9,9%)	n = 38 (14,4%)	n = 62 (23,6%)	n = 36 (13,7%)	n = 65 (24,7%)	n = 36 (13,7%)
Constituting dimension						
Autonomous motivation	$5,73_{a}$ (0,51)	$5,72_{a}$ (0,64)	$5,00_{b}$ (0,65)	$3,74_{c}$ (0,71)	$4,74_{b}$ (0,72)	$6,06_{a}$ (0,47)
Instructor trusting motivation	$2,70_{a}$ (0,89)	$3,87_{b}$ (0,38)	$5,00_{c}$ (0,68)	$3,17_{a}$ (0,81)	$4,80_{c}$ (0,55)	$5,60_{d}$ (0,54)
Positive image motivation	$1,79_{a}$ (0,65)	$3,30_{b}$ (0,47)	$4,24_{c}$ (0,60)	$1,95_{a}$ (0,69)	$2,11_{a}$ (0,64)	$2,97_{b}$ (0,73)

Note. Cluster means are significantly different if they have different a, b, c and d subscripts.

Relationship between integration designs and motivation profiles

In Table 2 and Figure 3, we have summarized the counts, expected counts and proportions of the six motivation types per MOOC integration design. All profiles were present in integration design B, with the majority of students (57%) moderately, highly or extremely trusting, a quarter grade hunting or CV building and a minority (18%) was (highly) self-determined. In integration design A only the Highly trusting profile was missing, and 75% of the students had a Self-determined motivation profile, of whom the minority was Highly self-determined. Finally, in integration design C the moderately and extremely trusting profiles were not present and over three quarters of students had a Self-determined motivation profile, of whom the majority was Highly self-determined.

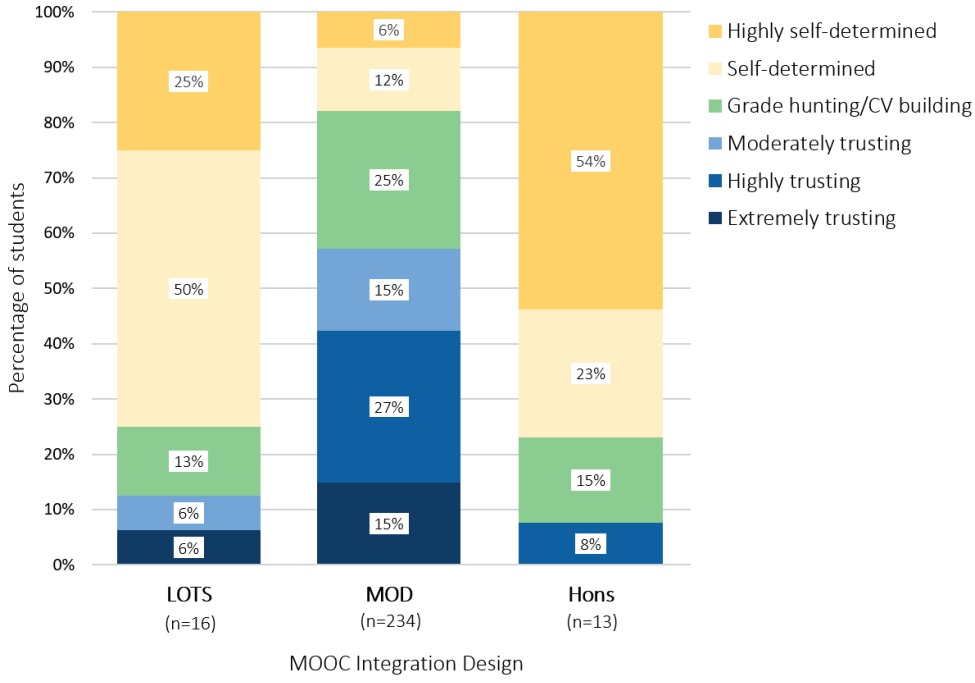


Figure 3. Proportions of students with each motivation profile in three MOOC integration designs.

A chi-square test of independence was performed to examine the association between MOOC integration design and motivation profile. A cross tabulation of counts and expected counts for students in MOOC integration design and profiles can be found in Table 2. The relation between these variables was significant, X^2 (10, N = 263) = 50.17 (Likelihood ratio), $p < .000$. Cramer's V was calculated as 66.7% of the expected counts was less than 5. This resulted in an effect size of 0.340, signifying a weak to medium association between MOOC integration design and motivation profile.

Table 2. Counts and expected counts of students with a specific motivation profile in each MOOC integration design.

		Integration design			Total
		LOTS	MOD	Hons	
Highly self-determined	Count	4	15	7	26
	Expected Count	1,6	23,1	1,3	26
Self-determined	Count	8	27	3	38
	Expected Count	2,3	33,8	1,9	38
Grade hunters / CV builders	Count	2	58	2	62
	Expected Count	3,8	55,2	3,1	62
Moderately trusting	Count	1	35	0	36
	Expected Count	2,2	32	1,8	36
Highly trusting	Count	0	64	1	65
	Expected Count	4	57,8	3,2	65
Extremely trusting	Count	1	35	0	36
	Expected Count	2,2	32	1,8	36
Total	Count	16	234	13	263
	Expected Count	16	234	13	263

Relationship between integration designs and students' needs satisfaction and frustration

In Table 3 we have summarized mean scores and standard deviations of psychological need satisfaction and frustration for the three MOOC integration designs. To examine the differences in psychological need satisfaction and psychological need frustration between MOOC integration designs a MANOVA was performed. the Wilks's lambda was significant, $F(8,496) = 6,215$, $p < .001$; Wilks' $\Lambda = .826$, partial $\eta 2 = .091$, indicating that significant differences were found between MOOC integration designs for psychological need satisfaction and/or frustration.

Tukey's honestly significant difference post hoc test revealed that Relatedness-autonomy satisfaction scores were statistically significantly lower in integration design B (2,41 ± 0,68) versus A (2,86 ± 0,76, $p = .025$) and C (2,96 ± 0,45, $p = .012$)**,** and that competence satisfaction scores were statistically significantly lower in integration design B (3,53 ± 0,57) versus A (3,97 ± 0,56, $p = .008$) and C (4,21 ± 0,45, $p < .001$). Relatedness-competence frustration scores were statistically significantly higher in integration design B (1,98 ± 0,59) versus A (1,54 ± 0,40, $p = .010$) and C (1,52 ± 0,42, $p = .014$), and autonomy frustration scores were also statistically significantly higher in integration design B (2,95 ± 0,77) versus C (2,19 ± 0,63, $p = .002$) but not A (2,52 ± 0,86). Scores from integration design A and C did not statistically differ significantly for any of the psychological needs. Overall, MOD students scored lower on psychological need satisfaction and higher on psychological need frustration than LOTS and Hons students.

Table 3. Mean scores and standard deviations of psychological need satisfaction and frustration for the three MOOC integration designs.

	LOTS	MOD	Hons
	n = 16 (6,3%)	n = 225 (88,6%)	n = 13 (5,1%)
Satisfaction of			
Relatedness-autonomy	$2{,}86_{b}$ (0,76)	$2{,}41_{a}$ (0,68)	$2{,}96_{b}$ (0,45)
Competence	$3{,}97_{b}$ (0,56)	$3{,}53_{a}$ (0,57)	$4{,}21_{b}$ (0,45)
Frustration of			
Relatedness-competence	$1{,}54_{b}$ (0,40)	$1{,}98_{a}$ (0,59)	$1{,}52_{b}$ (0,42)
Autonomy	$2{,}52_{a,b}$ (0,86)	$2{,}95_{a}$ (0,77)	$2{,}19_{b}$ (0,63)

Note. MOOC integration design means are significantly different if they have different a and b subscripts.

Discussion

In this study we found six distinct motivation profiles based on three forms of motivation: Self-determined learners and highly self-determined learners, grade hunters, and teacher trusters who are moderately, highly or extremely trusting. We also found proportions of motivation profiles to differ significantly between MOOC integration designs, and that MOOC integration designs satisfy and frustrate psychological needs significantly different.

Motivation in integrated MOOC learning versus informal MOOC learning

We found similar motivation factors as previous MOOC research (Kizilcec et al., 2017; Luik et al., 2019) while using a different instrument, however our findings deviate from prior findings in several ways. First, we did not find the same diversity in motivation factors for learning in a MOOC as for example Kizilcec et al. (2017) or Luik et al. (2018). It is possible that more motivation factors might have surfaced with a different instrument. Second, though our motivation factors are similar to some of the factors that informal MOOC learner profiles were based upon (Luik & Lepp, 2021), the profiles are not. Specifically, our factor autonomous motivation could be linked to Luik and Lepp's *interest in the course,* and positive image motivation could be linked to Luik and Lepp's *usefulness related to certification* and *social influence* based on similarity in items for these scales. However, the cluster solutions are not similar: the profile with the lowest score for *interest in the course* from Luik & Lepp (2021) had a mean 7-point Likert scale score of 5.7 while in our profiles five out of six profiles have mean 7-point Likert scale scores for autonomous motivation of 5.73 or lower. Similarly, we found one cluster to peak (mean score 4.24) in positive image motivation, while Luik & Lepp (2021) found one profile to dip (mean score 4.1) in *usefulness related to certification* and *social influence*. Finally, Kizilcec et al. (2017) found that in 57% of the informal MOOCs they investigated, learners said to be motivated by a prestigious university or professor to join the course. From their study it was unclear however to what extent this factor played a role. We have found instructor trusting motivation to play a major role in cluster

formation in integrated MOOCs, with some profiles emphasizing the role of the instructor in motivation in relation to other factors. Thus, motivation in integrated MOOC learning and informal MOOC learning seems to be measurable with similar factors, however previous and current results show that factor scores and learner motivation profiles differ between informal and formal MOOC learning. Specifically, in integrated MOOC learning, autonomous motivation seems lower, positive image motivation seems more condensed to one profile, and instructor trusting motivation seems more prevalent. This is in line with earlier findings regarding intrinsic motivation and motivation to earn a certificate in university affiliated students in MOOCs (Formanek et al., 2018; Watted & Barak, 2018).

Motivation profiles in different integrated MOOC learning designs

Within integrated MOOC learning, we found motivation to learn to be context dependent as well. Different MOOC integration designs related to different psychological need satisfaction and frustration and also to different (proportions of) motivation profiles per design. Predictably the two designs that were less obligatory, A and C, had substantially larger proportions of self-determined learners and better scores for psychological need satisfaction and psychological need frustration. The difference between design A and C in the amount of highly self-determined learners could stem from the fact that in design C the MOOC was voluntary in an extracurricular program and A was compulsory in an extracurricular program. In addition, as these courses were for credit but extracurricular, we are not surprised to see CV-builders are also similarly present in design A and C. The most deviant design in terms of MOOC integration choices, design B, is also the most deviant in proportions of present profiles. Notably, many students in this obligatory MOOC design are teacher trusters, with varying quantity of motivation. We believe, informed by a qualitative study in the same cohort (Hendriks et al., *submitted*), that students in this case acquiesce to what is expected of them. They do not study in the course out of interest per se, but will have to complete it to progress in their studies and thus they revert to being 'led' by the teacher, 'who probably knows best'. This trust in the teacher also fits Vygotsky's *Zone of Proximal Development* where the teacher is the designated 'more knowledgeable other' (Vygotsky, 1978). In addition, it resonates with the *Social Cognitive Path to Self-Regulatory Skills* as postulated by Zimmerman and Kitsantas (2005), describing a gradual transference of self-regulated learning skills and agency from the teacher to the learner. Our sample consists of undergraduate students only, however we found differences in the amount of teacher trusters between designs. Our current study cannot explain this difference, however we see possible explanations in two directions: 1) individual differences in self-regulated learning skills and learner maturity exist, and more advanced students self-select in voluntary MOOC integration designs; and 2) the design in which a MOOC is offered scaffolds a specific role for the teacher and the student. We expect both factors to play a role.

Psychological need satisfaction and frustration in different integrated MOOC learning designs

Design B differed significantly from design A and C for psychological need satisfaction and frustration. Self-selection might play a major role here. Specifically, higher scores for competence satisfaction and lower scores for relatedness-competence frustration in design A and C, might be explained by self-selection. Students that feel competent and or have high self-efficacy to learn in MOOCs, might be more prone to seeking voluntary extracurricular study credit in that form. Similarly, to us, it seems only logical that autonomy frustration scores increase in more obligatory designs. If this self-selection effect is indeed in place, specifically obligatory designs are in need of competence and autonomy support. Another important factor in psychological need satisfaction might be the emphasis that is placed on the MOOC in the larger MOOC integration design. Our analyses revealed that items from relatedness and autonomy satisfaction loaded together and that students in design B scored significantly lower on this factor. Looking at the items for this factor (see Appendix K), we believe they might portray a feeling of 'belonging to or fitting into the online course', instead of relatedness or belonging to other people in the course or having autonomous choices per se. In this regard, we believe the difference in online/f2f ratio might play a role, as in integration design B the MOOC is only a small portion of an extensive face to face course. Peacock et al. (2020) described that for a sense of belonging to an online course, engagement, the culture of learning and support are important themes. In our study, especially design B might not have had enough time or emphasis on the MOOC to develop real engagement or an online learning culture.

Future research, practical implications and limitations

While we found significant differences in motivation profiles between integration designs, in this study we can only speculate as to why these differences occur. In researching what works when in MOOC integration, many contextual variables are present, including the topic or discipline of the MOOC, the choices in the integration design and the instructional design or teaching mode profile of the final blend, to name a few. In this study we investigated three already existing MOOC integration designs with the same MOOC, and so our designs do not differ in topic or discipline, but they do on various other variables. The next step is to compare integration designs that differ on only one variable at a time. Informed by our findings, we also propose to investigate the role of the degree of obligation in MOOC integration designs, as it may lead to scaffolded student and teacher roles or self-selection of students. Finally, as we aimed to measure motivation in terms of autonomous and controlled motivation as previous studies in formal education, but found factors that resemble motivation previously described for MOOC learning, optimal instrumentation for measuring motivation in integrated MOOC settings should be studied.

The desired motivation profile is that of the highly self-determined student, as previously it has been shown that high quality motivation is related to better academic achievement

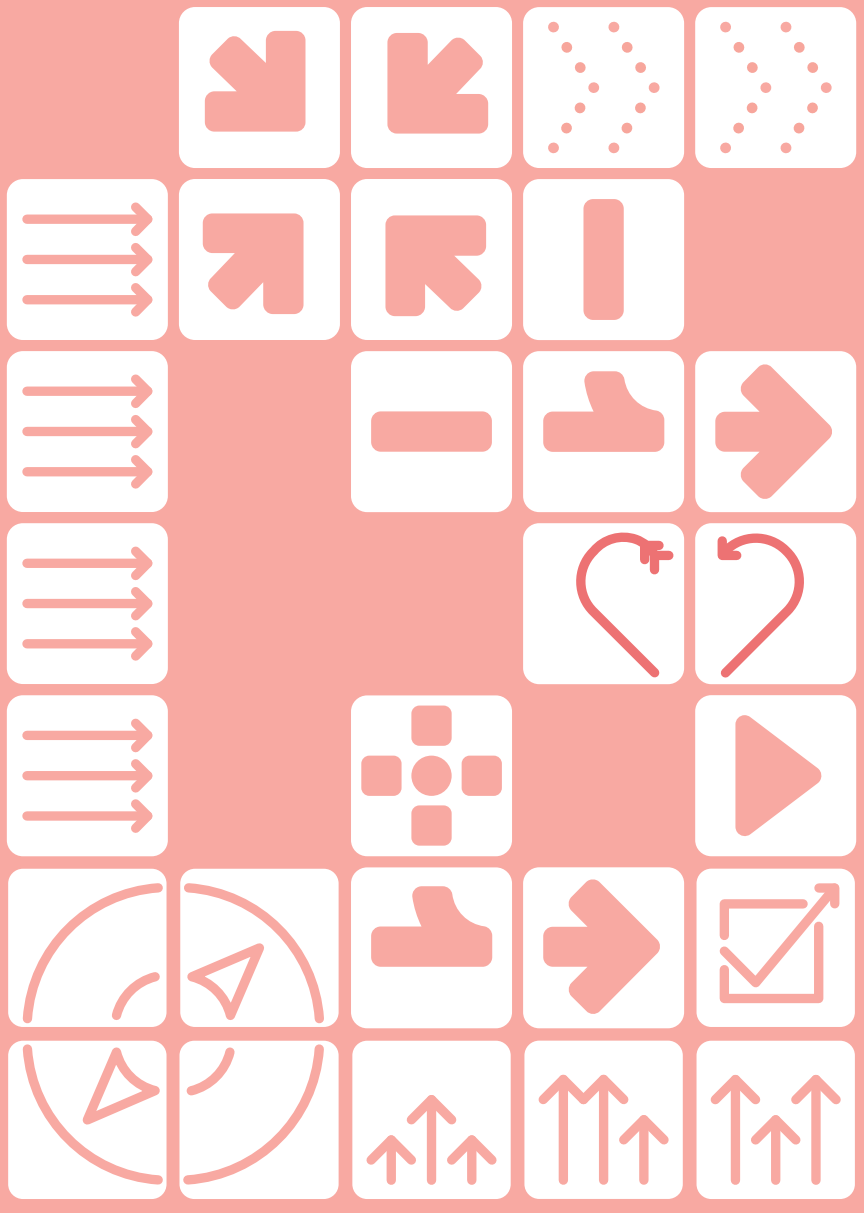
and high autonomous motivation is related to better learning strategies, well-being and enjoyment (Ryan & Deci, 2000). Our study showed that in MOOC integration designs similar to A and C, not much support may be needed. However in courses similar to integration design B, psychological need satisfaction and frustration could be improved. In this regard, it is advisable to monitor motivation when integrating a MOOC obligatorily and take precautions to support motivation beforehand. This can be done by integrating MOOCs that are already designed with improving motivation in mind, for example with game elements and personalised designs (Saputro et al., 2019), earning badges for completed assignments (Ortega-Arranz et al., 2019), improved content, accessibility and interactivity (Deshpande & Chukhlomin, 2017), and specific support for self-regulated learning skills (McCann et al., 2015). In addition support of feelings of autonomy, relatedness and competence in the final MOOC integration design can be realised through relatively small interventions (Reeve et al., 2008).

Two limitations need to be mentioned. First, generalisability to other MOOC integration designs and contexts needs to be examined as our findings are, per design of the study, highly context specific. Second, in this study participation rates of 95%, 67% and 48% were obtained for integration designs A, B and C, respectively. As the 'missing' data in this study could be missing due to low motivation, which is the measured construct in this study, we gather data is missing possibly not at random. As a group of students might in fact not have responded because of low motivation, we have to take into account a possible representation bias. This could mean our results present a slightly more positive view on motivation to learn in integrated MOOCs than it in reality is. Mean scores for motivation factors could thus be lower, or an extra very low motivation profile could be missing. Especially for integration design C it could mean that the proportion of self-determined learners is in fact smaller than we have found. As we did find a lower quantity motivation profile among the 'Teacher trusters' we do believe the findings are representative and implications are highly valuable for future research and practice.

Conclusions

In integrated MOOC learning students are motivated by autonomous motivation, trust in their instructor and the image others have of them. From these factors six different motivation profiles presented: highly self-determined students, self-determined students, grade hunters or CV builder, and moderately, highly and extremely trusting students. Motivation factors in integrated MOOC learning are similar to motivation factors in informal MOOC learning, however motivation profiles are not. Finally, motivation to learn in integrated MOOCs is dependent of the MOOC integration design, and most likely supported by psychological need satisfaction and frustration. This study is the first to characterise motivation to learn in formally integrated MOOCs, and the first to compare integration designs based on motivation.

CHAPTER 8



Assigned Learning Goal Acceptance Theory: a Model to Understand Learning Goal Acceptance Processes of Undergraduate Students

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Submitted

Abstract

For successful campus-integrated MOOC learning students require Self-Regulated Learning skills, specifically goal-setting. Goal-setting is most effective when goals are self-set, however in formal undergraduate education, learning objectives are often assigned. According to literature acceptance of assigned learning goals is key for learning when goals cannot be self-set, however processes of acceptance or rejection have not been described. The present constructivist grounded theory study offers Assigned Learning Goal Acceptance Theory, a model to understand learning goal acceptance of undergraduate students with four elements: 1) the perceived fit of learning goals as a tool with students' study strategies; 2) the level of explicit or implicit acceptance of content of learning goals depending on the student's strategies; 3) the level of acceptance that is based on considerations of usefulness, comprehensibility, and perceived constructive alignment of learning goals within a course; and 4) students' acquiescence to whatever is expected to pass the examination.

Introduction

Online delivery of higher education is still on a rise, currently pushed by global countermeasures in response to the COVID-19 pandemic. A clear example of innovative online delivery of higher education are Massive Open Online Courses (MOOCs). Since their origination in 2008, MOOCs have become an accustomed addition to the educational landscape ((Bozkurt et al., 2017). In addition to their informal availability, MOOCs are being integrated in formal campus education (Marks & Meek, 2018; Pickering & Swinnerton, 2017; Reinders & de Jong, 2016) as this integration offers several advantages (de Jong et al., 2019; Hendriks et al., 2019). How to optimally integrate MOOCs in campus education is still unclear.

Recently it was found that students require strong Self-Regulated Learning (SRL) skills for successful MOOC learning, because in the MOOC context teacher and tutor support is limited, similar to many other online learning contexts (Blau et al., 2020; Broadbent & Poon, 2015; Jivet et al., 2020; Kizilcec et al., 2017). In particular the aspect of goal setting has been described as an essential skill for informally learning in MOOCs as this is related to lower attrition and higher achievement (Kizilcec & Halawa, 2015; Rohloff et al., 2019). Goal setting is defined as 'the process of deciding what you want to achieve or what you want someone else to achieve over a particular period' (Cambridge dictionary, 2021).

Regarding the origin of the goal, five levels of goal setting have been previously described: 1) Setting goals personally, done by the person or group that is to pursue the goal; 2) setting goals jointly, done by the person that is to pursue the goal and another person that will not pursue the goal but has interest in attainment, in education this can be the teacher or mentor; 3) consultation, where the goals are assigned to the person that is to pursue the goal but she or he is consulted regarding the content and/or planning; 4) tell and sell, where the goals are assigned to the person that is to pursue them and a rationale is offered to support the goals; and 5) tell, where the goals are assigned to the person that is to pursue them without a rationale (Latham et al., 1988; Roberson et al., 1999). Moving from option 1 to 5, acceptance of the set goals by the person that is to pursue the goals is increasingly less assured, while acceptance of these goals is highly important (Erez et al., 1985; Latham & Seijts, 2016). This notion is supported by the findings that students who set their own learning goals are more autonomously motivated, set more challenging goals, show higher commitment and greater affect when attaining or not attaining a goal (Latham & Seijts, 2016). Therefore, when possible, (partly) self-set goals are preferred over assigned goals.

Efforts are being made to normalize personal goal setting in MOOCs (Rohloff et al., 2020), however having students set their own learning goals can be difficult to implement in a course design for several reasons. First, goal setting requires skills, as set goals are best when

articulated as measurable, difficult, long-term goals, which are then specified into short-term goals. Commitment to a goal and consideration of obstacles are essential (Latham & Seijts, 2016). Second, novice learners often do not know enough about a subject they are going to learn about to gauge what knowledge, skills and attitudes are essential, and thus what goals are relevant (Farrell, Bourgeois-Law, Buydens, & Regehr, 2019). Third, giving direction to one's own learning also requires some maturity (Jossberger et al., 2010; Saks & Leijen, 2014). Through scaffolding students could set high quality learning goals and learn what the criteria for effective goal setting are. This is especially feasible in online settings such as MOOCs. However scaffolding does not resolve the difficulties with gauging what relevant goals are or with readiness for setting one's own goals.

In short, personal goal setting is not always desirable, especially for younger and/or novice learners, which leaves the options of joint goal setting, consultation, tell and sell, and tell. In practice joint goal setting and consultation are very time consuming for a teacher and often nearly unattainable. Especially for larger numbers of student, as subsequent study activities and assessment need to be constructed in alignment with the learning goals. Thus, in most MOOCs, like in most regular courses, learning goals are still assigned (Rohloff et al., 2019) either implicitly or explicitly, and with or without a rationale (Hendriks et al., 2020a).

Latham et al., (1988) have suggested acceptance of a goal is probably even more important than who sets it, and Erez et al., (1985) found that goal acceptance significantly contributed to performance. Goal acceptance is understood as a necessary prerequisite for goal commitment: the continued state of attachment to or determination for attainment of a goal (Earley et al., 1992; Locke et al., 1988). The importance of acceptance can be supported by self-determination theory (Ryan & Deci, 2000). Student's acceptance and internalisation of assigned learning goals can be seen as autonomous motivation to learn: through *identification*, which entails the student's sincere understanding of the significance of an assigned goal; and *integration*, which entails that students connect assigned goals to their own norms and values (figure 1). Reversely, rejection of goals that are designed by others could steer students to the undesirable corner of the self-determination spectrum: controlled motivation or even amotivation. Promoting acceptance could thus be similar to changing the locus of causality from external to internal, by making goals personally meaningful.

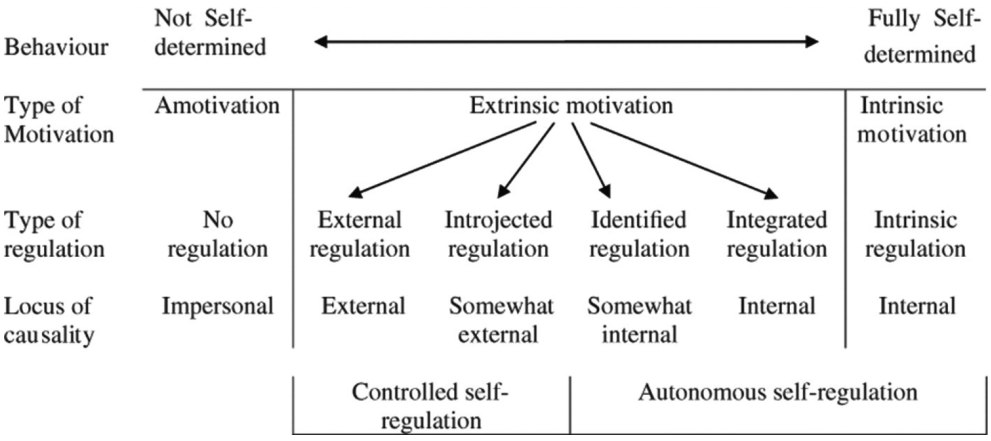


Figure 1: The spectrum of motivation according to SDT as adapted by ten Cate, Kusurkar & Williams (2011), printed in AMEE Guide No. 59, Med Teach, 33:12, 961-973. Original figure from Ryan RM, Deci EL. 2000. Self-determination Theory and the facilitation of intrinsic motivation, social development and well-being. Amer Psych 55 (1) 68–78.rations.

As far as we know, in regular higher education acceptance of learning goals is usually neither checked nor assured. In addition, literature that describes learning goal acceptance in online learning settings is lacking (Jiang & Elen, 2011), while it could bridge the gap between the theoretical preference to have students personally set their goals and the practical preference to assign them. For this reason we sought to gain insight in the processes that are involved in goal acceptance and rejection of undergraduate students in integrated MOOC designs with assigned learning goals. The research question of this study is:

What processes are involved in goal acceptance or rejection of undergraduate students in integrated MOOC designs with assigned learning goals?

Material and methods

Research design

As we searched for processes regarding goal acceptance and rejection an exploratory and a qualitative research design was applied. We wanted to understand the processes from the perspective of the students through individual interviews. As to our knowledge no theory has been described regarding this subject, we opted for a constructivist grounded theory approach. This study is part of a larger mixed methods research project (Hendriks et al., 2020b).

Context description

The study was conducted at Leiden University Medical Center (LUMC) in the Netherlands. Participants studied MOOC-content between May 2019 and March 2020, before the

COVID-19 pandemic spread to the Netherlands, and interviews were conducted online between June and September 2020, during the pandemic. Three MOOC integration designs for undergraduate students using a MOOC on Clinical Kidney transplantation (de Jong et al., 2019) were selected for this study, as previously described and depicted in Hendriks et al, (2020b). Three designs of the integration of one particular MOOC in campus education have been studied.

- *Integration design A* consists of completing the MOOC before joining the 3.5-day undergraduate level 'Leiden Oxford Transplantation Summer School' (LOTS) which runs annually in July (Leiden University website 2019). Joining this LOTS course is voluntary and acceptance of students is based on a letter of application. However, once accepted into the course, completing the MOOC is a prerequisite to be admitted to the face-to-face meetings. Students enrol in the MOOC individually, where they participate alongside other global MOOC learners. Approximately 20 students join the LOTS course every year.
- *Integration design B* is an 8-week compulsory second-year module called 'Mechanisms of Disease' starting in October in which 1 week of lectures at the end of the course has been replaced by several activities in the MOOC. In this design, the entire cohort of approximately 300 students is enrolled in a separated version of the MOOC course and thus has no contact with MOOC learners outside of their cohort.
- *Integration design C* is an elective course for undergraduate students that have enrolled in the Leiden University Honours Programme (Ommering et al., 2018). The honours programme is designed for students that long for more challenge in their studies. All students in this integration design have to complete the MOOC at any time in their first or second year of undergraduate studies and have to submit an additional written assignment. Students do not meet face-to-face with other students as it is an individual online course. Approximately 14 to 18 students enrol in this integration design annually.

Participant selection

We purposefully sampled students to capture a broad range of perspectives relevant to the research question. Information on motivation profiles, SRL scores, sex, age, MOOC integration design and university were used from a dataset that was available from a prior investigation in the same research project (Hendriks et al., 2020b). In the final sample of 13 participants, seven were female; three, ten and one student(s) participated in integration design A, B and C, respectively; and participants were from three different universities: Leiden University, Maastricht University and Plymouth University. Age ranged from 19-23. SRL scores and motivation profiles varied distinctly.

Materials

An information letter, semi-structured interview guides in Dutch and English, and an informed consent form were developed (Appendices E, F, H & I, respectively). All interviews were conducted online because of COVID-19 regulations.

Data collection

After selection of potential participants from the database, an invitation to partake in an interview including extended information about the research project was sent via email by RH who would also conduct the interviews. RH had no dependency relationship with the students. When a student accepted the invitation, a Microsoft Teams meeting was planned. At the beginning of the interview the research aims, course of events during the interview and informed consent were discussed. Consent for a recording of the meeting was requested before the interview. Participants were asked to confirm their consent to use the interview data after the interview had taken place, to ensure they could discern the information they would be sharing. After the interview participants were offered the opportunity to discuss the motivation and SRL scores they were selected upon. Interviews were recorded and transcribed verbatim by a trusted external commercial party that ensured confidentiality. In total, thirteen interviews were conducted from June 2020 to September 2020 and lasted between 38 and 61 minutes.

Participant validation was sought through written member checks of synthesized analysed data (Harvey, 2015): students received a summary of the interview transcript via email, written by the researcher that conducted the interview, based on the open and sometimes axial codes in the transcript. Participants were asked to comment on the summary and supplement any information they deemed relevant, to ensure a fit of the member checking method with our interpretivist research paradigm (Birt et al., 2016). All participants signed the informed consent, agreed or added to the member check summary and consented with use of their quotes.

Analysis

Analysis took place in iterations of open, axial and eventually selective coding (Glaser & Strauss, 1967; Watling & Lingard, 2012). Interviews were divided into four iterations: interview 1-4, 5-7, 8-10 and 11-13. Data collection, analysis and memo writing as approach to reflexivity were alternated as can be seen in appendix N. Open coding took place in Atlas.ti, by linking open codes to text selections in the transcripts. RH and PJ did this individually for all interviews, creating a list of open codes per interview transcription. RH and PJ discussed each open code, what it meant in its context and whether there was an appropriate super category. Then a list with associated codes was given an axial code, which could change if a new open code was added or removed in a later iteration, to better accommodate the list of open codes. In the first iteration of axial coding, we quickly learned that some open codes were irrelevant or awkwardly coded. We then adjusted those codes, or filtered them

out by constantly considering whether each code was relevant to the research question. Open coding then increasingly improved in relevance and accuracy. In the third iteration, ideas started to emerge as to how axial codes were related (start of selective coding) and some early sketches of the proposed model emerged then as well. During axial coding of iteration four, no new themes emerged and we deemed the data saturated. After axial coding in iteration four, selective coding was finalised by sketching the model. When the coding scheme and visual models were in a nearly final stage, WA performed an audit trail check to enhance confirmability (Frambach et al., 2013). The theory and model were then discussed among all authors for peer debriefing and then finalized.

Establishing the scope

Analysis influenced data collection and vice versa. When we realized that students mentioned learning in integrated MOOCs was sometimes similar and sometimes different from their normal study activities, we set out to analyse this difference further and add a question to the interview guide of interview 5 to 13: "why is this different for you?". We decided to extend our scope of relevant questions and answers to the standard curriculum as students indicated that their perceptions, acceptance and use of goals did not differ based on MOOCs or standard curriculum, but their strategies differed in relation to the obligatory nature of the activities and personal interest in the study subjects.

While analysing it also dawned on us that perceptions surrounding learning goals could explain the way that students accept, reject or use assigned learning goals, and that use of learning goals and other study strategies could be relevant for our research question. As described above, super categories of codes were constructed during analysis: 1) Studying and strategies, 2) Using or not using the learning goals, 3) Perceptions surrounding learning goals and 4) Processes of accepting and rejecting the learning goals, learning content or the assigned study system. During axial and selective coding these themes intertwined to form Assigned Learning Goal Acceptance Theory (ALGAT). Most themes in the first super category 'Studying and strategies' were helpful in understanding how students study, but were dismissed in the end as the themes did not offer new insights (Watling and Lingard, 2012).

Ethical considerations

This study was approved by the Educational Research Review Board (ERRB) of LUMC. It is subject to the Dutch General Data Protection Regulation (AVG) and was conducted according to it. Participants signed an informed consent form and were aware they were able to withdraw at any moment without consequence. Participants were not offered compensation for partaking, nor were they disadvantaged in any way. Participants could benefit from participation as they were offered personalised discussion and feedback of motivation and SRL scores collected during their studies.

Results

In this section we will describe a global description of Assigned Learning Goal Acceptance Theory, which is followed by an in depth explanation.

Assigned Learning Goal Acceptance Theory

The basic tenets of the theory are depicted in figure 2: There are five areas of acceptance and students flow through these from left to right. The five areas are 1) *Accepting the Prescribed Study System*, 2) *Accepting the tool*, 3) *Accepting the goal content implicitly*, 4) *Accepting the goal content explicitly* and 5) *Acquiescence*, leading to *Accepting the Prescribed Study System* again. Themes that belong to the areas *Accepting the goal content implicitly* and *Accepting the goal content explicitly* were closely related to specific study phases in a course, namely the start/instruction phase, and the middle/processing phase which both include activities that are planned by the instructors, such as lectures and working groups. Similarly, themes in the *Acquiescence* area were closely related to the final study phases of preparing for, taking and right after the final examination. The areas of *Accepting the Prescribed Study System* and *Accepting the tool* were not specifically related to a course phase, but to fundamental and persisting assumptions. In their flow, students either come through the area of *Accepting the goal content explicitly* or *Accepting the goal content implicitly*, creating two routes. Within h route more variation in acceptance and use of goals and perceptions and considerations about goals exists, as can be seen in figure 3 and tables 1 to 4, and as we will describe below.

Accepting the Prescribed Study System

In the process of accepting or rejecting assigned learning goals, the participant's acceptance of the formal system of their studies emerged as a fundamental theme. Here, the Prescribed Study System is defined as the combination of the guiding role of the teachers and coordinators by shaping the curriculum, the dependent role of the student, the assigned learning goals and content and the fact and function of final examinations. This acceptance is underpinned and illustrated by participant's considerations, listed in table 1, *considerations 1*.

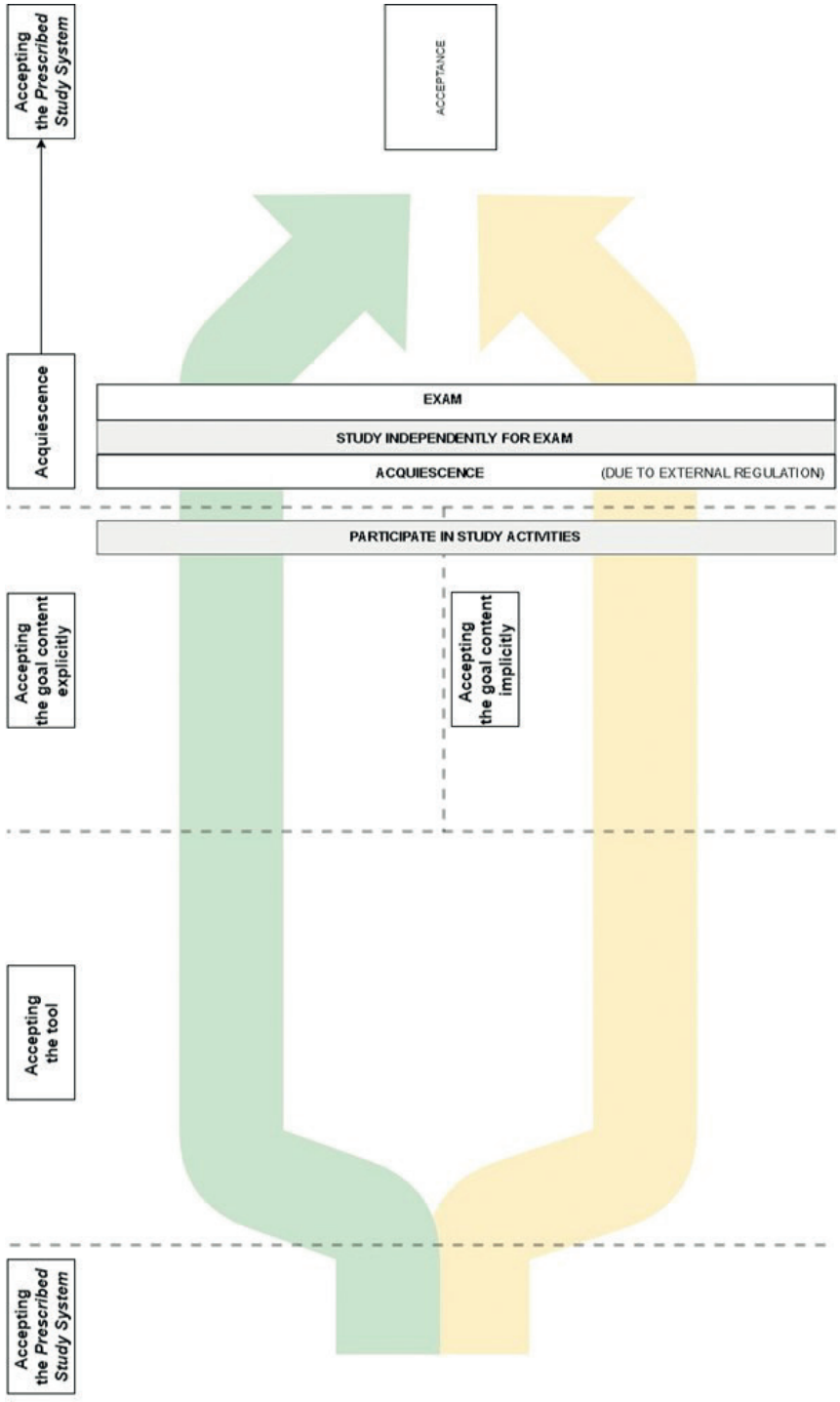


Figure 2: Basic flow of ALGAT. Students flow from left to right through five areas: 1) Accepting the Prescribed Study System, 2) Accepting the tool, 3) Accepting the goal content implicitly, 4) accepting the goal content explicitly and 5) Acquiescence, leading to Accepting the Prescribed Study System again. Students either come through the area of accepting the goal content explicitly or accepting the goal content implicitly creating two routes.

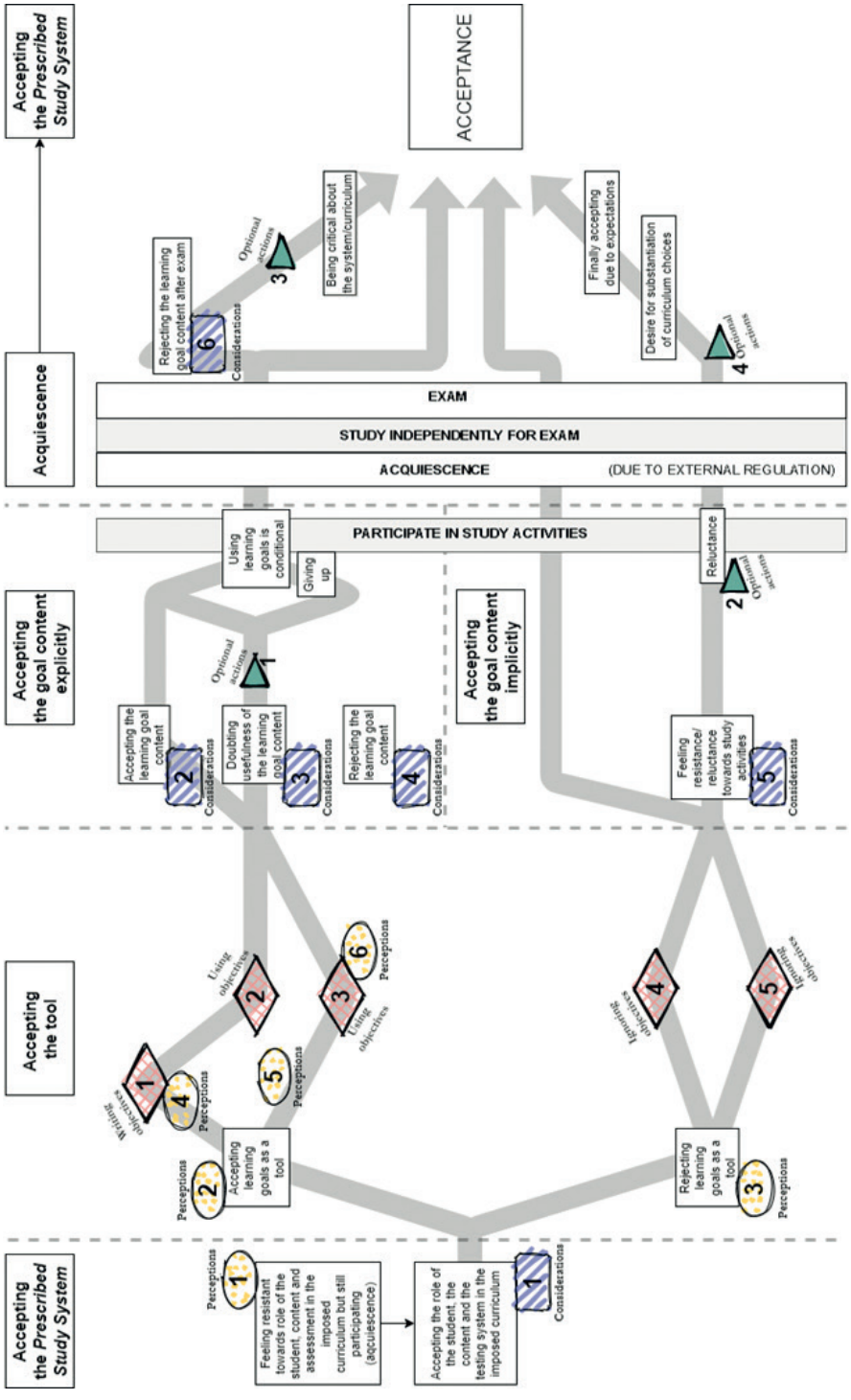


Figure 3: Detailed flow of ALGAT. Students flow from left to right through five areas: 1) Accepting the Prescribed Study System, 2) Accepting the tool, 3) Accepting the goal content implicitly, 4) accepting the goal content explicitly and 5) Acquiescence, leading to Accepting the Prescribed Study System again. In the figure multiple Considerations, Perceptions, Uses of objectives and Optional actions are included, which are specified in the related tables. In area 1

Continuation figure 3 subscript:

all students start out accepting the Prescribed Study System, with or without feeling resistant about it. In Area 2 students split into users and non-users of learning goals, with variations in strategies for both. In area 3 all goal users accept, doubt or reject the learning goal content explicitly. In Area 4 non-users accept or reject the learning goal content implicitly. When learning goal content is rejected implicitly, study activities are participated in with reluctance. In Area 5 all students acquiesce and study independently for their exam. After the exam some students feel critical which is sometimes discussed with instructor or peers. In the end all students defer to the Prescribed Study System because they are adamant on passing the exam.

Table 1. Considerations.

Considerations		
1	For accepting the guiding role of the teachers and coordinators, the dependent role of the student, the assigned learning goals and content and the fact and function of final examinations	The assigned curriculum is useful
		The program matches what I want to learn
		I will do what I signed up for
		Trust
		Someone must determine the direction and the instructors and coordinators are the best candidates for this because of their experience
		Not wanting the responsibility of deciding on the program to become a doctor
		There is also freedom to pursue subjects that interest them personally
		Studying becomes more and more interesting
		A curriculum based on learning goals that are democratically decided by the students would be very time consuming and tasking in the practical sense
2	For accepting the learning goal content	Can understand and relate to it or find it useful
3	Doubting usefulness of the learning goal content	Learning goals are contradictory to each other
		Learning goals are abstract
		The complementary information cannot be found in the offered study materials
4	For rejecting the learning goal content	Cannot understand or relate to it or find it not useful
5	For feeling resistance/ reluctance towards study activities	Activities do not feel authentic
		Activities are very energy or time consuming
		It is unclear to students as to why they are to do what is demanded
		Not all content should be mandatory for every student
6	For rejecting the learning goal content after the exam	Exam questions that did not link with a learning goal or a learning goal that was not examined

Considerations ranged from ‘the assigned curriculum is useful’ and ‘the program matches what I want to learn’ to ‘I will do what I signed up for’. Participants often mentioned to ‘trust’ the instructors and coordinators who created their studies, stating that ‘someone must determine the direction and the instructors and coordinators are the best candidates for this because of their experience’ and some even said to ‘not wanting to have the

responsibility themselves of deciding on the program to become a doctor'. Participants described that they accept the system because 'there is also freedom to pursue subjects that interest them personally' for example through electives. In addition, one participant mentioned that he believed 'studying becomes more and more interesting' and fulfilling to him, as with every new step in his educational trajectory, for example from secondary education to higher education, he could choose a direction that matched his interests even more. Finally, one participant reasoned that 'a curriculum based on learning goals that are democratically decided by the students would be very time consuming and tasking in the practical sense'.

> *'They just show a bit of all branches of the profession and they also give you a certain perspective. Certainly within a very collaboration oriented profession I think it is important to realize a little bit of what other people are doing and, um, what falls within other professions within medicine.'* – P

> *'Uh, and you know, if you choose (your education), then you have to go for it. You have been admitted for a reason'* – L

Not all students accepted the system right away (see *Table 2, perceptions 1*), K instead described his problems with the design and function of examinations, as he felt that in practice examinations instead of learning goals steer learning strategies.

> *'I am not really in favour of the current examination system anyway. … we've made a lot of progress in all forms of education except how we ultimately, judge people on how they performed... If you still use the old-fashioned, form of examination ... teachers cannot say exactly what is expected of you. Because ... if you had a lecture of one hour and they would (state) we are going to ask exam questions about this, then … people are going to look at those three slides and not at the rest … That's the problem with the examination system right now, the most important thing for the student … is getting your bachelor's degree. … If you know exactly what questions are going to be on the exam, then you are going to learn those topics and then you are not going to learn the rest because that is not important for now.'* – K

Table 2. Perceptions.

Perceptions		
1	Of students who feel resistant towards the *prescribed study system* but that still participate	The system is difficult to change
		I have no other option if I want a career
		I can succeed in the system
2	Of students that accept the learning goals as a tool	Learning goals are important
		Learning goals are enjoyable
		Learning goals give direction
		Learning goals give finality to an activity
		Learning goals give meaning to an activity
3	Of students that do not accept the learning goals as a tool	Learning goals are obvious
		Learning goals are not useful
		Learning goals are unnecessary
		Learning goals are abstract
		Learning goals are difficult to use
		Learning goals are time consuming to use
		Learning goals are a formality
		The instructors do not care for the learning goals either
		Learning goals are useful for the instructors and not for students
		Strategy without using learning goals works well
		Content is often more extended than the learning goals and the exam will be a reflection of the extended content
4	Of students that construct their own learning goals	setting my own learning goals is useful
		Setting my own learning goals is enjoyable
		Setting my own learning goals or adapting set goals links the content to me personally
5	Of students that do not construct their own learning goals	Setting my own learning goals is unnecessary
		Setting my own learning goals is not useful
		Setting my own learning goals is not useful yet
		Setting my own learning goals is difficult
		Setting my own learning goals is time consuming
		I have no experience in setting my own learning goals
		I would need assistance if I were to construct learning goals
		Setting personal learning goals together with an instructor is beneficial for others but not for me
		Setting personal learning goals independently is beneficial for others but not for me
6	Of students that use learning goals only right before the exam	The learning goals are part of the deal

In the end, however, K described he had to and would yield to this system, as he explained that the system is unwieldy and difficult to change, that there is currently no other path to the profession he desires, and finally that he is able to meet the requirements of the system.

Accepting the tool

Students view learning goals or objectives as a tool that can be used, but does not have to be used. This divided students into two groups: those who accept the tool and those who do not. This distinction is based on the perceptions that 'using learning goals or not is personal', 'learning goals are optional' and 'learning goals are useful for other students'. Both groups seem to know the other group exists. These groups have very different perceptions about learning goals as can be seen in table 2, *perceptions 2 and 3*.

The students who accept goals consider learning goals to be useful, important and/or enjoyable. They also state learning goals give direction, finality and/or meaning to an activity.

> *'You know, without the learning goals I wouldn't know which kind of (knowledge) level you want me to know … It is sometimes very difficult. Also you have the lectures, but you don't know if the teachers want you to know more than that or if the lectures are enough. And I think that is where the learning goals come in. So handy that you know what levels they are expecting, and it makes things easier for both sides.'* - E

> *'I think it's important … to know why you're doing something. And know the finality of that thing.'* - M

Students who do not accept learning goals as a tool perceive learning goals as obvious, not useful, unnecessary, abstract, difficult to use, and time consuming to use. In addition some view the learning goals as a formality that needs to be mentioned in class by the instructor, mentioning that possibly the instructors do not care for the learning goals either. Conversely, others see the goals mainly as a tool that is useful for the instructors and not for students. Participants state that their strategy without using learning goals works well and that it is better to focus on all content and activities than on learning goals, as the content is often more extended than the learning goals and the exam will be a reflection of the extended content.

> '*They are often somewhat cryptic terms.'* - F

> 'I*t seems obvious to me that if you learn all the material that is offered, that you will eventually still achieve the goals that were set.*' - J

'*I think learning objectives cover what you need to know in a lot of cases. Maybe not always during an exam, because then they go into more details*.' - D

The use of learning goals seems directly related to the acceptance or rejection of the learning goals as tool: the accepters use the goals and the rejecters do not. In using the goals, variation seems to exist, which can be found in table 3, *Use of objectives 1, 2 and 3*. Some students use the assigned learning goals and personalize these or they construct their own learning goals in addition. This was stated to be useful, enjoyable and viewed as linking the content to oneself, as described in Table 2 *Perceptions 4*.

'*Still, I like it very much. It can help you to make something concrete for yourself, a kind of plan for what you actually want to learn.*' - N

'*Well, because the course was there it, it is made for several people. For anyone that wants to learn. But me as an individual, I think I have specific needs and requirements, and I should adapt them to myself. … Because it stops being something that is far from me, to something that becomes personal*' - M

Table 3. Use of objectives.

Use of objectives		
1	Of students that write objectives/learning goals	Constructing personal learning goals
		Personalizing or adapting assigned learning goals
		Discussing personal learning goals with others
2	Of students that use objectives/learning goals (A)	Searching for assigned learning goals at the start of the course or MOOC
		Integrate assigned learning goals with content
		Using the learning goals as foundation for a written summary
3	Of students that use objectives/learning goals (B)	Only notice the learning goals in the beginning of the course if they are mentioned
		Search for the assigned learning goals at the end of a course before the exam
		Check if all the learning goals were accounted for in the summary
4	Of students that ignore objectives/learning goals (A)	Ignore assigned learning goals and focus on content, prioritizing specific sections or media
5	Of students that ignore objectives/learning goals (B)	Ignore assigned learning goals and focus on covering all content

These students go on to use the learning goals in the following way: they search for them at the start of a course or MOOC, integrate them with the content by linking goals to activities and vice versa, and use the learning goals as foundation for a written summary before the exam (table 3, *Use of objectives 2*).

Not all participants enjoy setting goals in addition to using the already offered goals. They find setting their own learning goals unnecessary, not useful or not useful yet, difficult or time consuming. Participants stated to have no experience in setting their own learning goals, to find it difficult and to need assistance if they were to construct learning goals. Finally some participants stated that setting personal learning goals together with an instructor or independently might be beneficial for others but not for themselves (table 2 *Perceptions 5*). These students either use the assigned learning goals in the same way as the students that do construct their own goals, or they used the goals in the following way: they skip the goals in the beginning of a course, but search for them at the end of a course before the exam, and check if all the learning goals were accounted for in their own summary of the content (table 3, *Use of objectives 2*). This last category of students also found learning goals to be 'part of the deal', meaning they could not be ignored (table 2, *Perceptions 6*).

In not using the goals we also discerned variation, as can be found in Table 3, *Use of objectives 4 and 5*. In this group, all students focused on content and not on goals, however some focused their attention and some were adamant on covering all offered content. The selecting participants focussed to a specific section or medium, such as lectures, because this was their tried and trusted strategy. One student even based his time and energy investment on the examination matrix, favouring subjects that were stated to be examined more extensively or with more difficult questions.

> '*Before I start studying, I always look in the test matrix to see what is important, and which lectures need a little less time. My entire study actually consists of a trade-off of time and what is worth the most points.'* - K

Accepting the goal content explicitly

Logically, only students that are aware of the learning goal content can accept or reject the learning goal content. From our data we gather that regardless of the way learning goals are used, students accept, reject or doubt the usefulness of the learning goal content, as can be seen in table 1, *Considerations 2* and *4*. However, students will give up their rejection and study the learning goals even if they cannot relate to them.

> *'I find receptors at the cellular level not necessarily interesting. And if you then have to learn all that … Then I think why should I have to cram it all for this exam while I will have forgotten that in a month or maybe next week. … If I need that later, I will look up the details then. And it seems to me that you only need that in a lab or something and I don't want to do that work myself. So I just question, why should I start cramming this now? But in the end I will cram it for the exam.'* – A

Doubt about learning goals occurs when learning goals are contradictory to each other, when they are abstract, or when the complementary information cannot be found in the offered study materials (table 1, *Considerations 3*).

> *'But for some modules, sometimes there's contradictory information. … people can create a module that says that we'll focus on the basics of microbiology, but then you also have to go into the specifics'* - M

> *'There were some learning goals which I felt like weren't really discussed in the lectures or in the tutorial that we had. So I think then it is really unfair If you state learning goals and as a teacher you don't really discuss them specifically enough to ask questions to students.'* - E

When in doubt, students discuss with the instructor, their peers or both, or they search for information independently outside of the study materials (table 4, *Optional Actions 1*). This can lead to acceptance if the doubt is taken away, or rejection if not. Acceptance of goal content is thus conditional and based on usefulness, concreteness, clarity of the goal and findability of the related content. Students will give up on goals they cannot accept.

> *'I sometimes do not know exactly what that learning objective is and where it was explained. Then I can search for it in the lectures, I can still look it up. I can check my notes of the lecture in question to see if I know what it is about. And if that doesn't work then I always have the internet to look it up. I will try to find out what they meant by those learning goals, so that I know for sure that I have also read that before the exam.'* - L

> *'If I still do not understand, I look it up on the internet, on YouTube I look for a good video, where it is completely explained. I then hope I have learned some extra things from that. So that, when asked at the exam, I know at least something to say about it.'* - L

Table 4. Optional actions.

Optional actions		
1	When doubting the assigned learning goals	Contact the instructor Discuss with peers Search for information independently
2	When feeling reluctant to fulfil or participate in study activities	Discuss with peers
3	When participation in study activities was unwillingly and the exam has passed	Discuss reluctance with instructor Discuss reluctance with peers
4	When exam questions that did not link with a learning goal or learning goals that were not examined are identified	Discuss with instructor Discuss with peers

Accepting the goal content implicitly

Students that do not use learning goals do not explicitly accept or reject the learning goal content. They do describe sometimes feeling reluctant to join the assigned study activities and content, in which the learning goals content is implicitly present. This happens when activities do not feel authentic, are very energy or time consuming, or when it is unclear to students why they are to do what is demanded. In addition students feel not all content should be mandatory for every student, especially when they have already developed certain skills (table 1, *Considerations 5*).

> *'Often I think okay, I'll get to work, but then I'll read the article and then- If the PDF already says at the top, this is ten or fifteen pages long, I start to feel like oh, it is a lot, but fine. Then when you start reading and you're two, three pages in and they still haven't really said anything useful, then I think why should I read those pages while they don't really get to the point? And that may also have something to do with the subject …, but then I start to think, why?'* - F

> *'I wonder whether that kind of education is necessary at all for a lot of students.'* - D

Participants describe that they sometimes discuss this reluctance with peers, but that they will participate in the activities either way as it is obligatory (table 4, *Optional actions 2*).

> *'Of course I just participated, because it was, in itself, quite funny to just mess around with your workgroup. But if I just think back to that, did this actually benefit me? Not much.'* - F

Acquiescence

All participants described that they would, in the end, defer to whatever was expected of them, even if they do not fully understand or agree with the expectation, as they were adamant to pass the examination. After finishing the exam the group of students that knew the learning goal content sometimes identified exam questions that did not link with a learning goal or a learning goal that was not examined, leading to a rejection of the learning goal after the exam (table 1, *Considerations 6*). This could then lead to discussions with peers, the instructor or both (table 4, *Optional actions 3*).

> *'But that is often just a written comment after an exam like: hey, I did not encounter this question in the course material, where is it?'* - I

> *'First of all I just talk to my workgroup mates, hey, did you have that too? And how did you do that? And does anyone happen to know where that information is? And we also have a very large Whats-app study group and then people just throw questions in it, hey, this came back, where was that actually? And if that doesn't work out, I*

just ask it during a workgroup or if there is a discussion of the exam. Then I just ask a question, where can I find that?' - I

Students described feeling critical about the curriculum or the instructors when this occurred, however they still seem to accept the underlying system and focus on what they could do themselves.

'I had the chance to actually talk with the professors about it and to see how they react and why they did it the way they did. … It is of course very disappointing to see something like that and to notice that (a learning goal) wasn't discussed. But I would try my best to just do it on my own and hope for the best.' - E

Some students that did not know the explicit learning goal content would, after the examination, discuss their reluctance regarding the activities or content with the instructor, peers or both (table 4, *Optional actions 4*). Participants described wanting for a substantiation to understand the choices that were made in what and how they had to understand or complete the content and activities they endured or passed reluctantly. In the end however, they viewed this as an acceptable critique as the system offers them clear expectations, that they are usually able to meet.

'Well, I know what to do and I can. So I'll write it down. So in that respect, I don't mind doing it at the time. But it does go against my will. And so (it is) reluctantly, to do that purely for that teacher and not for myself.' – D

In the end students accept the Prescribed Study System it seems, both because of the earlier described considerations, and also because they feel they have little other options.

Discussion

In our context undergraduate medical students accept the Prescribed Study System although some students feel very critical. Integrated MOOCs are perceived as part of the Prescribed Study System when examination is made as important as other formal components in the curriculum. Students see learning goals as a tool that does or does not fit in their personal study strategy, and we found five different strategies regarding use of the learning goals. Acceptance or rejection of learning goal content can happen explicitly or implicitly, depending on the student's strategy. When students run into a rejected goal, implicitly or explicitly, or if they doubt its usefulness, they discuss with instructors or peers, or they search for a solution on their own. In the end, students will acquiesce to whatever is expected of them because they are adamant on passing the exam. These combined findings form Assigned Learning Goal Acceptance Theory.

Not using Assigned Learning Goals

We found that students perceive learning goals as an optional tool that they are free to use. Some students do not even take note of the learning goal content and may not 'set' learning goals at all. This could lead to pedagogical distance: misalignment in the objective of learning tasks in theory, as designed by the teacher, and what the objective becomes in practice, as enacted by the students (Westberry & Franken, 2015). Our finding is in line with research from Brooks et al. (2014) and Osueke et al. (2018) in undergraduate courses in biology, (bio) medical and English students, who both found that not all students use learning goals and that this is related to their perceptions of learning goals. In addition to negative perceptions about learning goals, an interest-based learning approach might drive students not to follow the teachers agenda (Senko & Miles, 2008). In our study, many students stated that the examination focusses their study efforts, but that interest can exceed the examination. Although performance could be slightly hindered by focussing on interest-based learning, the participants in our study stated that their strategy without learning goals works for them; they can pass the exams.

Many studies seem to investigate goal setting and learning objectives in relation to other constructs with the assumption that (learning) goals are read and understood, which does not have to be the case (Jiang & Elen, 2011; Manzone et al., 2019). Consequently, participants in these studies might have been more focused on the assigned goals than usual and have acted differently than they would have in a more natural setting where they apparently feel free to not look at the goals at all. Checking personal goal setting strategies should always be considered when researching goal setting and related constructs.

Considerations for Accepting Assigned Learning Goals

Students accept or reject learning goals either explicitly or implicitly based on considerations of 1) usefulness, 2) comprehensibility and 3) perceived constructive alignment.

- *Usefulness.* Students that use learning goals go through them at the start of a course or right before the exam (Brooks et al., 2014; Osueke et al., 2018; this study), and consider the usefulness of the learning goal content when they do. This usefulness theme on goal content level aligns with the literature that underlines offering rationales when assigning learning goals, and with Simons et al. (2004), who found that students that see usefulness of a course for their current situation and for future situations 'are more task oriented and show more motivated behaviour'. The same consideration plays a role on the goals-as-a-tool-level for students that choose to not use the learning goals altogether: they reject the goals a priori based on the idea that learning goals as a tool are not useful. For students that do not use learning goals, the label 'not useful' might also depend on the difficulty that these students have in comprehending the learning goals and the mismatch they perceive between the learning goals and the exam questions.

- *Comprehensibility.* Students that use the learning goals check if they understand the goal content before they accept or reject the content, and take action when they do not understand. Students that do not use the learning goals stated that all learning goals are abstract and difficult to use. Brooks et al., 2014 found that over three quarters of their participants perceived learning objectives to be understandable only after they had completed the course. In our study some participants mentioned the same. The perceived abstractness of a learning goal might thus be closely related to the unfamiliarity with the content that is to be mastered. Formulating good learning objectives does demand certain knowledge and skills (Ferguson, 1998) and these could help in increasing comprehensibility, however the fact that some students have difficulty understanding while other students can understand the same goals, suggests that comprehensibility is also influenced by knowledge or skills of the student (Leone et al., 2019) such as verbal ability (McCrudden et al., 2010) and previous obtained content knowledge.
- *Perceived constructive alignment.* Students that use learning goals try to match them with the study materials. After the exam, students also try to match exam questions to learning goals when they feel an exam question referred to content they did not recognize. Students that do not use learning goals state that in their experience learning goal content does not cover all they need to know for the exam. This notion resonates with the finding that only 59% of students in the study by Brooks et al. (2014) agreed that 'learning outcomes specify the level of learning required to pass an assessment' and that nearly 60% of respondents found it 'possible to underestimate the level of learning required to pass an assessment from published learning outcomes'. Constructive alignment is thus important for students to accept learning goal content, and in the long run to accept the learning goals as a tool, as they might lose trust when goals repeatedly do not clearly align with examinations.

Acquiescence

A finding that we have not seen described explicitly in the context of goal setting or goal acceptance is the acquiescence to the Prescribed Study System in order to complete one's studies. Although it directs students to study the contents we want them to, we find this acquiescence undesirable as it is founded in external regulation. It is widely accepted that formal learning contexts are externally regulating the motivation of students through assessment (Allal, 2010; Harlen & Crick, 2003), in addition to intrinsic motivation that may exist. During our analysis the idea formed that students end up in a 'learner's trap': they enter the school system and comply to it because it is the normal thing to do. Society portrays few other options for success in work and life than to learn and study in the formal system, and studying is widely perceived as the best thing you can do for your future. When students have entered a Prescribed Study System they have to accept that they do not know enough to set out the path. They may not be aware of this or want to set out the path, or even enjoy that it is decided for them. As the Prescribed Study System includes high stakes assessment of the assigned goals, it acts as a powerful external motivator that exists in addition to the internal

motivation students can feel for their chosen subject of study. Students can thus barely escape external motivation to learn, even if intrinsic motivation is present, because they have to surrender to the prescribed path, designed by more experienced and more knowledgeable coordinators and instructors. The idea of the learner's trap is in line with the notion of the cognitive path to self-regulatory skill: learning and teaching SRL skills is initially social in form with explicit instruction and modelling of the instructor, but becoming increasingly self-directed ((Zimmerman & Kitsantas, 2005, p. 519). To change acquiescence of the Prescribed Study System into identified or internalized acceptance at the start of an educational path, different assessment methods, for example formative assessment (Allal, 2010; Harlen & Crick, 2003), could be implemented as it has been found that these are less stressful (Cobb et al., 2013). Minimalizing the focus on the exam might create the space that is needed to focus on what it is really about: the desired development, as formulated in the learning goals. In addition, explicitly aligning learning goals of students and faculty (Harlen & Crick, 2003; Westberry & Franken, 2015) to improve autonomous forms of motivation to learn should be desired. We found it interesting that the notion of the examination as a driving force was mentioned as a problem on a larger scale by one of our participants. The fact that a student pointed out this problem implicates that awareness is spreading and research directed towards retaliating this very complex problem in the education system can count on support among multiple stakeholders.

Acceptance in MOOC Integration Designs

Originally our study was aimed specifically at learning goal acceptance processes of students in three different formal MOOC integration contexts. However, we found we had to broaden our scope as students described that their acceptance, use and perceptions of learning goals did not relate specifically to integrated MOOCs, but to the degree of obligation of that MOOC as a mandatory study component in their study programme. Students estimated obligation based on formal examination and study points, and increased obligation led to increased effort, including using learning goals, if this was the preferred strategy. In addition students would invest more time and energy if they were interested in a topic, regardless of obligation. This means that for learning goal use and acceptance in MOOC integration designs specifically, either personal interest or perceived obligation should be highly supported. For example, when MOOCs are integrated as electives, joining students will already have higher interest. When a MOOC is a mandatory component and personal interest is not ensured, extra attention should be paid to align the importance of the learning goals and the examination of the MOOC with the other learning goals and examinations in the study programme.

Practical implications

Practical implications from our findings to increase acceptance of assigned learning goals are threefold. Offering more information has been found to enhance acceptance of

assigned goals (Earley et al., 1992; Erez & Kanfer, 1983), and our study suggests this might be because of 1) improved perceived usefulness, 2) enhanced understanding of a goal, or 3) because a link between the goal and the tasks and related materials can be identified. First, if no option for joint goal setting or consultation exists, pay attention to telling and selling instead of only telling. Underlining why a specific learning goal is important for the student can help to identify with the goal, and it offers a handle to integrate the learning goal with their own values and norms, as proposed by Self-determination Theory (Ryan & Deci, 2000). The importance of a learning goal for the student is best explained in a way that underlines the use of the knowledge, skill, attitude or perspective in a future authentic activity (Simons et al., 2004). For example, the importance of a learning goal concerning collaboration in medical education could be underlined by describing difficulties that can arise in collaborating with interprofessional or multi-speciality teams. While students might regard their current collaborating skills highly, they have probably not yet encountered such difficulties and would probably want to be able to understand and handle such complex situations in the future stages of their studies and career.

Second, actively present the learning goals, state where they are listed (Leone et al., 2019), have a conversation about the concrete meaning of the goals or make it explicit that questions are welcome, and if possible check understanding (Jiang & Elen, 2011). Sana et al. (2020) offered the learning objectives in the form of questions on a pre-test at the start of a course and found that this positively augmented the learning gains. This method directs attention to the learning goals and makes the aims clear or creates a moment to investigate the meaning of a learning goal.

Third, underline the connection between learning goal content, study materials and the exam. When designing a course, the starting point is often the learning objectives, which are to be aligned with the teaching and learning activities, content and examination, to achieve constructive alignment. This means, that in most courses, instructors should have a pretty good idea of how learning objectives are related to the activities, materials and exam questions. Students take learning objectives less seriously when this alignment fails (Crowe et al., 2008; Osueke et al., 2018). For students, it is helpful if instructors are transparent about the alignment in a course (Leone et al., 2019). This can be done by stating for each activity or material to what learning goal(s) it is related, and by offering a matrix that conveys where materials related to learning goals can be found.

In addition, keep in mind that having students setting their own learning goals could decrease acceptance of the assigned learning goals if there is a mismatch, so unless time and energy can be spent on aligning self-set and assigned goals, this is not advised (Austin, 1989; Erez et al., 1985). Finally to help students use learning goals, explaining how and when they are helpful (Osueke et al., 2018) could improve the acceptance of learning goals as a tool.

Future research

We propose future research efforts to be directed to three areas. 1) The confirmability of our findings in other context where learning goals are assigned. ALGAT poses a model to understand learning goal acceptance, however it was formed in a single context. Data from other contexts is needed to further ground the theory and possibly refine and add to it. 2) The portions of students that do or do not use the tools and the factors that predict these portions should be further studied. We propose to include into this analysis the quality of the learning goals and the quality of the rationale, the modality of the conversation that can be had about the learning goals, and (perceived) constructive alignment as a starting point. 3) The role of instructor's perceptions of learning goals in assigned learning goals use and acceptance. In our study we focussed on the student perspective, however our and prior findings suggest that instructors may play a significant role in how students perceive, use and accept learning goals (Osueke et al., 2018) and is thus worth the attention.

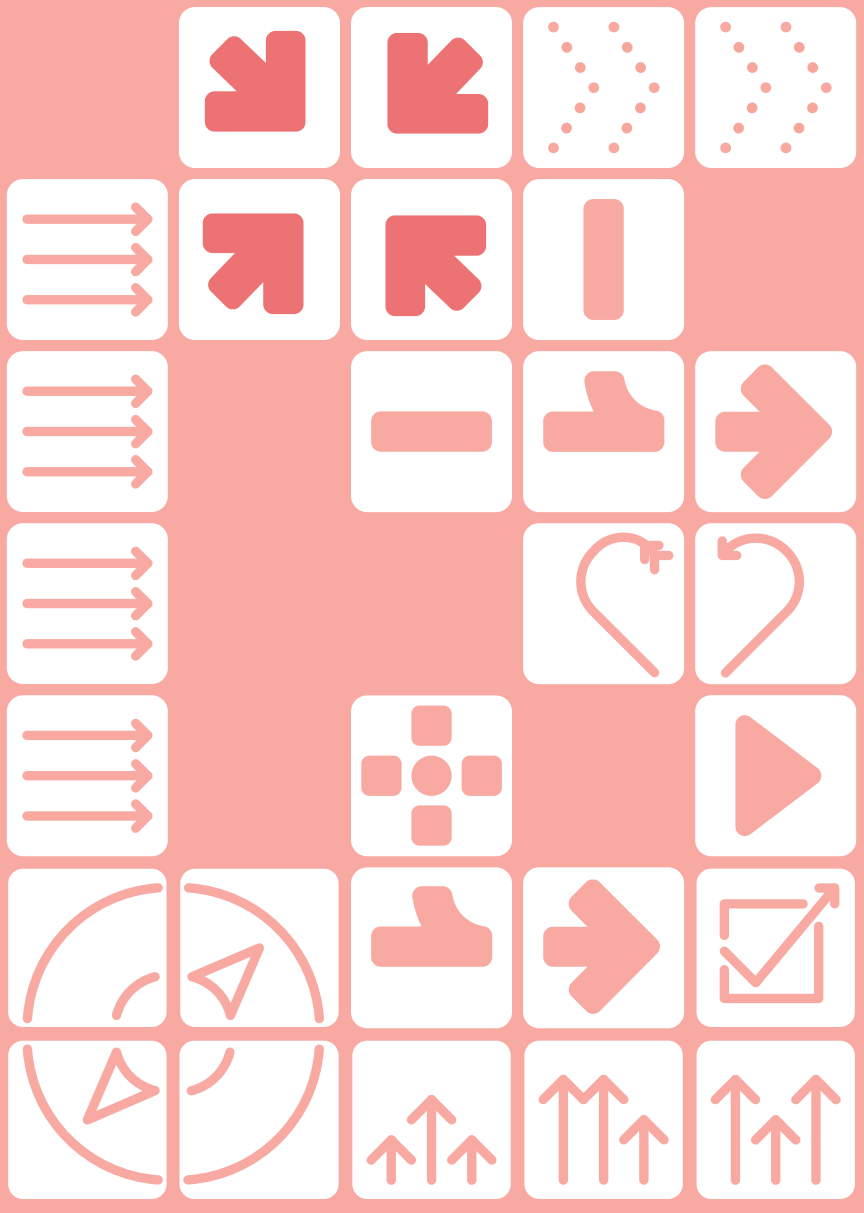
Conclusions

Assigned Learning Goal Acceptance Theory describes the processes involved in acceptance of assigned learning goals in a Prescribed Study System. Four essential elements were found: 1) the perceived fit of learning goals as a tool with students' study strategies; 2) the level of explicit or implicit acceptance of content of learning goals depending on the student's strategies; 3) the level of acceptance that is based on considerations of usefulness, comprehensibility, and perceived constructive alignment of learning goals within a course; and 4) students' acquiescence to whatever is expected to pass the examination. Assigned Learning Goal Acceptance Theory contributes to understanding and improving learning goal acceptance and offers directions for future research.

Highlights

- The present study offers Assigned Learning Goal Acceptance Theory, a model to understand learning goal acceptance processes of undergraduate students.
- Students see learning goals as a tool that does or does not fit in their personal study strategy
- Acceptance or rejection of learning goal content can happen explicitly or implicitly, depending on the student's strategy
- Acceptance or rejection is based on considerations of usefulness, com-prehensibility, and constructive alignment
- In the end students acquiesce to whatever is expected of them to pass the examination

CHAPTER 9



General Discussion

General aim

Since their origination in 2008 Massive Open Online Courses have grown to be a popular addition to the higher education landscape. Enthusiasm for medical MOOCs combined with opportunity and desire to reuse these opulent courses led to integration into medical campus education. The research in this thesis focusses on understanding and optimizing in campus integration of medical MOOCs. The aim of this work is to find valuable directions for high quality teaching and learning in campus integrated medical MOOCs.

In this Chapter, first a brief overview of the main findings of each study will be provided followed by six general conclusions. These include three on high quality teaching and three on high quality learning. Next, strengths and limitations are considered, followed by practical implications and avenues for future research.

Overview of main findings

In our first study (**Chapter 2**) we identified and categorized teaching modes of 33 MOOCs. We then categorized the found teaching modes into social-epistemological dimensions. We found 29 teaching modes, of which three had not been reported as part of a MOOC before, and we found multifunctional teaching modes that were used for instruction as well as assessment. The study showed medical MOOCs are richer than previously described, even richer than other, non-medical MOOCs that had been systematically investigated previously (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 MOOC differs in variety and amount of teaching modes. The analysis of social-epistemological dimensions showed that many of the investigated courses focus on constructivist teaching modes and only a few focus on group learning.

In the following study (**Chapter 3**) we investigated the same 33 MOOCs, but now we focused on the instructional design quality of the courses by examining to what extent the courses met each of eleven relevant principles of instructional design (Latham & Seijts, 2016; Locke et al., 1988; Margaryan et al., 2015; Merrill, 2002). We found medical MOOCs eligible for integration to meet these principles in varying degree. The principles of *application*, *authentic resources*, *problem-centeredness*, and *goal-setting* were present in many of the courses; *activation*, *collective knowledge*, *differentiation*, and *demonstration* were present in less than half of the courses; and finally, *integration*, *collaboration*, and *expert feedback* were present in less than 15% of the courses. Some principles might not be compatible with the MOOC format, or are currently under exploration by the MOOC research community. Assessment of instructional design quality of a MOOC is thus desired before integrating in campus settings to make an informed decision about the integration design. For integration,

MOOC quality should be considered in relation to the quality of the existing campus education and the finalized integrated course. Additionally, while conducting this study we concluded that assessment of instructional design quality demands an experienced assessor and is time-consuming. More effective and efficient MOOC assessment methods are needed for the purpose of large-scale integration.

We then aimed to share what we had learned in practice by developing, implementing and integrating the MOOC "Clinical Kidney, Pancreas and Islet Transplantation" in campus teaching (**Chapter 4**). We found creating a new MOOC is a time-consuming activity which requires many resources. We also experienced our MOOC to be effective in use as integrated materials in a wide range of educational contexts, from undergraduate to post-graduate teaching, and many informal learners and formal students considered the MOOC as added value. Although no statistical comparisons were made in this study, differences seemed to exist in intentions for enrolment, and for participation in optional content between students from different MOOC integration designs.

To inform and assist other medical teachers in integrating MOOCs in campus education we then bundled our research findings and practical experiences in twelve tips for integrating MOOC content into classroom teaching (**Chapter 5**). Together, these tips guide teachers through: defining what content needs to be integrated; options in how to use a MOOC; searching for MOOCs; determining access possibilities for students; gauging credibility; considering free availability for enrolment and reuse; determining desired teaching modes; determining social-epistemological dimensions; aligning learning goals, teaching activities, and assessments in the integration design; providing clear instructions on enrolment; providing students with clear instructions on how to utilize the MOOC and its resources; and finally, determining the success of their MOOC integration.

Next we developed a mixed-methods research protocol to examine motivation, Self-Regulated Learning and goal-setting in different MOOC integration designs (**Chapter 6**). Five research questions were posed and the study was designed so that all questions could be answered with data from two surveys and one set of interviews. Three of these questions are answered by the study in **Chapter 7**, in which we aimed to determine motivation profiles of students learning in integrated medical MOOCs, to find out if different integration designs relate to different motivation profiles, and to determine differences in motivation precursors in different integration designs. First we found motivation factors to differ from motivation factors previously described in formal education in literature, however factors did resemble factors described in informal MOOC learning. Second we found six distinct motivation profiles based on three forms of motivation: Self-determined learners, highly self-determined learners, grade hunters, and teacher trusters who are moderately, highly or extremely trusting. We also found proportions of motivation profiles to differ significantly

between MOOC integration designs, and that MOOC integration designs satisfy and frustrate psychological needs significantly different.

Another research question from the protocol was answered in our constructivist grounded theory study (**Chapter 8**). The aim was to better understand acceptance and rejection processes of students that learn with assigned learning goals in integrated MOOCs. It yielded Assigned Learning Goal Acceptance Theory, a model that describes five areas of accepting or rejecting learning goals that students can flow through in a course. We have found that for accepting assigned learning goals in graded undergraduate courses the following elements play a role: 1) the perceived fit of learning goals as a tool with students' study strategies; 2) the level of explicit or implicit acceptance of content of learning goals depending on the student's strategies; 3) the level of acceptance that is based on considerations of usefulness, comprehensibility, and perceived constructive alignment of learning goals within a course; and 4) students' acquiescence to whatever is expected to pass the examination.

General conclusions for high quality teaching with integrated medical MOOCs

Medical MOOCs provide a wealth of opportunities for integration into campus, including options to offer high quality, innovative teaching (Chapter 2, 3, 4 and 6).

In this thesis we found medical MOOCs to offer 29 different teaching modes, many focused on constructivist teaching (Chapter 2, and summarized in table 1 of this Chapter). We also found medical MOOCs to have relatively high scores for instructional design quality (Chapter 3). Our own experiences showed that with one MOOC multiple integration designs could be realized to offer students innovative learning experiences (Chapter 4). Finally, we condensed the diversity of possibilities for MOOC integration designs to a set of decisions regarding 1) level of education, 2) degree of obligation, 3) ratio of online versus face-to-face teaching, 4) MOOC content addition to, or replacement of formal courses and 5) level of contact with other online learners in the MOOC (Chapter 6).

Table 1. List of available teaching modes in medical MOOCs and their social-epistemological dimension.

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 dialogue				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***	

Note on meaning of abbreviations. OI: Objectivist-Individual; OG: Objectivist-Group; CI: Constructivist-Individual; and CG: Constructivist-Group.

*Other modes are sometimes included in videos, ** MOOC #1 and #33, *** MOOC #10 and #14

Our findings contradict conclusions by Toven-Lindsey et al. (2015), who questioned the possibility to innovate higher education by using MOOCs, as they found predominantly objectivist teaching modes. This included the one medical MOOC they investigated. Similarly, our findings contradict result from (Kasch & Kalz, 2021), who also included four medically oriented MOOCs in their sample of 40, and found activities to be focused on

factual knowledge. With our findings concerning quality we were able to partly confirm the statement of Subhi et al. (2014) that medical MOOCs are of high academic standard. Only some MOOCs were pedagogically deficient as Doherty et al. (2015) claimed. Further, our findings corroborate the idea by Stracke et al. (2019) that MOOCs are very suitable to be viewed as Open Educational Resources and confirms it specifically for medical MOOCs: with the inclusion criteria for our studies we found a generous offering of MOOCs on a medical topic with free course content suited for students (Chapters 2 and 3). Would we have included basic science topics, which are relevant for medical school as well, the list would presumably be much longer. Medical teachers virtually have an extra database filled with well-structured and -presented activities to pick and choose from, often created by experts in their field. Also, all the previously described advantages of MOOC integration apply, see table 2. The fact that we found so many different teaching modes, including many focused on constructivist teaching implies that medical campus education could improve in quality through integration, as medical education tends to be somewhat traditional and focused on objectivist teaching (Cooper & Richards, 2017; Tang et al., 2018). We could thus further substantiate the claim of Goldberg and Crocombe (2017) that innovative teaching models for students can be an advantage of MOOC integration.

Although our findings imply MOOC quality should not have to hamper MOOC integration, we believe general MOOC quality will improve as this has been a focus of recent research efforts (Bozkurt, 2021; Stracke & Trisolini, 2021; Zhu et al., 2018), and medical MOOC quality might improve further as well. As quality of general MOOCs was found to be low in multiple studies (Lowenthal & Hodges, 2015; Margaryan et al., 2015), several quality frameworks to guide MOOC design and creation were developed (Aloizou, 2018). These frameworks aim to guide MOOC design and creation, to support quality of the final products and the processes to get there. They do this by listing steps and relevant stakeholders in the creation, implementation and evaluation phases. They can further enhance quality of future medical MOOCs by supporting creators to design based on quality criteria. For the instructional design principles *integration, collective knowledge, activation, demonstration, and some items of problem-centeredness* we found lower scores. For example for *demonstration,* only three MOOCs (9%) offered 'solutions to problems with a range of quality, from excellent examples to poor examples' (Chapter 3). This might be related to the potential causes provided by Margaryan et al. (2015): (1) MOOC instructors and designers may lack knowledge of the relevant quality criteria, learning theories or instructional design principles; (2) instructor and designers might be aware and incorporate these in face-to-face teaching but not in MOOCs; (3) institutional marketing concerns rather than pedagogical considerations drive instructors when offering MOOCs.

Table 2. List of advantages of MOOC integration described previously by [1]Doherty et al., 2015; [2]Sharma et al., 2014; [3]Sarkar and Bharadwaj, 2015; [4]Davies, 2013; 5Goldberg and Crocombe, 2017.

Advantages of medical MOOC integration
• access to topics typically not included in the curriculum[1]
• receiving education from institutions that not all students can travel to[1]
• improved understanding of subjects that are not common in the students' country of residence[2]
• the ease of creating a class once and running it multiple times, with no additional effort or cost[3]
• the possibility to avoid the cost and inconvenience of reaching a single location[4]
• the opportunity to use "exemplar" learning materials from experts in their respective fields, rather than each university creating its own[1,2]
• innovative teaching models for student learning[5]
• improved communication among international communities of medical experts and students[5]

Specifically for the principles with low scores due to the causes listed by Margaryan et al. (2015) the developed quality frameworks offer much potential as they can educate MOOC designers and instructors regarding the relevant criteria and principles. In addition, by offering quality labels, they impel use of the frameworks by MOOC creating institutions, as an enhanced reputation for teaching and learning is one of the reason for universities to create MOOCs (Haywood et al., 2015). For the principles of *goal-setting* and *differentiation* recent research offers new opportunities for implementation in online education. For goal-setting, attention has grown extensively in the last years, as a major part and driver for self-regulated online learning. Prompts and pre-tests are being incorporated in MOOCs to support goal setting and many platforms now ask for personal goals. For differentiation, the rise in possibilities with learning analytics is contenting. Currently many researchers experiment with using student data to offer a personalized learning path, which is the superlative to differentiated paths. Moreover, as Wei et al. (2021) proposed tailored assessment based on student motivation profiles, innovations that combine goal setting and personalized learning may be on the horizon as well. Contradictory to promising developments for most of the instructional design principles we investigated, two seem to remain troublesome: *collaboration* and *expert feedback*. Recently Kasch and Kalz (2021) investigated MOOC quality with a focus on interaction, including student-student and student-teacher interaction, and feedback in 50 MOOCs, of which four could be considered medically oriented. They too found *collaboration* and *expert feedback* remarkably underrepresented.

Different ways to integrate MOOCs have been reported previously (Israel, 2015; Robinson, 2016; Swinnerton et al., 2017). Through our experiences and rationalizations of MOOC integration, we discovered that ways to integrate MOOCs are possibly inexhaustible. With descriptions of MOOC integrations from case studies in the back of our mind we were able to condense MOOC integration to design choices on five levels (Chapter 6 and summarized in figure 1).

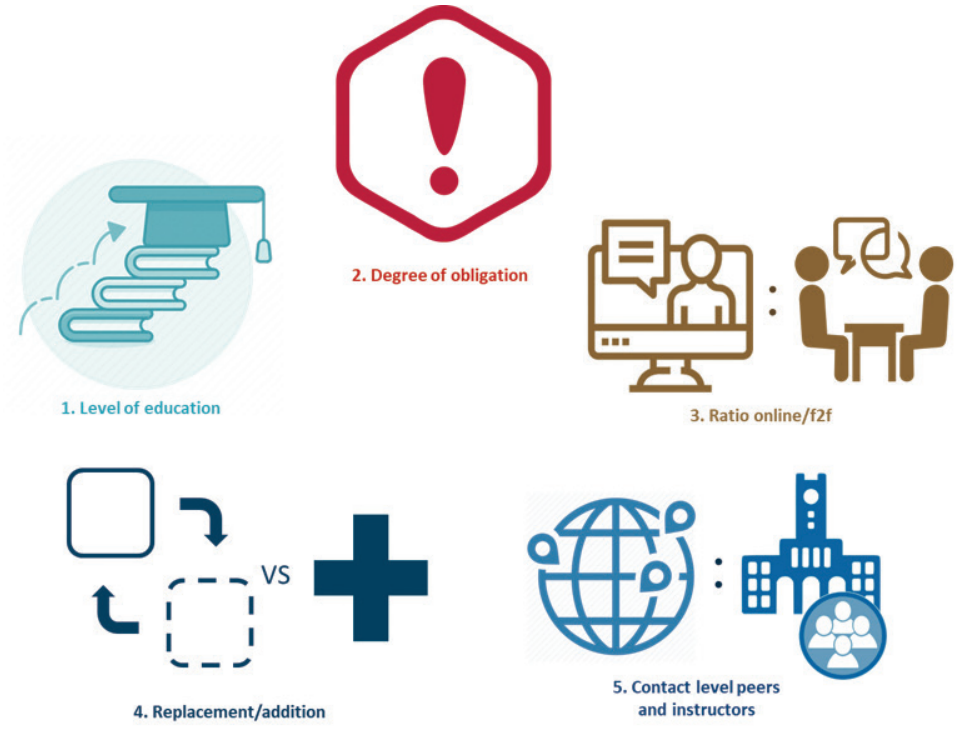


Figure 1. Relevant design choice levels for in campus integration of MOOCs.

These are: 1) the level of education, 2) the degree of obligation, 3) the ratio of online versus face-to-face activities, 4) use of the course as replacement or addition, and 5) the contact level with peers and instructors in the MOOC. Together, decisions on these levels characterize an abundance of options for MOOC integration in campus education. Different frameworks to characterize MOOC integration have also been developed, however as these are based on fewer characteristics, they yield fewer options. Pérez-Sanagustín et al. (2017) described integrated MOOC-based initiatives as a continuum of two factors: (1) institutional support to reuse an existing MOOC, and (2) curricular content alignment between the MOOC and the program. Four types of MOOC integration were conceptualized: MOOCs as a service when both are low, MOOC as a driver for integration when both are high, MOOCs as a replacement when the first is high and the second is low, and MOOCs as an added value when the first is low and the second is high. Alghamdi et al. (2019) coined the bMOOC model, a classification of ways to blend MOOCs into campus teaching, based on a literature review of 20 case studies. They found MOOCs can be used as an optional supplementary, or integrated. Integrated options focused on using MOOC content, using MOOCs as assessment with credit, and using MOOCs specifically for interaction. Cha and So (2020) described integration based on two factors, namely credit recognition and online learning. This led to three types of MOOC-integrated learning experiences: formal MOOC learning,

formal blended MOOC learning, and non-formal/informal MOOC learning. Clearly, MOOCs offer many options for integrating and also many options to classify and report integration. Concerning optimization of MOOC integration, we believe at least the five design choice levels of integration in figure 1, need to be described in every study, however other relevant levels might need to be added, based on the models by Alghamdi et al. (2019) and Cha and So (2020). Some recent MOOC integration studies are more advanced than previous case studies, comparing multiple designs (Cornelius et al., 2019; Larionova et al., 2018). However, similar to more recent case studies (Belenko et al., 2019; Corrado et al., 2021), they discuss the design levels of their integration only to some extent, and they do not systematically discuss the design levels as a contributing factor to their findings. In this regard, the search for what works when to seize the best opportunities MOOCs have to offer, seems to have only just begun.

Medical MOOCs do not all share one teaching mode profile or the same design quality principles, and so each course needs to be investigated separately before integration (Chapter 2, 3 and 5).

Through our studies we found medical MOOCs to differ considerably from each other specifically in their teaching mode profile (Chapter 2) and the instructional design principles that are present (Chapter 3). Although our findings were promising in the sense that many different teaching modes were found and instructional quality was quite acceptable comparing to previous studies, due to the disparity, each MOOC needs specific consideration prior to integration (Chapter 5).

Although different types of MOOCs including cMOOCs and xMOOCs had been described, MOOCs were said to characteristically contain video lectures, discussion forums and quizzes (Dandache et al., 2017; Hoy, 2014). Medical MOOCs were also described being all painted with the same brush: they were claimed to be of 'high academic standard' or 'pedagogically deficient', even though quality was never studied (Subhi et al., 2014). Granted, we found medical MOOCs indeed often include video lectures, discussion forums and quizzes. However, how many of each of these teaching modes were included differed greatly and additional teaching modes proved abundant and highly diverse (Chapter 2). In addition, we could only find similarities in quality for specific instructional design principles: nearly none of the MOOCs (0-6%) included *collaboration*, *expert-feedback* or *integration*, and nearly all MOOCs (97-100%) included *application*, *authentic resources*, *peer feedback* and activities building upon each other, as a part of *problem-centeredness*. All other principles and subitems were present in 12% to 76% of the investigated MOOCs (Chapter 3). MOOCs are thus to be investigated separately before integration to discern the teaching mode profile and quality, and design for improvements in the final integration design. For the practical enactment of this conclusion two challenges are present: MOOC assessment is demanding and for MOOC quality multiple different frameworks exist.

- *Demands for MOOC assessment.* In our experience, investigation of the instructional design of MOOCs, both teaching mode profile and quality, are rather demanding: experienced assessors and considerable time are needed. This might be the reason that only two studies that investigated MOOC quality included more than 40 MOOCs, while according to class-central, 50.000 currently exist (Kasch & Kalz, 2021; Margaryan et al., 2015). The assessment process currently needed to discern teaching mode profile and quality is bound to impede MOOC integration practices, and in need of an update. We have proposed two options that can ease MOOC quality assessment: (1) organized assessment by for example consortia of MOOC exchanging universities or MOOC platforms, so that many can benefit from the findings of a single assessor, and (2) teaching mode profiles and quality profiles can be shared by MOOC creators. A separate webpage or overview on the information page of each MOOC would be a great start, however including the information in the metadata would be even better as to enable specific searchers (Chapter 3).
- *Different frameworks for MOOC quality.* A possible obstacle in MOOC quality assessment is the diversity in assessment criteria and tools available (Aloizou, 2018). MOOC quality has been widely studied, often adopting a focus on instructional design (Stracke & Trisolini, 2021). Jansen et al. (2017) argued that MOOC quality can only be studied in relation to their design as execution of the course by the student can be different each time. The abundance in research has led to different quality assessment tools (Conole, 2013; Lowenthal & Hodges, 2015; Margaryan et al., 2015), Quality Frameworks for OER and Quality Frameworks for MOOCs specifically (Jansen et al., 2017; Stracke et al., 2018). For MOOC integration this is highly undesirable as it complicates the process of quality assessment: knowledge of multiple frameworks is needed and comparing quality based on different criteria and principles is difficult. For example: Kasch and Kalz (2021) report MOOC quizzes to mainly test factual knowledge. This is essentially the same as our finding that mostly objectivist assessment is present. A shared language, and a widely supported set of quality criteria and principles are needed to facilitate quality assessment.

MOOC integration practice is not an easy process and it demands time, several steps and specific knowledge (Chapters 2, 3, 4 and 5).

While our MOOC creation and integration proved to be of added value, the process to organize it took extended time, and required substantial financial investments and faculty commitment (Chapter 4). MOOC integration can also be realized by using an existing MOOC from another institution, and in this case MOOC selection requires employing search and evaluation strategies, which can also take considerable time (Chapter 2 and 3). To help others structure the process, we bundled our experiences and knowledge into twelve tips to describe a step-by-step approach for medical MOOC integration (Chapter 5 and summarized in table 3).

Table 3. Twelve tips summarized.

Twelve tips for medical MOOC integration summarized
1. Clearly define what content you want to include in your course
2. Determine the way you like to use the online materials
3. Search for MOOCs on the selected topic
4. Determine the availability of the specific MOOC and its contents
5. Gauge the credibility of the MOOC before deciding to integrate
6. Ensure the MOOC content is freely available to your students
7. Determine if the MOOC contains the desired teaching modes
8. Determine the social-epistemological dimensions of the course
9. Make sure you align the goals, the teaching activities, and the assessments
10. Provide clear instructions to students on how to enrol onto the MOOC
11. Provide clear instructions to students on how to utilize the MOOC and its resources
12. Determine the success of MOOC integration

Although many studies have described cases of MOOC integration as we have in Chapter 4, we found none describing the process clearly. In 2015 Yousef et al. did describe their implementation of a blended MOOC, however their project was quite ambitious and descriptions seemed research and development oriented rather than practical. Chen et al. (2019) described six steps to offer medical curriculums online including with MOOCs, however integration was not mentioned. In 2020 Virani et al. presented a model to test determinants of teachers' acceptance and use of MOOCs. They found that among other factors, perceived ease of use and content quality have major influence on the teacher's intentions to adopt MOOCs. In this regard, our step-by-step approach should promote acceptance and use of medical MOOCs for integration. With regard of tip 12, concerning assessment of success of MOOC integration, specific progress had been made that can inform practice directly: Wei et al. (2021) recently described all the ways that studies on MOOCs have assessed cognitive, behavioural, and affective learning outcomes, and the related instruments. We believe the study by Wei et al. (2021) can offer extremely valuable insight in finding fitting outcome measures and instruments for MOOC integration.

General conclusions for high quality learning with integrated medical MOOCs

Monitoring of autonomous motivation and use of self-regulation skills is essential for personalized support of effective learning in MOOC integration. Personalized motivation support may be targeted through specific integration designs (Chapter 6, 7 and 8).

EReeve et al. (2008) hypothesized a two tier condition which implies that after self-regulated learning skills have been learned, autonomous motivation is needed to use these skills (Chapter 6). We found six different motivation profiles of students, for which frequency of appearance differed significantly between three different integrated MOOC learning settings. Findings showed greater proportions of self-determined learners in integration designs A and C, which were voluntary undergraduate courses for credit in which the MOOC

was supplemented by an assignment or by 3.5 days of a face-to-face summer school, than in design B, where interaction activities in the MOOC replaced a week of face-to-face lectures in an obligatory undergraduate course of eight weeks (Chapter 7). In addition, precursors for autonomous motivation were reported to be significantly higher in integration designs A and C as opposed to design B (Chapter 7). Finally, we found self-regulated learning strategies related to goal setting may differ greatly between students in prescribed study systems (Chapter 8).

In the protocol in Chapter 6 one of the aims was to discern the relation between autonomous motivation and self-regulated learning. However, we have not yet been able to examine this relationship properly as new insights regarding cross-lagged panel analysis showed three timepoints of data are needed, while we collected data on two occasions (Hamaker et al., 2015). During a current research project to scope the secondary and higher education literature regarding this relation, we did find motivation and self-regulated learning are often described and measured simultaneously, or in each other's presence, hinting towards at least correlation (Hendriks et al., *in progress*). Although we have not specifically characterized the relationship yet, we do believe both autonomous motivation and self-regulated learning are highly important for effective learning in online settings, including integrated MOOC learning. The importance of self-regulated learning skills, specifically goal setting, in online learning and in broader higher education has been underlined in research frequently, as has the importance of autonomous motivation (Kizilcec et al., 2017; Littlejohn et al., 2016; Vanslambrouck et al., 2018).

To our knowledge, these investigations are the only ones considering these constructs in light of MOOC integration. It is important to note that motivation factors in integrated MOOC learning resemble selected motivation factors found in informal MOOC learning (Luik et al., 2019) rather than formal university learning (Vansteenkiste et al., 2009), online learning in university (Vanslambrouck et al., 2018) or learning in a medical curriculum (Kusurkar et al., 2013). Additionally, students in MOOC integration designs are less, and less positively motivated for learning in comparison to informal MOOC learners (Luik & Lepp, 2021), and so profiles of formally integrated MOOC learners are not similar to profiles of informal MOOC learners (Chapter 7).

Our findings regarding diverging and personal self-regulated learning strategy use are corroborated by Broadbent and Fuller-Tyszkiewicz (2018), who found five profiles of health students regarding self-regulated learning ranging from minimal regulators to super regulators. In addition, they found the super regulators to include significantly more online learners, which might indicate selection effects: students who are adequate self-regulators might prefer online learning and thus choose it more often, and/or students who are less advanced in self-regulated learning might steer clear of online learning. Nevertheless they

concluded: 'most group differences between online and on-campus students were small in magnitude, suggesting that in practice, online and traditional learner groups may not be noticeably different at the level of individual strategies in how they approach learning, but may be more easily discerned from the pattern of strategies they commonly employ.' We did not profile students based on goal-setting. However, we found specific strategies for goal setting and we found students describing their strategies as their 'style', and always approaching learning the same way in a prescribed study system, suggesting it is personal. Monitoring and moreover, profiling students based on self-regulated learning strategies, could be extremely profitable to offer tailored support (Araka et al., 2020).

Person-centred analysis such as profiling students has indeed been described recently, as a promising way to support online medical student learning and to inform differentiation or even personalization (Biwer et al., 2021; Kusurkar et al., 2021). Kusurkar et al. (2021) described three types of person-centred analysis and their advantages and disadvantages: cluster analysis, latent class analysis and Q-sort analysis. Among other parameters, sample size and type of data determine which analysis is most advantageous. Although clustering and profiling are useful methods to inform personalized learning, input variables for cluster formation should be well-considered and factor-analyses should be performed. We have found that several different instruments are used for measuring motivation and self-regulated learning as input for profiling students in recent online learning literature (Binali et al., 2021; Biwer et al., 2021; Luik & Lepp, 2021; Vanslambrouck et al., 2018). Sometimes constructs were intertwined in the used instruments. This could be the result of divers perspectives on and definitions of motivation and self-regulated learning in the literature (Hattie et al., 2020; Panadero, 2017). The measure has possible practical implications as we have found when we identified unexpected motivation factors, and so an instrument should be chosen with caution, informed by previous studies in similar contexts.

Profiling may in time also support teachers to apply motivation theories in their designs, which is much needed for the current and future educational landscape (Chiu et al., 2021). While many motivation principles and theories exist (Ryan & Deci, 2020), currently teachers may not be able to implement theoretical ideas to support motivation. In this regard, profiling may bridge the gap between theory and practice, as results in the form of profiles are often more recognizable for practice (Kusurkar et al., 2021). In theory person-centred analysis methods could be used by teachers, however as they require specific expertise and skill, acquired by only some teachers, intelligent automated options might be more suited. As learning analytics and intelligent learning and tutoring systems are investigated for personalized learning increasingly, including to optimize motivation, it is expected that implementable options will be readily available in due course (Kucirkova, Gerard, et al., 2021; Li & Wong, 2021). Until they are, our findings suggests that for MOOC integration, the specific design can inform what motivation profiles are present and thus which designs

demand specific motivation support. It should be noted though, that correlations between motivation profiles and integration designs need further investigation in other MOOC integration designs to generalize our results.

In this regard, McPartlan et al. (2021) recently also noted that when comparing motivation for students in online and face-to-face modalities in authentic settings, selection effects might occur. They found that demographic groups that described competing responsibilities (older, part-time students, women) performed worse in online settings than face-to-face courses, whereas demographic groups that did not select online courses for these reasons (younger, full-time students, men) performed just as well as their face-to-face peers. They reasoned: 'demographic variables such as age, gender, and ethnicity may be associated with student outcomes if they also happen to be associated with motivational processes that can directly influence student outcomes'. This underlines the idea that the design of a course can influence the selection of students especially by offering it non-obligatorily and in a specific modality, corroborating the correlation between integration designs and motivation profiles. As we described in Chapter 7, and Broadbent & Fuller-Tyszkiewicz, (2018) implied by mentioning selection effects, a possible explanation is that the shape of motivation influences the course students want to join. However, more research is needed.

Instructor trusting motivation is highly important for students in formal medical MOOC learning, and it may be the key to foster high quality motivation (Chapters 7 and 8).

We found instructor trusting motivation to have a prominent role in shaping motivation profiles in integrated MOOC learning, leading to three profiles that are characterized predominantly by trust in their teacher: moderately trusting, highly trusting and extremely trusting students (Chapter 7). Further, many students mentioned trust in the teachers and coordinators as a consideration for accepting the prescribed study system (Chapter 8).

Finding that trust in the instructor played such an important role was somewhat unexpected, as we used an instrument that, to our knowledge, had not yielded this factor before. The items that loaded together for the instructor trusting motivation factor originally were validated and were supposed to load with autonomous or controlled motivation (Black and Deci, 2000; table 4). However, our results were corroborated by motivation measures used in informal MOOC learning research (Luik et al., 2019), and our qualitative study offered further insight. Phrases from the interviews that supported the importance of trust in the instructor were: 'someone must determine the direction and the instructors and coordinators are the best candidates for this because of their experience' and 'I do not want to have the responsibility of deciding on the program to become a doctor' and finally, 'teachers do not look at learning goals either'. Although the last statement describes a reason not to use learning goals while we hope teacher would encourage using learning goals, the statement does supports the

idea that students look to their teacher for guidance and trust their strategies. Osueke et al. (2018) also found students to use learning goals in the way suggested by instructors, supporting the idea that students trust their instructors. Furthermore, Binali et al. (2021) found that a specific group of 'course-driven' online learners accepted new information based on authority as opposed to 'self-driven' online learners who checked new information with multiple sources or based acceptance of new information on personal understanding.

Teachers as role models with authority as a reason for trust also resonates with Vygotsky's *Zone of Proximal Development* where the teacher is the designated 'more knowledgeable other' (Vygotsky, 1978). For students this motivation might also partly be a proxy for autonomous motivation. Motivation for learning itself might be internalized or identified; students might reason 'learning and progressing in my studies is good for me and my future, and the teacher knows what to learn'. It seems students trust instructors to vouch for the reasons they have to learn something and how: it will help them during assessment, in clinical stages of their studies or in their future profession (Chapter 8). The assumption that learning is important for future clinical activities is already quite close to rationalizations that can lead to identified or integrated regulation of motivation. However, by trusting the teacher to oversee the significance of an assigned goal, the connection to students' own norms and values might be obstructed.

Table 4. Items for instructor trusting motivation and original factor allocation (Black and Deci, 2000).

Items for instructor trusting motivation	Original factor allocation
I have followed the instructor's suggestions for studying transplantation medicine online because it is easier to follow his/her suggestions than come up with my own study strategies.	Controlled motivation
I have followed the instructor's suggestions for studying transplantation medicine online because he/she seems to have insight about how best to learn the material.	Autonomous motivation
I have followed the instructor's suggestions for studying transplantation medicine online because I am worried that I am not going to perform well in the course.	Controlled motivation
I have followed the instructor's suggestions for studying transplantation medicine online because I would get a bad grade if I didn't do what he/she suggests.	Controlled motivation

Leaning heavily on the teacher to determine what needs to be learned or how, is per definition not self-determined and possibly an indication of low self-regulation: it resonates with wanting to succeed, and not having or wanting full responsibility yet. It is also somewhat contradictory to the academic mindset which is to critically review new information rather than to receive and accept. However, it does suit compliance to the hierarchical atmosphere in the hospital and the hidden curriculum in medicine (Lempp & Seale, 2004). Further, the objectivist ways of teaching that are still abundant in medical schools might add to the idea that there is an expert who knows everything, and students who do not. Finally, the

education students have had prior to starting medical school might affect their maturity in self-regulation and self-direction, and subsequently the amount of responsibility they take in their learning (Vosniadou, 2020).

As the self-regulatory skillset and self-determined attitude are needed in clinical stages of training and in the medical profession, it is desirable to have responsible and self-regulating medical students early on in the curriculum (Berkhout et al., 2018). Luckily, trust in the teacher also poses an opportunity to make students see the connection between the learning goals and personal values. Teachers can help students to truly accept goals and learning activities, explicitly and autonomously (Leone et al., 2019), and improve the quality of their motivation. It is important to underline that acquiescence is not acceptance and not an option to improve goal-setting practice: it is undesirable that students spend energy resisting implicit or explicit learning goals and then have to relent. In this regard, teachers might have a vital role in increasing the perceived usefulness of goal content by clarifying exactly how it will serve students in the professional role they are pursuing. Additionally, offering more constructivist teaching activities, for example by MOOC integration, might help some students to start viewing information as something to be constructed and discover their own voice in this process. It may help make students more prone to ask 'why' questions and become more autonomous and self-determined.

Goal acceptance may bridge theoretical desires to set goals personally and practical preferences to assign goals, not only in MOOC integration designs (Chapters 3, 6 and 8).

We found goal-setting to be described as important for self-regulated learning in MOOCs and other online learning settings (Chapters 3 and 6). However in medical MOOCs goals are assigned and in almost a quarter of our sample not even communicated to students (Chapter 3). In addition to MOOC integration designs, goals are also predominantly assigned in the undergraduate medical curriculum, making both prescribed study systems (Chapter 8). Students in a prescribed study system differ in strategies to accept and use the assigned goals (Chapter 8). Students that never use assigned learning goals, and students that do not use learning goals based on goal content can be assisted in their acceptance of goals by increasing comprehensibility of goals, perceived usefulness of goals and perceived interconnectedness of goals, activities and assessment (Chapter 8).

Table 5. Types of goal-setting classified based on their origin, and examples in education.

Type of goal-setting	Origin of the goal	Example in education
Personal	the person or group that is to pursue the goal	Students set their own learning goals
Joint	the person that is to pursue the goal and another person that will not pursue the goal but has interest in attainment	Students set goals with their teacher
Consultation	another person that will not pursue the goal but has interest in attainment	Teacher consult students on what they want or need to learn and sets goals for them
Tell and sell	another person that will not pursue the goal but has interest in attainment	Teacher sets the learning goals and inform students of them, explaining why they are important
Tell	another person that will not pursue the goal but has interest in attainment	Teachers sets the learning goals and informs students of them without a rationale

In education literature goal acceptance has been understudied. Goal-setting theory has identified different sources for setting goals, however it is silent on what source is best. The founders do state self-set goals are at the core of self-determination (Latham & Seijts, 2016). Sources of a goal classify goal-setting into five types: personal, joint, consultation, tell and sell, and tell (Latham et al., 1988; Roberson et al., 1999; summarized in table 5). Moving from the first to the last option, acceptance of the set goals by the person that is to pursue the goals is increasingly less assured, while acceptance of these goals is highly important (Erez et al., 1985; Latham & Seijts, 2016).

Our compiled findings on perceptions, considerations and use of learning goals of students in a prescribed study system yielded a model to understand the processes in accepting assigned learning goals (Chapter 8). These processes had not been previously described, however partial corroboration of our model can be found in the task value component of Expectancy-Value theory (Eccles, 1983; Eccles & Wigfield, 2002). This theory posits that a combination of people's expectations for success and subjective task value motivates achievement-related choices. It further differentiates task value into four elements: utility value (i.e., perceived usefulness for future goals), intrinsic value (i.e., personal enjoyment), attainment value (i.e., importance of doing well), and cost (i.e., competition with other goals). We found students perceptions regarding the value of learning goals to be closely related to their use of it. For example, use of the goals as a tool and setting personal goals was described as useful or not, which could be considered as perceived utility value. Further, using and setting goals were also described as enjoyable, which could be considered as an intrinsic value. Our findings revealed that students who feel resistant towards the prescribed study system but still participate, perceive they have no other option than participate if they want a career, which could be considered a description of attainment value. Similarly, all participants described that they would, in the end, acquiesce to whatever was expected of

them as they were adamant to pass the examination, even if they did not fully understand or agree with the expectation. Our practical implications to enhance perceived usefulness and interrelatedness between goals, activities and assessment, and enhance comprehensibility of goals to improve goal acceptance are also corroborated by literature, but only partly related to Expectancy-Value Theory. In this regard the need for perceived usefulness and perceived interrelatedness of goals, activities and assessment can be viewed as need for utility value, however is does not describe comprehensibility. Leone et al. (2019) recently did describe comprehensibility, and in addition interrelatedness of goals, activities and assessment, as highly important factors for converging identification of course objectives by faculty and students.

We found acceptance to be present for some students and others described it to be attainable. We therefore see learning goal acceptance as a potential bridge between the desire to set goals personally and the practical preference to assign goals, not only in MOOC integration designs, but in all prescribed study systems. That being said, for students to become self-regulated or even self-directed, it is important that they learn to have increasingly more say in their learning goals (Jossberger et al., 2010). This also means education will be increasingly more personalized. Kucirkova, Toda, et al. (2021) coined the 'agency paradox' to describe the tension in personalized education that arises through individual and collective agency in educational practice, adding designers as a third stakeholder, in addition to teachers and student. Many teachers and designers want to support individual students' choices, however these also need to be narrowed down to adhere to the shared curriculum. Higher levels of student participation in goal setting requires a dire balancing act of teacher-regulation and student-regulation, as they can get in each other's way and create destructive friction if both regulate too much or too little (Vermunt & Verloop, 1999). In this regard, students in the same cohort will rarely be all at the same self-regulated learning or goal-setting level, and the balancing act will thus need to be performed on differentiated levels by the teacher.

In addition to information about the level the student is in, clear task division of regulation between student and teacher is needed. For goal-setting, teachers might think that students will ask questions about the learning objectives if they need information, however this already requires self-regulated learning skills from the students. For a portion of the undergraduate students we have studied, it seems teachers are right to assign goals, however, in that case they are also responsible for supporting acceptance of the goals. Some students already set their own goals and might thus be ready for more responsibility. Similar to *Entrustable Professional Activities* (EPAs) that assess qualification of students to perform increasingly advanced clinical tasks (Cate, 2016), we propose *Entrustable Regulation of Learning Activities* could inform both student and teacher of the status quo in their journey of increasing agency, to full self-regulated and directed learning. *Entrustable Regulation of Learning Activities* could include subtasks of the planning, monitoring and reflection stages described by the self-regulated

learning models (Panadero, 2017), complemented with activities belonging to designing learning paths (Kirschner & Van Merriënboer, 2008). For example, in early stages students can help identify short term goals, based on the long term goals. In later stages, students could decide on how and by whom their academic goals should be assessed. Implementation could be challenging as transference of responsibility requires room for student agency in organizing education, also in early stages. However, the idea fits the cognitive path to self-regulatory skill needed for lifelong learning in today's society (Zimmerman & Kitsantas, 2005). Additionally, for EPA's implementation has also proved possible (Ten Cate et al., 2018). Support for self-regulated learning is thus not taking regulation out of students' hands, which might be about to happen in online settings (Araka et al., 2020). Using data to personalize learning unseen might also take something away from the student. In our opinion, creating personal learning goals, matching activities and testing oneself is an invaluable skillset, essential for medical professionals and lifelong learners.

Strengths and limitations

We identify three strengths for this thesis. First, teaching was approached in two ways in Chapter 2 and 3 and learning was approached in two ways in Chapter 7 and 8, strengthening the final perspective. In addition, by considering both high quality teaching and high quality learning in the approach to identify the added value of medical MOOC integration, MOOC integration design guidelines are more holistic. Second, the pragmatic research paradigm enabled us to implement methods and analyses needed to do groundwork for this specific problem. And third, research was driven by and conducted in highly authentic contexts. This means that considerations and ideas regarding major constructs mostly came from practice and were enhanced by theory, which we consider to be a strength when tackling a practical problem.

The research in this thesis also comes with some limitations. First, the studies described in Chapter 2 and 3 are time sensitive. As the number of medical MOOCs has grown extensively and availability and what is offered for free continually change, the determined inclusion criteria might offer more or different MOOCs for investigation if the studies were conducted now. In part, all research can be regarded as somewhat time-sensitive and in this sense we have to adopt the post-positivist stance that reality can only be known imperfectly. Luckily, our findings underline that what medical MOOCs have to offer is predominantly positive, and developments in the field of MOOC research make us believe that if the studies would be replicated today, results would be similar or more positive. Second, in Chapter 7 a possible selection bias may have occurred as response levels were not 100% and less motivated students may not have participated. In this regard, motivation profiles may in reality be somewhat different: mean scores for motivation factors could be lower, or an extra low motivation profile could be missing. It is possible that even less obligated MOOC

integration designs similar to design C need interventions that support motivation. One of our conclusions therefore is, that motivation should be monitored.

Practical implications

This thesis was instigated by a practical question: (How) can high quality teaching and learning be offered in campus-integrated medical MOOCs? Practical implications are thus of major importance. They can be divided into implications that will directly enhance MOOC integration and implications that will indirectly enhance MOOC integration.

Implications for directly enhancing teaching and learning in medical MOOC integration
Teachers interested in medical MOOC integration should:

- Follow the step-by-steps approach to structure the organization of MOOC integration (Chapter 5, summarized in table 3 in this discussion section)
- Use the availability of diverse teaching modes in the integration design to spark interest through novelty when possible
- Use social-epistemological dimensions to guide fitting integration (see figure 2)
- Evaluate the instructional design quality of the selected MOOC before integration
- Add activities to an integrated design to accommodate specific principles and upgrade quality if needed
- Assess MOOC integration success based on relevant outcome measures (see Wei et al., 2021)
- Ask for help - experienced MOOC integration teachers or designers of a MOOC are often highly enthusiastic about MOOCs, integration and sharing knowledge
- Monitor motivation and support it extensively in obligatory designs - for example by autonomy supportive interventions
- Share with students the information needed to support perceiving learning goals as useful, comprehensible, and aligned with activities and assessment, to aid assigned learning goal acceptance

Implications for indirectly enhancing teaching and learning in medical MOOC integration

- MOOC instructors and designers should share the teaching mode profile of their MOOC, and the criteria for quality they have taken into account
- MOOC platforms should accommodate relaying this information into metadata
- MOOC integration researchers should include the teaching mode profile and choices regarding design levels to aid overarching investigations concerning what works when
- MOOC integration researchers can use person-centred analysis such as profiling to inform differentiated or personalized improvement of designs

Figure 2. Practical directions for integrating teaching modes based on their social-epistemological dimensions.

		Epistemological dimension	
		Objectivist	**Constructivist**
		• 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. • Constructivist teaching modes require more advanced skills of the learner. They need to be able to assess the quality of different information sources (Huang, 2002), to navigate in less-structured teaching activities, and to 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 capable to take the role of facilitator (Huang, 2002).
Social dimension	**Individual**	individual-objectivist teaching modes are effective for transfer of factual knowledge, for example epidemiological findings about diseases that might in a later stage support clinical reasoning.	Individual-constructivist teaching modes are suited for analysing, evaluating or synthesizing tasks. For example, clinical reasoning problems. To do this individually, students need to be advanced cognitively, for example to order their information, and meta-cognitively, for example to know when to ask for help.
	Group	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.	Group-constructivist are very helpful to learn navigating in complex problem solving tasks. In many professional settings, combining information from multiple sources to construct a diagnosis is an individual task, but, conferring with peers will support learning to do so.

Future research avenues

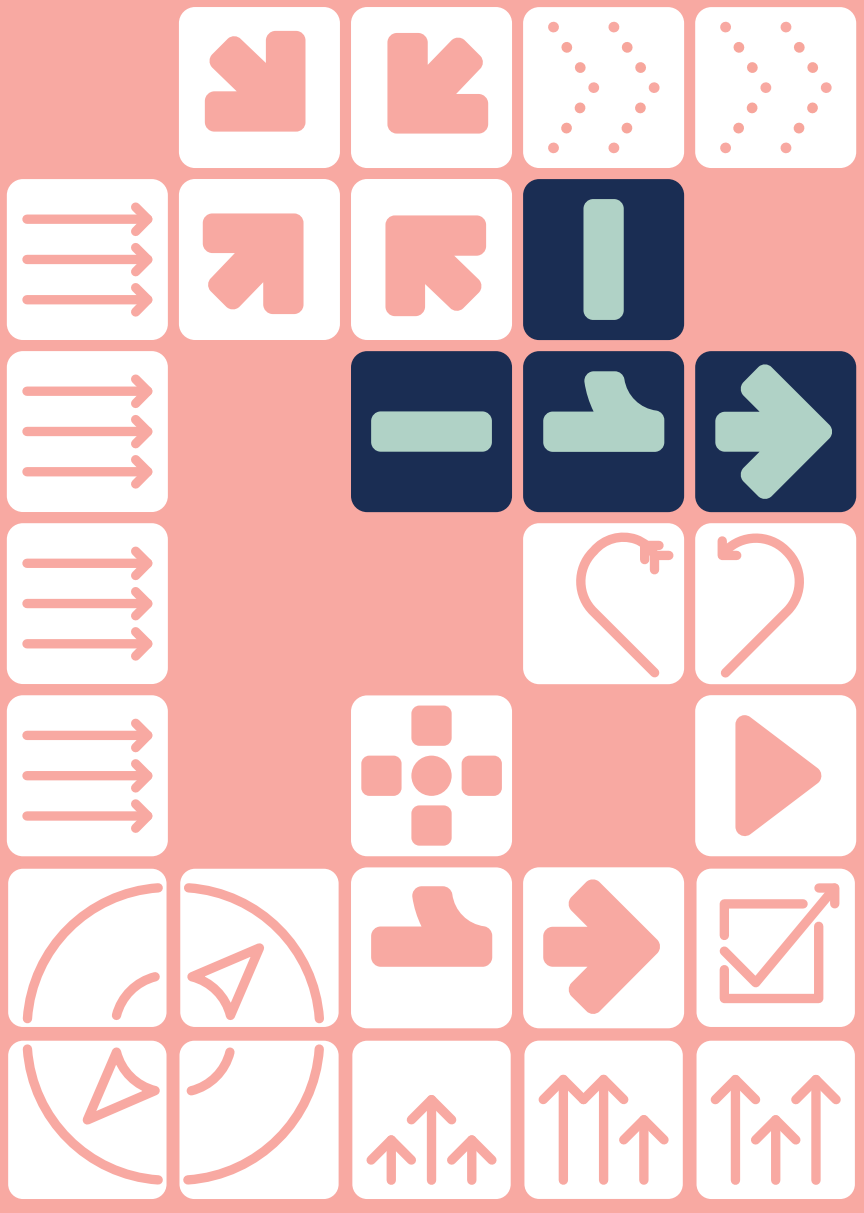
Based on the research within this thesis, several avenues for future research can be identified, of which a few will be discussed below.

- First, the improvement of instructional design quality principles collaboration and expert feedback needs investigation. In MOOCs these might pose a problematic fit and research is needed to find solutions, for example in the directions of barriers and promotors of collaborative learning in MOOCs, or options for effective team formation (Sankaranarayanan et al., 2018; Sanz Martínez, 2022; Staubitz & Meinel, 2017; Wen, 2016) in regard to collaboration. For investigating expert feedback upscaling and outsourcing offer options (Balfour, 2013; Joyner, 2017; Toxtli & Savage, 2020), and in addition identifying which students need personal attention, through analysis of sentiment or tone in text (Schubert et al., 2018), or monitoring peer feedback results (McMichael et al., 2021), seems to be a promising avenue. However for MOOC integration specifically, best practices to upgrade integration designs should be investigated, for example, how to best implement instructional design principles missing in the MOOC by adding in campus activities or assignments.
- Second, conformity is needed on the criteria and principles that encompass instructional quality in MOOCs. In this regard, it is possible that for different purposes different

criteria must be considered. Assessment for informal MOOC learning might be more lenient towards principles that are difficult to implement than assessment for formal MOOC learning. An integration of the existing principles and criteria would be a good starting point, possibly extended by expert review, for example through a Delphi study.

- Third, future investigations into what works when for MOOC integration designs are needed. Specifically experiments are needed in which variables are altered one at a time. We suggest starting with studies into the effects of degree of obligation, as it may lead to scaffolded student and teacher roles or self-selection of students.
- Fourth, optimal instrumentation for measuring motivation in integrated MOOC settings should be studied. We selected an instrument previously used for formal learning, however factor analysis revealed instruments previously used for measuring motivation in informal MOOCs might have been more appropriate.
- Fifth, confirmability or refinement of Assigned Learning Goal Acceptance Theory in similar contexts is needed, and the role of teachers and instructors in goal acceptance processes needs further attention. Our studies revealed students rely greatly on their instructor for their motivation to learn in MOOCs, and that trust in their teacher is an important factor to accept learning objectives implicitly and explicitly. Positive or negative perceptions or actions of teachers surrounding learning goals, may thus greatly affect goal acceptance processes of students and need to be studied.
- Sixth and final, the idea of *Entrustable Regulation of Learning Activities* might provide a solution for the agency paradox and deserves further investigation.

APPENDIX



SUMMARY

In **Chapter 1** medical Massive Open Online Courses (MOOCs) and the desire to integrate these courses into formal campus education are introduced. Then the problem focused on in this thesis is identified: the added value of medical MOOC integration lies in high quality teaching and learning, however how to design optimal teaching and learning is unclear. We operationalize high quality learning and teaching: high quality teaching is approached through the concepts of teaching modes, social-epistemological dimensions of teaching modes, instructional design principles and practical organization of MOOC integration. For high quality learning in integrated medical MOOCs we concentrate on students' motivation to learn, self-regulated learning skills and the act in which these concepts overlap: goal-setting. The aim of this thesis is to provide answers to the following questions: 'What do medical MOOCs have to offer for integration?' in Chapters 2 and 3; 'What does creating and integrating a medical MOOC entail?' in Chapters 4 and 5; and 'How can learning in integrated MOOCs be supported?' in Chapters 6, 7 and 8. Finally, an overview of research questions and aims, methods and analyses for each chapter is provided and the research paradigm is shortly discussed.

In **Chapter 2** we performed a document analysis of webpages to identify and characterize teaching modes in medical MOOCs that are available for integration purposes. First, an overview of 410 medical MOOCs was composed and inclusion criteria were determined: 1) a medical condition in the title, 2) availability in English during time of investigation, 3) no charges for course content, and 4) the stated target audience does not exclude students. Based on these criteria 33 MOOCs on a medical topic were included for analyses. A data collection tool was created and calibrated to analyse teaching modes and their social-epistemological dimensions. For this purpose, researchers enrolled in the MOOCs and examined all course pages. Teaching modes were categorized into existing or new modes and social-epistemological dimensions were identified for each teaching mode through coding according to the Teaching Approach Framework. We found 29 teaching modes, including three that were not described previously as available in MOOCs. The distribution of teaching modes varied considerably among MOOCs. Video lectures, discussion forums and multiple choice quizzes were included regularly, however medical MOOCs were diverse in additional teaching modes and they did not have a universal teaching mode profile. Regarding social-epistemological dimensions, teaching modes in medical MOOCs were mostly focused on constructivist and individual teaching instead of objectivist and group teaching. This means that medical MOOCs have much to offer for integration into campus education and may even support innovative teaching. In addition, provision of a specific teaching mode profile for each MOOC by its creators would ease integration as analyses for this study revealed that identification of a teaching mode profile is quite time-consuming.

In **Chapter 3** we performed a document analysis of all webpages of the same 33 MOOCs as described in chapter 2 to investigate their instructional design quality. An eleven-principle

framework for instructional design quality of MOOCs was compiled, including five principles for learning activities: *problem-centeredness, activation, demonstration, application and integration*; five principles for learning resources and support: *collective knowledge, collaboration, differentiation, authentic resources and feedback;* and one principle for support of self-regulated learning: *goal-setting*. A data collection tool to code the presence of these principles was compiled and calibrated. Subsequently and all course pages were reviewed. We found medical MOOCs to meet the principles in varying degree: *Application, authentic resources, problem-centeredness and goal-setting* were present in many courses. *Activation, collective knowledge, differentiation, and demonstration* were present in less than 50% of the courses. Last, *integration*, *collaboration*, and *expert feedback* were present in less than 15% of the courses. This study showed that the instructional design quality of medical MOOCs varies considerably and should be assessed prior to integration into campus education in order to ensure the instructional quality of the integrated design. In addition this study described *collaboration* and *expert-feedback* to fit poorly to the MOOC concept, and *differentiation* and *goal-setting* as currently under investigation to progressively include in online settings. Finally, more efficient MOOC assessment methods for large scale MOOC integration were described.

In **Chapter 4** we described our experiences with creating the medical MOOC 'Clinical Kidney, Pancreas and Islet Transplantation', and integrating it into campus education. We also discussed experiences of learners who participated in the MOOC between 2016 and 2020. Development of the MOOC took almost a year and was conducted by a multidisciplinary team. The targeted audience was (bio)medical students and healthcare professionals. The product was a course of four weeks, addressing a stage in the transplantation process each week, including activating and innovative activities. The outline and teaching mode profile were provided. In January 2016 the course went live on Coursera, free of charge for everyone interested. Additionally, the MOOC was used in two formal courses of the second year of the medical curriculum at the Leiden University Medical Center, the Leiden Oxford Transplantation Summer School (LOTS), and the Leiden University Honours program. The way the MOOC was used differed in each curriculum. Data of the informal learners were gathered through the Coursera analytics dashboard (n=14996), learner stories (n=112) and a survey regarding learning intentions (n=29). Dashboard data showed that 66% of the enrolled learners started the course, 7.9% earned a certificate, and learners originated from over 90 countries. Learners expressed personal learning goals (30%), achievement of learning goals (22%), liking the design of the course (14%) and gratitude for availability of the course (75%) in learner stories, and mostly joined because of personal growth, interest, the prestigious university or relevance to their job/education. Formal student data were gathered using an evaluative questionnaire with 15-60% response in each course. Additionally the survey regarding learning intentions was used to which 52 students responded. Most students found the MOOC inspired them for knowledge yield and enhanced their learning quite a lot. Over 40% of the respondents in each integration participated in more than the obligated content. Regarding learning intentions, second year

medical school students focused on educational intentions whereas LOTS students focused on personal intentions. Although student data most likely suffered selection bias, integration of this MOOC had added value to many instructors and learners. In addition, we decided that motivation differences between informal and formal learning, and between integration designs needed further investigation.

In **Chapter 5** we constructed a step-by-step approach for integrating medical MOOCs into campus teaching which included 12 steps: 1) Clearly define what content you want to include in your course; 2) Determine the way you like to use the online materials; 3) Search for MOOCs on the selected topic; 4) Determine the availability of the specific MOOC and its contents; 5) Gauge the credibility of the MOOC before deciding to integrate; 6) Ensure the MOOC content is freely available to your students; 7) Determine if the MOOC contains the desired teaching modes; 8) Determine the social-epistemological dimensions of the course; 9) Make sure you align the goals, the teaching activities, and the assessments; 10) Provide clear instructions to students on how to enrol onto the MOOC; 11) Provide clear instructions to students on how to utilize the MOOC and its resources; and 12) Determine the success of MOOC integration. For each step, considerations, tips and literature were provided. We concluded that MOOC integration is not an easy process. It can be made more efficient and effective however, by following the provided steps.

In **Chapter 6** we outlined a mixed methods research protocol in which five research questions regarding motivation to learn, self-regulated learning, and goal-setting in integrated medical MOOC learning are addressed. Research aims were to: 1) describe motivation profiles of medical students learning in integrated MOOCs, and discern if motivation profiles are associated with specific MOOC integration designs; 2) investigate how psychological needs of medical students are satisfied or frustrated in different MOOC integration designs; 3) investigate the relationship between autonomous motivation to learn in an integrated MOOC and use of self-regulated learning skills in that MOOC; 4) uncover processes that are involved in goal acceptance or rejection of medical students in integrated medical MOOC designs with assigned learning goals; and 5) identify obstacles medical students encounter when learning with assigned learning goals in integrated medical MOOCs. Undergraduate students enrolled in three different formal MOOC integration designs using the same medical MOOC, were asked to participate. Integration designs differed on 4 levels: degree of obligation, ratio of online versus face-to-face teaching, replacement or addition of MOOC content to formal courses, and level of contact with other online learners in the MOOC. Data collection consisted of 3 parts: a pre-test survey before the start of the courses, a post-test survey after completion of the MOOC part of the course, and interviews after initial analyses of the surveys, as to inform purposive sampling. Self-reported *motivation to learn* (Aim 1 and 3) and *self-regulated learning* (Aim 3) were measured by the pre- and post-test, and the post-test also included the measures of *psychological need satisfaction and frustration* (Aim

2). Primary qualitative measures to extract from the interviews were *processes that are involved in goal acceptance or rejection* (Aim 4) and *obstacles and promoting factors that medical students encounter* (Aim 5) when learning with assigned learning goals in integrated medical MOOCs. Described analyses included a two-step cluster analysis followed by a chi-square test (Aim 1), a one-way ANOVA followed by post-hoc tests (Aim 2), a cross-lagged panel analysis using Pearson's r (Aim 3), a constructivist grounded theory analysis (Aim 4) and a Cultural Historical Activity Theory template analysis (Aim 5). Results of these studies will help to characterize the motivation to learn in different MOOC integration designs and the underlying reasons, identify the relation between motivation to learn and self-regulated learning, and offer insight into acceptance processes, obstacles and promoting factors surrounding assigned learning goals. Findings will lay a foundation for further MOOC integration practices and research.

In **Chapter 7** we executed a cross-sectional study to explore and describe motivation to learn in formally integrated medical MOOCs for undergraduate students. This study encompasses research aims 1 and 2 as described in chapter 6. Students in three MOOC integration designs (A-C) were asked to participate in a survey after completing the MOOC part of their course, measuring motivation to learn and psychological need satisfaction and frustration. Integration design A added the full MOOC as prerequisite for a face-to-face summer school of 3,5 days. Design B replaced one week of lectures in an eight-week face-to-face module with a set of MOOC activities in a separate iteration of the MOOC, blocking contact with worldwide learners. Finally, Design C added the full MOOC combined with a written assignment as an optional individual course for credit in an extracurricular Honours program. Respectively, 19 (95%), 240 (67%) and 13 (49%) students completed the survey. Exploratory factor analyses showed different factors for motivation than previously described in formal education. However, they resembled motivation factors previously described for learning in informal MOOCs: autonomous motivation, instructor trusting motivation and positive image motivation. These factors were combined to identify motivation profiles, using a two-step cluster analysis, a double split cross validation, and a MANOVA to discern if constituting motivation factors could explain variance. Six motivation profiles were found, with a Cohen's Kappa of .547 for stability of the clusters: self-determined learners and highly self-determined learners, grade hunters, and teacher trusters who are moderately, highly or extremely trusting. Motivation factors in integrated MOOC learning resembled factors in informal MOOC learning, but motivation profiles did not. Further, a chi-square test revealed that a weak to medium association existed between MOOC integration design and motivation profile. This idea was supported by the fact that overall, students in Design B scored lower on psychological need satisfaction and higher on psychological need frustration than students in Design A and C. This study is the first to characterize motivation to learn in formally integrated MOOCs, and the first to compare integration designs based on motivation. Findings imply that motivation factors should be measured as in informal MOOC learning, motivation should be monitored in MOOC integration

contexts, and for obligatory designs specifically, effort should be made to support autonomous motivation to learn.

In **Chapter 8** we performed a constructivist grounded theory interview study to understand acceptance and rejection processes that occur when students learn with assigned learning goals in formally integrated MOOC contexts, since goal setting is an essential self-regulated learning skill for MOOC learning. In this iterative study we found however, that the processes were not limited to integrated MOOC learning, but extended to all assessed undergraduate courses and thus we broadened our scope. Participants were purposively sampled based on motivation and self-regulated learning scores previously gathered, and integration designs. Full saturation of the data was reached after 13 interviews. Through open, axial and selective coding of all interviews by two researchers, Assigned Learning Goal Acceptance Theory (ALGAT) formed. ALGAT describes the processes involved in acceptance of assigned learning goals in a Prescribed Study System. Four essential elements were found: 1) the perceived fit of learning goals as a tool with students' study strategies; 2) the level of explicit or implicit acceptance of content of learning goals depending on the students' strategies; 3) the level of acceptance that is based on considerations of usefulness, comprehensibility, and perceived constructive alignment of learning goals within a course; and 4) students' acquiescence to whatever is expected to pass the examination. Assigned Learning Goal Acceptance Theory contributes to understanding and improving learning goal acceptance and offers directions for future research.

In **Chapter 9** main findings are summarised for each study, and overarching conclusions are drawn. Regarding the added value of medical MOOC integration for high quality teaching we conclude: (1) Medical MOOCs provide a wealth of opportunities for integration into campus, including options to offer high quality, innovative teaching; (2) Medical MOOCs do not all share one teaching mode profile or the same design quality principles, and so each course needs to be investigated separately before integration; and (3) MOOC integration practice is not an easy process and it demands time, several steps and specific knowledge. For high quality learning in integrated medical MOOCs we conclude: (1) Monitoring of autonomous motivation and use of self-regulation skills is essential for personalized support of effective learning in MOOC integration, and personalized motivation support may be targeted through specific integration designs; (2) Instructor trusting motivation is highly important for students in formal medical MOOC learning, and it may be the key to foster high quality motivation; and (3) Goal acceptance may bridge theoretical desires to set goals personally and practical preferences to assign goals, not only in MOOC integration designs. These conclusions are discussed in light of recent literature. Additionally, strengths and limitations are discussed. We conclude with practical implications of this thesis and future research avenues.

NEDERLANDSE SAMENVATTING

In **Hoofdstuk 1** worden medische Massive Open Online Courses (MOOCs) en de wens om deze cursussen te integreren in het formele campusonderwijs geïntroduceerd. Vervolgens wordt het probleem in kaart gebracht waar dit proefschrift op gericht is: de toegevoegde waarde van medische MOOC-integratie ligt in kwalitatief hoogstaand doceren en leren, maar hoe voor optimaal doceren en leren kan worden ontworpen, is onduidelijk. We operationaliseren hoogstaand doceren en leren: hoogwaardig doceren wordt benaderd door middel van de concepten van onderwijsmodi, sociaal-epistemologische dimensies van onderwijsmodi, kwaliteitsontwerpprincipes voor instructie, en praktische organisatie van MOOC-integratie. Voor hoogwaardig leren in geïntegreerde medische MOOCs concentreren we ons op de motivatie van studenten om te leren, zelfregulerende leervaardigheden en de handeling waarin deze concepten elkaar overlappen: het stellen van doelen. Het doel van dit proefschrift is om antwoord te geven op de volgende vragen: 'Wat hebben medische MOOCs te bieden voor integratie in campusonderwijs?' in hoofdstuk 2 en 3; 'Wat houdt het opzetten en integreren van een medische MOOC in?' in hoofdstuk 4 en 5; en 'Hoe kan leren in geïntegreerde MOOCs worden ondersteund?' in hoofdstuk 6, 7 en 8. Ten slotte wordt voor elk hoofdstuk een overzicht gegeven van onderzoeksvragen of -doelen, methoden en analyses en wordt het onderzoeks-paradigma kort besproken.

In **Hoofdstuk 2** is een documentenanalyse uitgevoerd van webpagina's om onderwijsmodi te identificeren en te karakteriseren in medische MOOCs die beschikbaar zijn voor integratiedoeleinden. Eerst werd een overzicht van 410 medische MOOCs samengesteld en werden inclusiecriteria bepaald: 1) een medische aandoening in de titel, 2) beschikbaarheid in het Engels gedurende de tijd van het onderzoek, 3) geen kosten voor cursusinhoud, en 4) de vermelde doelgroep sluit studenten niet uit. Op basis van deze criteria zijn 33 MOOCs over een medisch onderwerp geïncludeerd voor analyse. Er werd een tool gemaakt en gekalibreerd voor het verzamelen van data en vervolgens werden onderwijsmodi en hun sociaal-epistemologische dimensies geanalyseerd. Hiervoor schreven we ons in voor de MOOCs en bekeken we alle cursuspagina's. Activiteiten werden gecategoriseerd in bestaande of nieuwe modi en sociaal-epistemologische dimensies werden voor elke onderwijsmodus geïdentificeerd door middel van codering volgens het Teaching Approach Framework. We vonden 29 onderwijsmodi, waaronder drie die niet eerder werden beschreven als beschikbaar in MOOCs. De verdeling van de onderwijsvormen varieerde aanzienlijk tussen MOOCs. Videocolleges, discussieforums en meerkeuzetoetsen waren regelmatig opgenomen, maar de medische MOOCs waren divers in aanvullende onderwijsmodi en ze hadden geen universeel onderwijsmodusprofiel. Wat betreft sociaal-epistemologische dimensies waren de onderwijsvormen in medische MOOCs vooral gericht op constructivistisch en individueel onderwijs in plaats van op objectivistisch en groepsonderwijs. Dit betekent dat medische MOOCs veel te bieden hebben voor integratie in het campusonderwijs en mogelijk zelfs innovatief onderwijs kunnen ondersteunen. Daarnaast zou het verstrekken van een specifiek leermodusprofiel voor elke MOOC door de makers de integratie vergemakkelijken. Dit omdat

analyses voor dit onderzoek aantoonden dat het identificeren van een leermodusprofiel behoorlijk tijdrovend is.

In **Hoofdstuk 3** hebben we een documentenanalyse uitgevoerd van alle webpagina's van dezelfde 33 MOOCs als beschreven in hoofdstuk 2, om de kwaliteit van hun instructieontwerp te onderzoeken. Er is een raamwerk met elf principes opgesteld voor de kwaliteit van het onderwijsontwerp van MOOCs, inclusief vijf principes voor leeractiviteiten: *probleemgerichtheid, activering, demonstratie, toepassing* en *integratie*; vijf principes voor leermiddelen en ondersteuning: *collectieve kennis, samenwerking, differentiatie, authentieke bronnen* en *feedback*; en één principe ter ondersteuning van zelfregulerend leren: *het stellen van doelen*. Een tool voor het verzamelen van gegevens werd samengesteld en gekalibreerd om de aanwezigheid van deze principes te coderen. Vervolgens werden alle cursuspagina's doorgenomen. We vonden dat medische MOOCs in verschillende mate aan de principes voldeden: *Toepassing, authentieke bronnen, probleemgerichtheid* en *het stellen van doelen* waren in veel cursussen aanwezig. *Activering, collectieve kennis, differentiatie* en *demonstratie* waren in minder dan 50% van de cursussen aanwezig. Tot slot waren *integratie, samenwerking* en *feedback van experts* aanwezig in minder dan 15% van de cursussen. Dit onderzoek toonde aan dat de kwaliteit van het onderwijsontwerp van medische MOOCs aanzienlijk varieert en voorafgaand aan integratie in het campusonderwijs moet worden beoordeeld om de onderwijskwaliteit van het geïntegreerde ontwerp te waarborgen. Daarnaast beschreef deze studie *samenwerking* en *feedback van experts* als slecht passend bij het MOOC-concept, en *differentiatie* en het *stellen van doelen* als momenteel veelvuldig onderzocht om beter toe te kunnen passen in online leeromgevingen. Ten slotte werden efficiëntere MOOC-beoordelingsmethoden voor grootschalige MOOC-integratie beschreven.

In **Hoofdstuk 4** hebben we onze ervaringen beschreven met het opzetten van de medische MOOC '*Clinical Kidney, Pancreas and Islet Transplantation*' en het integreren daarvan in het campusonderwijs. We beschreven ook ervaringen van lerenden die tussen 2016 en 2020 deelnamen aan de MOOC. De ontwikkeling van de MOOC nam bijna een jaar in beslag en werd uitgevoerd door een multidisciplinair team. De doelgroepen waren (bio)medische studenten en zorgprofessionals. Het product was een cursus van vier weken, waarbij elke week een fase in het transplantatieproces aan de orde kwam, inclusief activerende en vernieuwende activiteiten. Het cursusoverzicht en het leermodusprofiel werden verstrekt. In januari 2016 is de cursus gratis live gegaan op Coursera voor iedereen. Daarnaast is de MOOC gebruikt in twee formele vakken van het tweede jaar van het medisch curriculum van het Leids Universitair Medisch Centrum, de Leiden Oxford Transplantation Summer School (LOTS) en het Leiden University Honours Programme. De manier waarop de MOOC werd gebruikt, verschilde per curriculum. Gegevens van de informele learners werden verzameld via het Coursera-analysedashboard (n=14996), berichten van learners

(n=112) en een enquête over leerintenties (n=29). Uit de dashboardgegevens bleek dat 66% van de ingeschreven learners aan de cursus begon, 7,9% een certificaat behaalde, en dat de deelnemers afkomstig waren uit meer dan 90 landen. Learners beschreven persoonlijke leerdoelen (30%), het behalen van leerdoelen (22%), het ontwerp van de cursus leuk vinden (14%) en dankbaarheid voor de beschikbaarheid van de cursus (75%) in de openbare berichten, en deden meestal mee vanwege persoonlijke groei, interesse, prestige van de universiteit of relevantie voor hun baan of opleiding. Studentgegevens van formele studenten werden verzameld met behulp van een evaluatieve vragenlijst met een respons van 15-60% in elke cursus. Daarnaast werd gebruik gemaakt van de enquête naar leerintenties waarop 52 studenten reageerden. De meeste studenten vonden dat de MOOC hen inspireerde voor kennisopbrengst en hun leerproces aanzienlijk verbeterde. Meer dan 40% van de respondenten in elke integratie nam deel aan meer dan de verplichte inhoud. Wat leerintenties betreft concentreerden tweedejaarsstudenten geneeskunde zich op intenties gerelateerd aan onderwijs, terwijl LOTS-studenten zich concentreerden op persoonlijke intenties. Hoewel studentgegevens hoogstwaarschijnlijk te lijden hadden van selectiebias, had de integratie van deze MOOC een meerwaarde voor veel docenten en studenten. Daarnaast besloten we dat motivatieverschillen tussen informeel en formeel leren, en tussen integratieontwerpen nader onderzocht moesten worden.

In **Hoofdstuk 5** hebben we een stapsgewijze aanpak ontwikkeld voor het integreren van medische MOOCs in campusonderwijs met 12 stappen: 1) Definieer duidelijk welke inhoud u in uw cursus wilt opnemen; 2) Bepaal de manier waarop u de online materialen wilt gebruiken; 3) Zoek naar MOOCs over het geselecteerde onderwerp; 4) Bepaal de toegankelijkheid van de specifieke MOOC en de inhoud ervan; 5) Bepaal de geloofwaardigheid van de MOOC voordat u besluit te integreren; 6) Zorg ervoor dat de MOOC-inhoud vrij beschikbaar is voor uw studenten; 7) Bepaal of de MOOC de gewenste leermodi bevat; 8) Bepaal de sociaal-epistemologische dimensies van de cursus; 9) Zorg ervoor dat je de doelen, de onderwijsactiviteiten en de toetsing op elkaar afstemt; 10) Geef duidelijke instructies aan studenten over hoe ze zich kunnen inschrijven voor de MOOC; 11) Geef studenten duidelijke instructies over het gebruik van de MOOC en de bijbehorende hulpmiddelen; en 12) Bepaal het succes van MOOC-integratie. Bij elke stap werden overwegingen, tips en literatuur gegeven. We concludeerden dat MOOC-integratie geen eenvoudig proces is. Het kan echter efficiënter en effectiever worden gemaakt door de aangegeven stappen te volgen.

In **Hoofdstuk 6** beschreven we een onderzoeksprotocol met gemixte methoden waarin vijf onderzoeksvragen met betrekking tot motivatie om te leren, zelfregulerend leren en het stellen van doelen in geïntegreerd medisch MOOC-leren worden behandeld. De onderzoeksdoelen waren om: 1) motivatieprofielen te beschrijven van studenten geneeskunde die leren in geïntegreerde MOOCs, en te onderscheiden of motivatieprofielen geassocieerd zijn met specifieke MOOC-integratieontwerpen; 2) onderzoeken hoe

psychologische behoeften van geneeskundestudenten worden bevredigd of gefrustreerd in verschillende MOOC-integratieontwerpen; 3) de relatie te onderzoeken tussen autonome motivatie om te leren in een geïntegreerde MOOC en het gebruik van zelfregulerende leervaardigheden in die MOOC; 4) processen bloot te leggen die betrokken zijn bij doel-acceptatie of -afwijzing van geneeskundestudenten in geïntegreerde medische MOOC-ontwerpen met toegewezen leerdoelen; en 5) obstakels en bevorderende factoren te identificeren die geneeskundestudenten tegenkomen bij het leren met toegewezen leerdoelen in geïntegreerde medische MOOCs. Bachelor studenten die deelnamen aan drie verschillende formele MOOC-integratieontwerpen met dezelfde medische MOOC werden gevraagd om deel te nemen. Integratieontwerpen verschilden op vier niveaus: de mate van verplichting, de verhouding van online versus face-to-face onderwijs, de vervanging of toevoeging van MOOC-inhoud aan formele cursussen, en het niveau van contact met andere online studenten in de MOOC. De dataverzameling bestond uit drie delen: een pre-test-enquête vóór de start van de cursussen, een post-test-enquête na voltooiing van het MOOC-gedeelte van de cursus, en interviews na de eerste analyses van de enquêtes, om kandidaatselectie daarop te kunnen baseren. Zelf gerapporteerde *motivatie om te leren* (doel 1 en 3) en *zelf gereguleerd leren* (doel 3) werden gemeten door de pre- en posttest, en de posttest bevatte ook de meting van *psychologische behoefte bevrediging en frustratie* (doel 2). Primaire kwalitatieve uitkomsten om uit de interviews destilleren waren *processen die betrokken zijn bij het accepteren of afwijzen van doelen* (doel 4) en *obstakels en bevorderende factoren die geneeskundestudenten tegenkomen* (doel 5) bij het leren met toegewezen leerdoelen in geïntegreerde medische MOOCs. De beschreven analyses omvatten een clusteranalyse in twee stappen gevolgd door een chi-kwadraattest (doel 1), een MANOVA gevolgd door post-hoctests (doel 2), een cross-lagged panelanalyse met behulp van Pearson's r (doel 3), een constructivistische Grounded Theory-analyse (doel 4) en een sjabloonanalyse gebaseerd op Cultural Historical Activity Theory (doel 5). De resultaten van deze onderzoeken zullen helpen om de motivatie om te leren in verschillende MOOC-integratieontwerpen en de onderliggende redenen te karakteriseren, de relatie tussen motivatie om te leren en zelfregulerend leren te identificeren, en inzicht te bieden in acceptatieprocessen, obstakels en bevorderende factoren rond leren met toegewezen leerdoelen. De bevindingen zullen een basis leggen voor verdere MOOC-integratiepraktijken en -onderzoek.

In **Hoofdstuk 7** hebben we een cross-sectionele studie uitgevoerd om de motivatie om te leren van bachelor studenten te onderzoeken en te beschrijven in formeel geïntegreerde medische MOOCs. Deze studie omvat onderzoeksdoelen 1 en 2 zoals beschreven in hoofdstuk 6. Studenten in drie MOOC-integratieontwerpen (A-C) werden gevraagd om deel te nemen aan een enquête na het voltooien van het MOOC-gedeelte van hun cursus, waarbij de motivatie om te leren en de psychologische behoefte bevrediging en frustratie werden gemeten. In integratieontwerp A was de volledige MOOC toegevoegd

als voorwaarde voor een face-to-face zomerschool van drie-en-een-halve dag. Ontwerp B verving een week colleges in een face-to-face module van acht weken door een reeks MOOC-activiteiten in een aparte iteratie van de MOOC, waardoor het contact met internationale studenten werd geblokkeerd. Ten slotte voegde ontwerp C de volledige MOOC in combinatie met een schriftelijke opdracht toe als optionele individuele cursus voor studiepunten in een extra curriculair honoursprogramma. Respectievelijk 19 (95%), 240 (67%) en 13 (49%) studenten vulden de enquête in. Verkennende factoranalyses lieten andere factoren voor motivatie zien dan eerder beschreven in het formele onderwijs. Ze leken op eerder beschreven motivatiefactoren voor leren in informele MOOCs: autonome motivatie, motivatie gebaseerd op vertrouwen in de docent en motivatie bericht op een positief imago. Deze factoren werden gecombineerd om motivatieprofielen te identificeren, met behulp van een clusteranalyse in twee stappen, een dubbele split-kruisvalidatie en een MANOVA om te onderscheiden of de motivatiefactoren variantie zouden kunnen verklaren. Er werden zes motivatieprofielen gevonden, met een Cohen's Kappa van 0,547 voor de stabiliteit van de clusters: zelfbepalende studenten en zeer zelfbepalende studenten, cijferjagers, en leraar-vertrouwende studenten die matig, sterk of extreem vertrouwen. Motivatiefactoren in geïntegreerd MOOC-leren leken op factoren in informeel MOOC-leren, maar motivatieprofielen niet. Verder bleek uit een chi-kwadraattest dat er een zwak tot gemiddeld verband bestond tussen het MOOC-integratieontwerp en het motivatieprofiel. Dit idee werd ondersteund door het feit dat studenten in het meest afwijkende ontwerp B over het algemeen lager scoorden op psychologische behoeftebevrediging en hoger op psychologische behoeftefrustratie dan studenten in ontwerp A en C. Dit onderzoek is het eerste dat de motivatie om te leren karakteriseert in formeel geïntegreerde MOOCs, en de eerste die integratieontwerpen vergelijkt op basis van motivatie. Bevindingen impliceren dat motivatiefactoren moeten worden gemeten zoals bij informeel MOOC-leren, motivatie moet worden gemonitord in MOOC-integratiecontexten, en specifiek voor verplichte ontwerpen moeten inspanningen worden geleverd om autonome motivatie om te leren te ondersteunen.

In **Hoofdstuk 8** voerden we een constructivistische, Grounded Theory-interviewstudie uit om inzicht te krijgen in acceptatie- en afwijzingsprocessen die optreden wanneer studenten leren met toegewezen leerdoelen in formeel geïntegreerde MOOC-contexten, aangezien het stellen van doelen een essentiële zelfregulerende leervaardigheid is in MOOC-leren. In deze iteratieve studie ontdekten we echter dat de processen niet beperkt waren tot geïntegreerd MOOC-leren, maar alle getoetste bachelor cursussen aangingen en dus verbreedden we ons vizier. De deelnemers werden doelbewust geselecteerd op basis van eerder verzamelde motivatie en zelfregulerende leerscores en integratieontwerpen. Na 13 interviews werd volledige verzadiging van de data bereikt. Door open, axiale en selectieve codering van alle interviews door twee onderzoekers, werd Assigned Learning Goal Acceptance Theory (ALGAT) gevormd. ALGAT beschrijft de processen die betrokken zijn bij de acceptatie van

toegewezen leerdoelen in een voorgeschreven studiesysteem. Er werden vier essentiële elementen gevonden: 1) de gepercipieerde aansluiting van leerdoelen als hulpmiddel bij de studiestrategieën van studenten; 2) het niveau van expliciete of impliciete acceptatie van de inhoud van leerdoelen, afhankelijk van de strategieën van de studenten; 3) het acceptatieniveau dat gebaseerd is op overwegingen van bruikbaarheid, begrijpelijkheid en waargenomen constructieve afstemming van leerdoelen, activiteiten en toetsing binnen een cursus; en 4) het neerleggen van studenten bij wat er ook maar van hen verwacht wordt, om het examen te halen. ALGAT draagt bij aan het begrijpen en verbeteren van leerdoelacceptatie en biedt richtingen voor toekomstig onderzoek.

In **Hoofdstuk 9** worden de belangrijkste bevindingen voor elk onderzoek samengevat en worden overkoepelende conclusies getrokken. Met betrekking tot de toegevoegde waarde van medische MOOC-integratie voor onderwijs van hoge kwaliteit concluderen we: (1) Medische MOOCs bieden een schat aan mogelijkheden voor integratie in campusonderwijs, inclusief opties om hoogwaardig, innovatief onderwijs aan te bieden; (2) Medische MOOCs delen niet één onderwijsmodusprofiel of dezelfde ontwerpkwaliteitsprincipes, en daarom moet elke MOOC afzonderlijk worden onderzocht voordat ze worden geïntegreerd; en (3) de praktijk van MOOC-integratie is geen eenvoudig proces en vereist tijd, verschillende stappen en specifieke kennis. Voor kwalitatief hoogstaand leren in geïntegreerde medische MOOCs concluderen we: (1) Monitoring van autonome motivatie en gebruik van zelfregulerende vaardigheden is essentieel voor gepersonaliseerde ondersteuning van effectief leren in geïntegreerde MOOCs, en gepersonaliseerde motivatie-ondersteuning kan gericht worden op specifieke integratieontwerpen; (2) Motivatie gebaseerd op vertrouwen in de docent, is van groot belang voor studenten in het formele medische MOOC-onderwijs, en het kan de sleutel zijn om motivatie van hoge kwaliteit te bevorderen; en (3) Acceptatie van doelen kan een brug slaan tussen theoretisch gestoelde wensen om persoonlijke doelen te stellen en praktische voorkeuren om doelen toe te wijzen, niet alleen in MOOC-integratieontwerpen. Deze conclusies worden besproken aan de hand van recente literatuur. Daarna worden sterke punten en limitaties besproken. We sluiten af met de praktische implicaties van dit proefschrift en toekomstige onderzoeksmogelijkheden.

SUPPLEMENTS

Table of contents

Appendix A: MOOC Teaching Modes Tool

Massive Open Online Course Teaching Modes Tool

This tool was assembled to study the instructional design (teaching modes) of MOOCs. It has been updated to include teaching modes we have found available. The tool consists of sections A and B. Original categorization was first published by Toven-Lindsey, Rhoads and Lozano in 2014 in their research paper: Virtually unlimited classrooms; pedagogical practices in Massive Open Online Courses. Journal: Internet and Higher Education.

A - Course info

B - Presence of
1. instruction modes
2. interaction modes
3. assessment modes

(Assembled in 2017 by RA Hendriks, Center for Innovation in Medical Education, Leiden University Medical Center, The Netherlands)

A0 Initials of researcher:

A1 Course name:

A2 Course startdate/Self-paced:

A3 Date of analysis:

B1a. Modes of instruction / resources in the course:

	Number:		Number:
Text/digital textbook		Audio or podcasts	
Illustrations; simulations (a)		Flashcards	
White board voiceover (b)		Thought trees or word clouds	
Power point presentation			
PPT with voiceover (c)			
Instructor talking to camera (d)			
Recorded traditional lecture (e)			
Links to external resources			
Prompts to use external resource for activity			
Interactive online labs			
Virtual patient cases			
Games			
Animation (f)			

B1b. Did you encounter any other mode of instruction/resources in the course? Specify type and number.

Notes:
(a) Category includes static digital images and interactive digital images. Both were used to help further explain concepts in the curriculum.

(b) Category includes digital whiteboard image with instructor drawing text and images while talking to the student. Instructor's face is generally not visible.

(c) Category includes video capture of PowerPoint slides with voice over from instructor to help explain concepts.

(d) Category includes video capture of course instructor talking directly into the camera. Often coupled with PowerPoint slides, whiteboard, images etc.

(e) Category includes video capture of classroom with instructor lecturing to a room of students. Often includes chalkboard, whiteboard, or other tools.

(f) Category includes use of avatar as instructor, with recorded voiceover, or use of animation or animated figures to teach course concepts.

B2a. Mode of interaction among peers:

	Y or N:
Asynchronous: Discussion board for Q&A available (a)	
Asynchronous: Discussion board for discussing course content available (b)	
Asynchronous: Discussion board prompt for introducing oneself	
Asynchronous: Discussion board prompt for answering course questions	
Asynchronous: Discussion board prompt for responding to peers on specific topics	
Synchronous: Chat/Study groups (c)	

B2b. Mode of interaction with the instructor:

	Y or N:
Asynchronous: active on discussion board for Q&A (a)	
Asynchronous: active on discussion board for dialogue (b)	
Asynchronous: active on discussion board for introducing oneself	
Synchronous: "live" event (d)	

Notes:
(a) Discussion board serves as a platform for question and answer sessions as opposed to discussion/dialogue among participants.

(b) Discussion board serves as a platform for threaded, back-and-forth dialogue among participants.

(c) Category includes platforms for chat or study groups, student-led study groups, etc.

(d) Category includes synchronous or "live" sessions hosted by instructor/TA such as virtual office hours, webcasts, and Skype chats with select students broadcast for full class.

B3a. Mode of assessment — assignments, exams and quizzes

	Number:
Multiple choice questions (a)	
Open ended short / fill in the blanks (b)	
Open ended long (c)	
Open ended long - peer assessed (d)	

B3b. If formal assessment was present, what parts were included in the formal assessment?

B3c. Mode of formal assessment

	Y or N:
Multiple attempts allowed	
Certificate of completion (e)	
Optional exam for credit (f)	

Notes:
(a) Category includes multiple choice questions that offered either computer -generated response or static answer key.

(b) Category includes short-response formats, typically students received computer-generated stock answer to compare, answer key or where students were required to offer a numerical response, often to an equation..

(c) Category includes long-response formats, typically essays or reflections.

(d) Category includes long-response formats, typically essays or reflections that are peer assessed.

(e) Course provider would generate a certificate stating that the study completed the course with a particular grade or percentage, sometimes for a fee.

(f) Category includes courses linked to institutions of higher education with option to enroll for credit; option to sign up for specific exams to earn credit.

B4. Have you encountered any activities that were not part of instruction or assessment but part of processing information or practicing skills? Please list type and number of these activities.

Appendix B: List of investigated MOOCs

#	Massive Open Online Course Title	Platform	Offered by
1	Introduction to the Science of Cancer	Canvas Network	The Ohio State University
2	Understanding Common Diseases	OpenEdXstudy	University of Wollongong
3	The Social Context of Mental Health and Illness	Coursera	University of Toronto
4	Managing Addiction: A Framework for Successful Treatment	EdX	University of Adelaide
5	Introduction to Cataract Surgery	Coursera	University of Michigan
6	Histology: Using Microscopy to Study Anatomy and Identify Disease	Futurelearn	The Open University
7	Talking About Cancer: Reducing Risk, Early Detection, and Mythbusting	Futurelearn	Cancer Research UK
8	Genomic Medicine: Transforming Patient Care in Diabetes	Futurelearn	University of Exeter
9	The Many Faces of Dementia	Futurelearn	University College London
10	Clinical Kidney, Pancreas and Islet Transplantation	Coursera	Leiden University Medical Center
11	Diabetes - A Global Challenge	Coursera	University of Copenhagen
12	Diabetes - The Essential Facts	Coursera	University of Copenhagen
13	Well and Able: Improving the Physical Health of People with Intellectual Disability	Coursera	University of Queensland
14	Epidemics: the dynamics of Infectious Diseases	Coursera	The Pennsylvania State University
15	ADHD: Everyday Strategies for Elementary Students	Coursera	The State University of New York, University at Buffalo
16	AIDS: Hope and Fear	Coursera	University of Michigan
17	In the Footsteps of ZIKA: Approaching the Unknown	EdX	Université de Genève, Institut Pasteur, Université Paris Descartes and Centre Virchow-Villermé
18	Ebola Virus Disease: An Evolving Epidemic	Coursera	Emory University
19	Preventing the ZIKA virus: Understanding and controlling the Aedes Mosquito	Futurelearn	London School of Hygiene and Tropical Medicine and the Arthropod Control Product
20	Easing the burden of obesity and cadiovascular disease	Coursera	The University of Sydney
21	Organ donation: from death to life	Coursera	University of Cape Town
22	Introduction to breast cancer	Coursera	Yale University
23	Tropical parasitology, protozoans, worms, vectors ans human diseases	Coursera	Duke University and Kilimanjaro and Christian Medical University College
24	Bacteria and chronic infections	Coursera	University of Copenhagen
25	Good brain, bad brain, Parkinson's disease	Futurelearn	University of Birmingham
26	Understanding Alzheimer's disease: A molecular and genetic approach	EdX	The University of Texas at San Antonio
27	MalariaX: Defeating malaria/ from the genes to the globe	EdX	Harvard University
28	Better conversations with aphasia	UCLeXtend	University College London
29	Clinical management of HIV	Iversity	European AIDS Clinical Society
30	Congenital hypothyroidism, what every primary care provider needs to know	Stanford Online	Stanford Medicine
31	Prescription drug misuse ans addiction: compassionate care for a complex problem	Stanford Online	Stanford Medicine
32	Perspectives on disability	Open Education by Blackboard	Northern Illinois University
33	Understanding dementia	desireEdXlearn	The University of Tasmania

Appendix C: MOOC Instructional Design Tool

MOOC Instructional Design Quality Tool
- CourseScan extended with Goal-Setting Items -

This tool was assembled to study the instructional design quality of MOOCs, based on a 10 principle framework named CourseScan by Margaryan, Bianco and Littlejohn (2015), published in *Computers & Education.* Goal-setting was added as 11th principle. In addition information about course presentation and organization can be gathered with the tool.
The tool consists of 3 sections:

A - Researcher information and course information that can be gathered on the course information page

B - Course information that can be gathered once one is enrolled in the course

C - Instructional design principles: goal-setting, problem-centeredness, authentic resources, activation, application, integration, differentiation, demonstration, collective knowledge, feedback and collaboration

(Assembled by Renée Hendriks, Center for Innovation in Medical Education, Leiden University Medical Center, The Netherlands, 2019)

SECTION A

This section concerns the information page of the course

A1 Initials of researcher:

A2 Course name:

A3 Course startdate/Self-paced:

A4 Date of analysis:

A5 Course website:

A6 Course platform:

- Coursera
- EdX
- Iversity
- Futurelearn
- Canvas Network
- Independent
- OpenEx
- Open2study
- Open Education by Blackboard
- Other:

A7 Does the course information page specify the learner population that will engage in the course?

- Yes
- No

MOOC Instructional Design Quality Tool - page 1 of 7

A8 Does the course information page specify the change that needs to be promoted in the skill set of the learner population?

- ○ Yes
- ○ No

A9 Are distal goals described on the course information page (at the end of this course...)?

- ○ No
- ○ Yes, namely:

A10 Are the course enrollment requirements clearly outlined on the course information page?

- ○ Yes
- ○ No

A11 Are the course completion requirements clearly outlined on the course information page?

- ○ Yes
- ○ No

A12 Is the course description on the course information page clear?

- ○ Yes
- ○ No

Please enter the course for the following sections

SECTION B

Likert-scale items scoring system for section B and C:

- **None.** The course does not reflect a given principle at all.
- **To some extent.** Serious gaps were found, the course reflects a given principle in less than 50% of the included teaching modes.
- **To large extent.** The course reflects a given principle mostly sufficient, in 51% to 80% of included teaching modes.
- **To very large extent.** The course reflects a given principle to complete satisfaction, in 81% to 100% of included teaching modes.
- **Not applicable.** 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.
- **No information.** No information is available to determine if a given principle is reflected in the course.

B1 Is the course description clear?

- Yes
- No

B2 Does the course specify the learner population that will engage in the course?

- Yes
- No

B3 Does the course specify the change that needs to be promoted in the skill set of the learner population?

- Yes
- No

B4 To what extent are the course materials well organised?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

B5 Are the course enrollment requirements clearly outlined?

- Yes
- No

B6 Are the course completion requirements clearly outlined?

- Yes
- No

SECTION C

Goal setting

C1 Are distal goals described (at the end of this course...)?

- No
- Yes, namely:

C2 Are proximal goals described (per week or per activity)?

- No
- Yes, namely:

C3 To what extent are the course objectives measurable?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

C4 Are students encouraged to make a commitment statement about learning goals or a change in their knowledge, skill set or attitude?

- Yes
- No

C5 Are students invited to construct or set their own goals?

- Yes
- No

C6 Are students encouraged to think about possible obstacles that might impede their development in the course?

- Yes
- No

Problem-centeredness

C7 To what extent do the activities build upon each other?

- None
- To some extent
- To large extent
- To very large extent
- No information

C8 To what extent are the course objectives relevant to real-world problems?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

C9 To what extent are the problems in the course typical of those learners will encounter in the real world?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

C10 To what extent do the activities in the course relate to the participants' real workplace problems?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

C11 To what extent are the problems ill-structured – ie have more than one correct solution?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

C12 To what extent are the problems divergent from one another?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

Authentic resources

C13 To what extent are the resources reused from real-world settings?

- None
- To some extent
- To large extent
- To very large extent
- No information

Activation

C14 To what extent do the activities attempt to activate learners' relevant prior knowledge or experience?

- None
- To some extent
- To large extent
- To very large extent
- No information

Application

C15 To what extent do the activities require learners to apply their newly acquired knowledge or skill?

- None
- To some extent
- To large extent
- To very large extent
- No information

Integration

C16 To what extent do the activities require learners to integrate the new knowledge or skill into their everyday life or work?

- None
- To some extent
- To large extent
- To very large extent
- No information

Differentiation

C17 To what extent are there activity options for participants with various learning needs?

- None
- To some extent
- To large extent
- To very large extent
- No information

Demonstration

C18 Are there examples of problem solutions?

- Yes
- No
- Not applicable

C19 If there are examples of solutions, to what extent do these solutions represent a range of quality from excellent examples to poor examples?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

Collective knowledge

C20 To what extent do the activities require participants to learn from each other?

- None
- To some extent
- To large extent
- To very large extent
- No information

C21 To what extent do the activities require learners to build on other participants' submissions?

- None
- To some extent
- To large extent
- To very large extent
- No information

C22 To what extent do the activities require participants to contribute to the collective knowledge, rather than merely consume knowledge?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

Feedback

C23 Is there feedback on activities by the instructor(s) in this course?

- Yes
- No

C24 If there is feedback, is the way feedback will be provided clearly explained to the participants?

- Yes
- No
- Not applicable

Collaboration

C25 To what extent do the activities require participants to collaborate with other course participants?

- None
- To some extent
- To large extent
- To very large extent
- No information

C26 To what extent do the activities require participants to collaborate with others outside the course?

- None
- To some extent
- To large extent
- To very large extent
- No information

C27 To what extent do the activities require that the peer-interaction groups be comprised of individuals with different backgrounds, opinions, and skills?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

C28 To what extent can the individual contribution of each learner in the group be clearly identified?

- None
- To some extent
- To large extent
- To very large extent
- Not applicable
- No information

C29 Are the peer-interaction groups given specific directions for interaction?

- Yes
- No
- Not applicable

C30 Does each member of a peer-interaction group have a specific role to play?

- Yes
- No
- Not applicable

Appendix D: Extended results table for Instructional Design

MOOC number*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Present in (n)	Present in (%)	Sum of scores	Mean score of represented
Organisation																																					
The course materials are well organised	3	3	2	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2	3	33	100%	93	2,82
The course description is clear	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	33	100%	33	1
The learner population that will engage in the course is specified	1	1	0	1	1	1	1	1	1	1	0	1	1	0	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	26	79%	26	1
The course completion requirements are outlined clearly	0	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	1	1	0	1	1	1	1	1	24	73%	24	1
The course enrolment requirements are outlined clearly	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	1	1	0	0	0	1	12	36%	12	1
The change that needs to be promoted in the skill set of the learner population is specified	0	1	0	1	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	11	33%	11	1
Problem-centered																																					
The activities build upon each other	2	2	2	3	3	3	1	2	2	3	2	2	1	3	2	1	1	2	1	2	2	3	2	3	2	3	3	2	2	2	3	3	3	33	100%	73	2,21
The activities in the course relate to the participants' real workplace problems	0	0	0	3	3	3	1	0	0	2	0	0	2	0	2	0	1	0	1	2	2	1	2	0	0	1	3	2	3	3	3	0	2	20	61%	42	2,10
The course objectives are relevant to real-world problems	0	0	0	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	2	3	3	3	0	3	11	33%	32	2,91
The problems in the course are typical of those learners will encounter in the real world	0	0	0	3	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	2	2	1	1	0	2	11	33%	21	1,91
The problems are ill-structured – have more than one correct solution	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	0	0	0	0	5	15%	7	1,40
The problems are divergent from one another	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	4	12%	5	1,25
Activation																																					
The activities attempt to activate learners' relevant prior knowledge or experience	0	3	2	2	0	1	1	0	1	3	0	0	0	1	0	0	0	0	0	1	0	2	0	0	1	0	1	0	0	1	1	1	3	16	48%	25	1,56
Demonstration																																					
There are examples of problem solutions	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	1	1	0	1	11	33%	11	1,00
Solutions represent a range of quality from excellent examples to poor examples	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	3	9%	3	1,00
Application																																					
The activities require learners to apply their newly acquired knowledge or skill	1	1	1	1	1	2	1	1	1	2	1	2	1	1	1	1	2	1	1	1	1	2	1	0	1	1	2	2	2	1	1	1	2	32	97%	41	1,28
Integration																																					
The activities require learners to integrate the new knowledge or skill into their everyday work	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	2	6%	2	1,00
Collective knowledge																																					
The activities require contributing to the collective knowledge, rather than merely consuming	0	0	1	1	0	0	1	1	0	1	0	1	0	1	0	1	1	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	15	45%	15	1,00
The activities require learners to build on other participants' submissions	0	1	1	1	1	0	0	1	0	1	1	1	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	13	39%	13	1,00
The activities require participants to learn from each other	0	0	1	0	0	1	0	0	0	1	1	1	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	9	27%	9	1,00
Collaboration																																					
Activities require participants to collaborate with other course participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0	-
Activities require participants to collaborate with others outside the course	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	3%	1	1,00
Activities require peer-interaction groups with individuals with different backgrounds, opinions, and skills	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0	-
The individual contribution of each learner in the group can be clearly identified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0	-
Peer-interaction groups are given specific directions for interaction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0	-
Each member of a peer-interaction group has a specific role to play	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0	-
Differentiation																																					
There are activity options for participants with various learning needs	0	0	0	0	0	0	0	1	1	3	1	1	1	0	0	1	0	1	0	1	1	0	0	0	0	0	0	3	1	0	0	1	0	13	39%	17	1,31
Athentic resources																																					
The resources are reused from real-world settings	1	0	1	1	1	1	1	2	1	3	1	1	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	32	97%	39	1,22
Feedback																																					
There is feedback on activities by the instructor(s) in this course	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	32	97%	32	1,00
If there is feedback, the way feedback will be provided, is clearly explained to the participants	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	6	18%	6	1,00
Goal-setting																																					
Goals are measurable	3	1	3	3	3	3	2	0	2	3	0	3	0	0	3	3	2	2	2	2	3	0	0	0	3	2	0	3	3	3	3	3	3	25	76%	66	2,64
Course contains distal goals	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0	1	1	1	0	1	1	1	1	0	20	61%	20	1,00
Course contains proximal goals	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	1	0	1	1	1	1	0	0	0	0	1	0	1	1	0	0	1	1	14	42%	14	1,00
Personal goals are incorporated	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	8	24%	8	1,00
Obstacles to attain goals are considered	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3%	1	1,00
Commitment statement about goals is required	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0	-

*the matching titles can be found in appendix A.

Appendix E: Interview protocol Dutch version

Interview protocol

Naam student:
Identificatienummer:

1) Voorstellen
Mijn naam is Renée Hendriks en ik ben promovenda bij het Onderwijs Expertise Centrum (OEC) van het LUMC. Hier doe ik in het kader van mijn promotietraject onderzoek binnen de medische opleidingen. Ik zal het interview vandaag met je afnemen.

2) Achtergrond
Bij het Onderwijs Expertise Centrum is drie jaar geleden een onderzoeksgroep gestart. Eén van de onderzoekslijnen richt zich op Technology Enhanced Learning. In dat kader onderzoeken we, onder andere middels deze interviewstudie, hoe medische MOOCs optimaal geïntegreerd kunnen worden in het campus onderwijs.

3) Doelen van het interview
Dit interview heeft twee hoofddoelen: 1) inzicht krijgen in hoe studenten werken met toegewezen leerdoelen in een online omgeving, en 2) achterhalen of en welke problemen studenten ondervinden in het werken met deze doelen. Het interview is in 3 thema's onderverdeeld.

- Starten met een MOOC
- Leerdoelen accepteren of niet
- Mogelijke problemen met toegewezen leerdoelen

4) Rapportage van het interview
De geluidsopnames van dit interview en de transcripties van die opnames zullen we beveiligd opslaan. Weet je wat een transcriptie is? (*Indien ja*: verder gaan met de volgende zin / *Indien nee*: uitleggen wat een transcriptie is). Alleen ikzelf en de databasebeheerder van het onderzoek zullen er toegang tot hebben. De resultaten van dit interview zullen samen met de andere interviews geanalyseerd worden en gerapporteerd worden in de vorm van een wetenschappelijk artikel. In dit artikel worden je antwoorden uiteraard anoniem verwerkt.

5) Duur van het interview
Het interview zal ongeveer 60-75 minuten duren.

6) Afspraken

- Geef je toestemming dat de resultaten vanuit de interviews in een weten-schappelijk artikel verwerkt worden?
- Geef je toestemming voor een geluidsopname?
- Geef je toestemming dat ik je mag benaderen voor een vervolginterview?
- Als ik een quote uit je interview wil gebruiken vraag ik je daarvoor om toestemming.
- Je mag te allen tijde je toestemming intrekken zonder opgaaf van redenen.
- Heb je nog andere vragen of opmerkingen?

Start interview

Thema 1: Starten met een MOOC

1. Wanneer heb je voor het laatst in een MOOC geleerd voor je studie? Was dit de eerste keer?
2. Wat doe als eerste als je begint met een MOOC voor je studie?
3. Wat doe je daarna?

Thema 2: Leerdoelen accepteren of niet

1. Doe je iets met de cursusinformatie, syllabus of leerdoelen in de MOOC?

   Ja: - Weet je nog wat de leerdoelen zijn/waren?
   - Wat doe je ermee?
   - Waarom?
   - Wat vind je ervan dat deze informatie en doelen worden gegeven?
   - Zit er een volgorde in die activiteiten?

   Nee: - Wat vind je ervan dat deze informatie en doelen worden gegeven?
   - Is er een reden dat je niets doet met deze informatie?
   - Hoe bepaal je of je iets doet met de leerdoelen?
   - Wat is het eerstvolgende dat je doet na (antw. vraag 3 van thema 1)?

2. Stel je eigen doelen op voor het leren in de MOOC?

   Ja: - Kun je een voorbeeld geven van zo'n doel?
   - Hoe ga je te werk als je doelen opstelt?
   - Waarom doe je dit zo?

   Nee: - Wat vind je van het opstellen van doelen?
   - Stel je wel eens doelen in andere contexten?
   - Is er denk je een reden dat je geen doelen stelt voor het leren in de MOOC?

Thema 3: Mogelijke problemen met toegewezen leerdoelen

1. Vindt je het prettig om op deze manier met/zonder toegewezen leerdoelen te werken?

   Ja: - Wat vind je er prettig aan?
   - Waarom?

   Nee: - Wat vind je er niet prettig aan?
   - Waarom?

Appendix F: Interview protocol English version

Interview protocol (English)

Student name:
Identification number:

1) Introductions
My name is Renée Hendriks and I am a PhD candidate at the Center for Innovation in Medical Education (OEC) at the Leiden University Medical Center. As part of my PhD trajectory, I am doing research within the medical courses here. I'll be doing the interview with you today.

2) Background
A research group was started three years ago at the Center for Innovation in Medical Education. One of the research focuses is on Technology Enhanced Learning. In this context we are investigating, through this interview study, how medical MOOCs can be optimally integrated into campus education.

3) Objectives of the interview
This interview has two main goals: 1) gain insight into how students work or do not work with assigned learning goals in an online environment, and 2) find out if and what problems students experience working with these goals. The interview is subdivided into 3 themes.

- Starting with a MOOC
- Accepting learning objectives or not
- Possible problems with assigned learning objectives

4) Reporting the interview
We will store the audio recordings of this interview and the transcriptions of those recordings securely. Do you know what a transcription is? (If yes: continue with the following sentence / If no: explain what a transcription is). Only myself and the database administrator of the study will have access to it. The results of this interview will be analyzed together with the other interviews and reported in the form of a scientific article. In this article your answers will of course be processed anonymously.

5) Duration of the interview
The interview will last approximately 30-60 minutes.

6) Agreements

- Do you give permission for the results from the interviews to be processed in a scientific article?
- Do you give permission for a sound recording?
- Do you allow me to approach you for a follow-up interview?
- If I want to use a quote from your interview, I will ask you for permission.
- You may withdraw your consent at any time without giving reasons.
- Do you have any other questions or comments?

Start interview

Theme 1: Starting with a MOOC

1. When did you last learn in a MOOC for your studies? Was this the first time?
2. What do you do first when you start a MOOC for your studies?
3. What do you do next?

Theme 2: Accepting learning objectives or not

1. Do you do something with the course information, syllabus or learning objectives in the MOOC?

   Yes: - Do you remember the objectives?
   - What do you do with it?
   - Why?
   - What do you think about this information and goals being given?
   - Is there a sequence in those activities?

   No: - What do you think about this information and goals being given?
   - Is there a reason that you do not do anything with this information?
   - How do you determine whether you do something with the learning objectives?
   - What is the next thing you do after .... (answer to question 3 of theme 1)?

2. Do you set your own goals for learning in the MOOC?

   Yes: - Can you give an example of such a goal?
   - How do you proceed when you set goals?
   - Why are you doing this?

   No: - What do you think about setting goals?
   - Do you ever set goals in other contexts?
   - Is there a reason why you don't set goals for learning in the MOOC?

Theme 3: Possible problems with assigned learning objectives

1. Do you like working in this way with / without assigned learning goals?

   Yes: - What do you like about it?
   - Why?

   No: - What do you dislike about it?
   - Why?

Appendix G: Information letter and informed consent form for quantitative data collection

'Motivation and self-regulated learning skills in integrated medical mooc learning'

Dear student,
We want to ask you to participate in this educational study. In this study we investigate motivation and independent (or self-regulated) online learning skills of students that learn in Massive Open Online Courses (MOOCs) for their medical studies. We ask all medical students of the Leiden University Medical Center (LUMC) that have enrolled in one of the following courses to participate in this research: *Mechanisms of Disease (MOD), Leiden Oxford Transplantation Summer school (LOTS), and students that participate in in the Virtual Exchange or Honors program (Hons)*. Your participation will have no consequences for your study progress and results will only be used for research purposes. We would ask you to read the following points carefully and if you agree to participate in the study, provide the consent form with a date and your confirmed consent.

Purpose of the investigation
The purpose of this research is to 1) compare motivation between different courses that use the MOOC, and 2) see how motivation and independent learning are related when learning in a MOOC. Results will inform future MOOC use in the LUMC and other universities.

Conducting the investigation
Participation consists of filling in two questionnaires (Q1 and Q2), one before starting the MOOC and one after you have finished learning in the MOOC. Each will take approximately 15-20 minutes. A small number of the participants will be asked to also partake in an interview to deepen understanding of the results. Students that are approached for the interview study will receive additional information after results of the questionnaires have been analyzed. You will receive Q1 via email, and Q2 will be distributed after a lecture (LOTS), before a workgroup, or after an exam (MOD), and via email (Hons, and all previously unreached students of LOTS and MOD).

What is expected of you?
If you participate in the study, you do not have to make specific preparations.

Advantages and disadvantages and possible risks
Your participation is entirely voluntary. If you decide not to participate or withdraw at any time during the study, you do not have to give a reason. If you withdraw, we will not include the collected data in our investigation and destroy it. Participating or not participating in the study will in no way affect your further study progress negatively. If you decide to participate,

it is greatly appreciated by us as it will provide useful information for future use of MOOCs in medical education. Your participation in this research can offer you new insights into your motivation and self-regulated learning skills if you wish to see your analyzed results, which can ultimately benefit your academic performance and enjoyment of learning. There are no risks associated with participating in this study. Confidentiality and privacy are guaranteed.

What happens with your data?
The data will be stored encrypted and stored in a protected folder on a protected LUMC server. Coded means that it cannot be directly traced back to you. Only the principal investigator Renée Hendriks (PhD candidate) or her possible successor, have access to the directly traceable data. The other researchers involved only have access to the coded data. You have the right to see the way in which your data is stored.

Review committee
Approval for this research has been obtained from the Educational Research Review Board (ERRB) of the LUMC.

Contact information
If you have any questions about the research or your participation, you can contact the principal investigator.

Renée Hendriks

Center for Innovation in Medical Education (OEC),
LUMC, Postbus 9600, 2300RC Leiden

r.a.hendriks@lumc.nl
Many thanks in advance, on behalf of the research team,

drs. Renée Hendriks, PhD candidate, LUMC
dr. ir. Peter de Jong, Assistant Professor of Technology Enhanced Learning, LUMC
prof. dr. Wilfried Admiraal, Professor of Educational Sciences, Leiden University
prof. dr. Marlies Reinders, Professor of Internal Medicine, LUMC

CONSENT

Please select your choice below. You may print or request a copy of this consent form for your records. Selecting the “Agree” button indicates that:

- You have read the above information
- You voluntarily agree to participate
- You give permission to use your data for the purposes stated in the information letter

☐ Agree
☐ Disagree

Name: _____ Date: __ /__ /__

To be completed by researcher:

I hereby declare that I have sufficiently informed this participant about the aforementioned study. If information becomes known during the investigation that could influence the consent of the participant, I will inform him / her in a timely manner in a manner that ensures that the information has reached the participant.

Researcher’s name: Renée Hendriks

Signature: Date: __ / __ / __

Appendix H: Information letter for qualitative data collection

'Motivation and self-regulated learning skills in integrated medical mooc learning'

Dear student,
We want to ask you to participate in the interview part of the 'motivation and self-regulated learning in medical MOOCs' study. In this interview study we investigate the processes involved in accepting or rejecting course learning goals, and problems students might encounter when working with these goals. We ask students that have participated in the previous part of the study and that have specific combinations of motivation and self-regulated learning skills. Your participation will have no consequences for your study progress and results will only be used for research purposes. We would ask you to read the following points carefully. If you agree to participate in the study, the consent form for using the interview data will be provided afterwards as you will then know what was discussed and what you agree on sharing with the researchers.

Purpose of the investigation
The purpose of this research is to 1) gain insight into how students work or do not work with assigned learning goals in an online environment, and 2) find out if and what problems students experience working with these goals.

Conducting the investigation
Participation consists of answering questions regarding course goals and personal goals in an interview. If you decide to participate in the study, the researcher will schedule an appointment with you. To relieve you of any traveling time, the interview will take place in the educational building of the LUMC if you are a student in Leiden. If you study elsewhere, the researcher will arrange a meeting closer to you or via skype. The investigation will take approximately 30-60 minutes. In case of a face-to-face meeting, drinks and snacks will be available during the interview.

What is expected of you?
If you participate in the study, you do not have to make specific preparations.

Advantages and disadvantages and possible risks
Your participation is entirely voluntary. If you decide not to participate or withdraw at any time during the study, you do not have to give a reason. If you withdraw, we will not include the collected data in our investigation and destroy it. Participating or not participating in the study will in no way affect your further study progress negatively. If you decide to participate, it is greatly appreciated by us as it will provide useful information for future use of learning goals in MOOCs in medical education. Your participation in this research can offer you new

insights into your motivation and self-regulated learning skills, which can ultimately benefit your academic performance and enjoyment of learning. There are no risks associated with participating in this study. Confidentiality and privacy are guaranteed.

What happens with your data?
A sound recording is made of the interview. This recording will be deleted from the recording device after transcribing the data. The data will also be stored encrypted and stored in a protected folder on a protected LUMC server. Coded means that it cannot be directly traced back to you. Only the principal investigator Renée Hendriks (PhD candidate) or her possible successor, and the person who will transcribe the data, have access to the directly traceable data. The other researchers involved only have access to the coded data. You have the right to see the way in which your data is stored.

Review committee
Approval has been obtained for this research from the Educational Research Review Board (ERRB) of the LUMC.

Contact information
If you have any questions about the research or your participation, you can contact the principal investigator.

Renée Hendriks

Center for Innovation in Medical Education (OEC), LUMC, Postbus 9600, 2300RC Leiden

r.a.hendriks@lumc.nl

Many thanks in advance, on behalf of the research team,

drs. Renée Hendriks, PhD candidate, LUMC
dr. ir. Peter de Jong, Assistant Professor of Technology Enhanced Learning, LUMC
prof. dr. Wilfried Admiraal, Professor of Educational Sciences, Leiden University
prof. dr. Marlies Reinders, Professor of Internal Medicine, LUMC

Appendix I: Informed consent form for qualitative data collection

INFORMED CONSENT

To be filled in by participant:

Previous to the interview, I have read the information and was able to ask additional questions. I had enough time to decide if I would like to participate. I know that participating is entirely voluntary and I am aware that I can decide at any time to withdraw. I don't have to give reasons for that. I know that researcher Renée Hendriks can view my data. I myself have the right to see how my data is stored.

I give permission to use my data for the purposes stated in the information letter. If there is reason to use the data for another research purpose, permission will be requested again from me.

I also give permission to retain data for a further 10 years after the end of this study for further analysis in the context of this study (if applicable). I know that if the researchers want to use specific quotes, I will be asked for consent for each quote.

Name contestant:

Signature: Date: __ / __ / __

To be completed by researcher:

I hereby declare that I have sufficiently informed this participant about the aforementioned study.

If information becomes known during the investigation that could influence the consent of the participant, I will inform him / her in a timely manner in a manner that ensures that the information has reached the participant.

Researcher's name:

Signature: *Date: __ / __ / __*

Appendix J. Factor loadings of three types of motivation for all items.

	Component			*N = 265, sample size threshold for loading significance =.35*
	Autonomous motivation	**Instructor trusting motivation**	**Positive image motivation**	
Item #	*1*	*2*	*3*	*Item*
T2AQ9	0,859			The reason that I worked to expand my knowledge of transplantation in the MOOC is: 9. Because it is interesting to learn more about the nature of transplantation medicine.
T2AQ4	0,835			I have participated actively in the MOOC: 4. Because a solid understanding of transplantation medicine is important to my intellectual growth.
T2AQ1	0,816			I have participated actively in the MOOC: 1. Because I feel like it is a good way to improve my understanding of the material.
T2AQ10	0,806			The reason that I worked to expand my knowledge of transplantation in the MOOC is: 10. Because it is a challenge to really understand how to solve transplantation problems.
T2AQ3	0,580			I have participated actively in the MOOC: 3. Because I would feel proud of myself if I did well in the course.
T2AQ7		0,819		I have followed the instructor's suggestions for studying transplantation medicine online: 7. Because it is easier to follow his/her suggestions than come up with my own study strategies.
T2AQ8		0,781		I have followed the instructor's suggestions for studying transplantation medicine online: 8. Because he/she seems to have insight about how best to learn the material.
T2AQ6		0,668		I have followed the instructor's suggestions for studying transplantation medicine online: 6. Because I am worried that I am not going to perform well in the course.
T2AQ5		0,595		I have followed the instructor's suggestions for studying transplantation medicine online: 5. Because I would get a bad grade if I didn't do what he/she suggests.
T2AQ11			0,768	The reason that I worked to expand my knowledge of transplantation in the MOOC is: 11. Because a good grade in the MOOC will look positive on my record.
T2AQ12			0,768	The reason that I worked to expand my knowledge of transplantation in the MOOC is: 12. Because I want others to see that I am intelligent.
T2AQ2			0,640	I have participated actively in the MOOC: 2. Because others might think badly of me if I didn't.

Appendix K. Factor loadings of three and two subscales of psychological need satisfaction and frustration for all items.

	Component			*N = 259, sample size threshold for loading significance = .35*
	Relatedness-autonomy satisfaction	**Competence satisfaction**	**Autonomy satisfaction**	
Item #	*1*	*2*	*3*	*Item*
T2CQ15	0,898			I feel close and connected with other people in the MOOC who are important to me.
T2CQ9	0,767			I feel connected with people in the MOOC who care for me, and for whom I care.
T2CQ21	0,760			I experience a warm feeling with the people I spend time with in the MOOC.
T2CQ3	0,667			I feel that the people in the MOOC I care about also care about me.
T2CQ13	0,589			I feel my choices in the MOOC express who I really am.
T2CQ7	0,576			I feel that my decisions in the MOOC reflect what I really want.
T2CQ5		0,851		I feel confident that I can do things well in the MOOC.
T2CQ17		0,783		I feel competent to achieve my goals in the MOOC.
T2CQ11		0,773		I feel capable at what I do in the MOOC.
T2CQ23		0,698		I feel I can successfully complete difficult tasks in the MOOC.
T2CQ1			0,871	I feel a sense of choice and freedom in the things I undertake in the MOOC.
T2CQ19			0,489	I feel I have been doing what really interests me in the MOOC.

	Component		*N = 262, sample size threshold for loading significance = .35*
	Relatedness-competence frustration	**Autonomy frustration**	
Item #	*1*	*2*	*Item*
T2CQ24	0,796		I feel like a failure because of the mistakes I make in the MOOC.
T2CQ18	0,743		I feel insecure about my abilities in the MOOC.
T2CQ10	0,711		I feel that people who are important to me in the MOOC are cold and distant towards me.
T2CQ12	0,705		I feel disappointed with many of my performances in the MOOC.
T2CQ16	0,697		I have the impression that people I spend time with in the MOOC dislike me.
T2CQ4	0,613		I feel excluded from the group I want to belong to in the MOOC.
T2CQ6	0,608		I have serious doubts about whether I can do things well in the MOOC.
T2CQ2		0,826	Most of the things I do in the MOOC feel like “I have to”.
T2CQ8		0,787	I feel forced to do many things in the MOOC I wouldn’t choose to do.
T2CQ14		0,770	I feel pressured to do too many things in the MOOC.
T2CQ20		0,735	My daily activities in the MOOC feel like a chain of obligations.

Appendix L. Variation Ration Criterion calculation results, showing an optimal combination of parsimony, a high VRC score and a low (negative) Omega score for the cluster solution when 6 clusters are formed.

	SSB10	SSW10	SSB9	SSW9	SSB8	SSW8	SSB7	SSW7	SSB6	SSW6	SSB5	SSW5	SSB4	SSW4	SSB3	SSW3	SSB2	SSW2
Auto-nomous	168,644	70,388	164,852	74,18	161,363	77,669	141,122	97,911	117,723	121,31	104,429	134,604	99,826	139,206	40,946	198,086	30,282	208,75
Teacher trusting	236,37	92,939	222,214	107,095	220,66	108,649	217,517	111,793	212,74	116,57	203,206	126,104	154,709	174,6	147,067	182,242	50,473	278,836
Positive image	255,314	69,036	253,531	70,819	238,563	85,788	233,298	91,053	226,066	98,285	200,55	123,801	195,646	128,704	195,386	128,964	193,553	130,798
Total	660,328	232,363	640,597	252,094	620,586	272,106	591,937	300,757	556,529	336,165	508,185	384,509	450,181	442,51	383,399	509,292	274,308	618,384
N	263		263		263		263		263		263		263		263		263	
K	10		9		8		7		**6**		5		4		3		2	
SSB/K-1	73,36977778		80,074625		88,65514286		98,65616667		111,3058		127,04625		150,0603333		191,6995		274,308	
SSw/N-K	0,91843083		0,992496063		1,067082353		1,174832031		1,308035019		1,490344961		1,708532819		1,958815385		2,369287356	
VRC	79,8860136		80,68004296		83,08181896		83,9746994		**85,09389913**		85,2462036		87,82993906		97,86501653		115,7765854	
Difference a	-		-0,794029362		-2,401775995		-0,892880442		-1,11919973		-0,152304473		-2,58373546		-10,03507747		-17,91156889	
Difference b	-0,794029362		-2,401775995		-0,892880442		-1,11919973		-0,152304473		-2,58373546		-10,03507747		-17,91156889		-	
omega	-		1,607746633		-1,508895552		0,226319287		**-0,966895257**		2,431430987		7,451342013		7,876491417		-	

Appendix M. Explained variance of cluster solution by constituting dimensions.

Constituting dimension	F(5, 263)	η2
Instructor trusting motivation	109,72***	0,68
Positive image motivation	111,45***	0,68
Quantity of motivation	149,057***	0,74
Quality of motivation A	56,05***	0,52
Quality of motivation B	102,15***	0,67

Note. Quality of motivation A is calculated as Autonomous motivation and Instructor trusting motivation combined minus Positive image motivation. Quality of motivation B is calculated as Autonomous motivation minus Instructor trusting motivation and Positive image motivation. As Instructor trusting motivation can consist of both autonomous and controlled forms of regulation, two types of quality of motivation we calculated.

***p<.001.

APPENDIX N: Chronological sequence of analysis approach

Step	Activity	Researcher(s)	Program(s)	Corresponding memo's*
1	Write reflexivity memo	RH and PJ	Microsoft Word	Reflexivity memo's
2	Conduct interview 1 to 4	RH	Microsoft Teams	
3	Open coding interview 1 and 2	RH and PJ	Atlas.ti	
4	Discussion on open codes	RH and PJ	Microsoft Teams	Analysis memo 1
5	Conduct interview 5	RH	Microsoft Teams	
6	Open coding interview 3	RH and PJ	Atlas.ti	
7	Conduct interview 6	RH	Microsoft Teams	
8	Follow-up open coding interview 3	RH and PJ	Atlas.ti	
9	Discussion on open codes	RH and PJ	Microsoft Teams	Analysis memo 2
10	Create Word files with tables	RH and PJ	Microsoft Word	
11	Discussion on axial codes	RH and PJ	Microsoft Word	Analysis memo 3
12	Create more Word files with tables	RH and PJ	Microsoft Word	
13	Discussion on axial codes	RH and PJ	Microsoft Teams	Analysis memo 4
14	Open coding interview 4 to 6	RH and PJ	Atlas.ti	
15	Discussion on axial codes	RH and PJ	Microsoft Teams	Analysis memo 5
16	Conducting interview 7	RH	Microsoft Teams	
17	Discussion on axial codes	RH and PJ	Microsoft Teams	Analysis memo 6 to 8
18	Reconsider names of open codes	RH	Microsoft word	Analysis memo 9
19	Conduct interviews 8 and 9	RH	Microsoft Teams	
20	Changing codes in Atlas for int 1-6	RH	Atlas.ti	Analysis memo 10
21	Discussion on axial codes	RH and PJ	Microsoft Word	Analysis memo 11 to 15
22	Logical ordering of axial codes	RH and PJ	Microsoft Word	Analysis memo 16
23	Conduct interview 10 to 12	RH	Microsoft Teams	
24	Open coding interview 8 to 10	RH and PJ	Atlas.ti	Analysis memo 17 and 18
25	Conduct interview 13	RH	Microsoft Teams	
26	Open coding interview 11 to 12	RH and PJ	Atlas.ti	Analysis memo 19 to 21
27	Axial coding	RH and PJ	Microsoft Word	Analysis memo 21 to 27
28	Selective coding	RH and PJ	Microsoft Word, diagrams.net	Analysis memo 26 to 28
29	Traceability check	WA	All produced Word and Atlas.ti files	
30	Final discussion on results	All authors	Microsoft Teams	

*can be shared upon request

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LIST OF SCIENTIFIC CONTRIBUTIONS

Scientific publications

van Klaveren, C.W., de Jong, P.G.M., **Hendriks, R.A.**, Luk, F., de Vries, A.P., van der Boog P.J., & Reinders, M.E.J. (2022). Didactical characteristics of Dutch websites about kidney transplantation targeted for kidney patients and living donors: An exploratory study. *PEC Innovation*, 100026.

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Manuscripts under review

Hendriks, R.A., de Jong, P.G.M., Admiraal, W.F., & Reinders, M.E.J. (*Submitted*). Students learning in different MOOC integration designs are self-determined learners, grade hunters and teacher trusters.

Hendriks, R.A., de Jong, P.G.M., Admiraal, W.F., & Reinders, M.E.J. (*Submitted*). Assigned Learning Goal Acceptance Theory: a model to understand learning goal acceptance processes of undergraduate students.

Manuscripts in preparation

Hendriks, R.A., van Blankenstein, F., Ommering, B.W.C., & de Jong, P.G.M. (*In preparation*). On the relation between autonomous motivation to learn and Self-Regulated Learning in secondary and higher education: A scoping review.

Reviewed for

NVMO conference
Medical Education Online
BMJ Open
Advances in Medical Education and Practice
Journal of Workplace Learning

Awarded grants

NRO overzichtsstudie: De eigen wil in zelfstandig leren (2021).

Paper presentations

New opportunities to teach on-campus by using massive open online courses (MOOCs)	de Jong PGM, Hendriks RA, Reinders MEJ	2017	IAMSE
Framework for integrating Massive Open Online Courses into classroom teaching	de Jong PGM, Hendriks RA, Reinders MEJ	2018	APMEC
Enrolment intentions of learners for open online courses in different educational settings	de Jong PGM, Hendriks RA, Reinders MEJ	2018	IAMSE
Integration of a Massive Open Online Course on clinical kidney, pancreas and islet transplantation into a regular medical science curriculum	Reinders MEJ, Hendriks RA, Luk F, de Jong PGM	2018	International Congress of The Transplantation Society
Teaching modes and social-epistemological dimensions in Medical Massive Open Online Courses	de Jong PGM, Hendriks RA, Reinders MEJ	2018	AMEE
Instructional Quality of Medical Massive Open Online Courses	Hendriks RA, de Jong PGM, Reinders MEJ	2018	EARLI SIG 6&7
De kwaliteit van het instructie-ontwerp van medische Massive Open Online Courses	Hendriks RA, de Jong PGM, Reinders MEJ	2018	NVMO
Onderwijsvormen en sociaal-epistemolische dimensies in medische Massive Online Courses	Hendriks RA, de Jong PGM, Reinders MEJ	2018	NVMO
Identifying Instructional Design Principles in MOOCs to Inform Integration	Hendriks RA, de Jong PGM , Admiraal WF, Reinders MEJ	2019	AMEE
Spaced learning in het medisch onderwijs. Een scoping review.	Versteeg M, Hendriks RA, Thomas A, Ommering BWC, Steendijk P	2019	NVMO
Research findings for using medical MOOCs in campus education	de Jong PGM, Hendriks RA	2019	Symposium Best of Both Worlds
Motivation profiles and psychological need satisfaction and frustration in medical MOOC integration designs	Hendriks RA, de Jong PGM , Admiraal WF, Reinders MEJ	2020	EARLI SIG 8
Psychological need satisfaction and frustration of medical students that learn in different MOOC integration settings	Hendriks RA, de Jong PGM , Admiraal WF, Reinders MEJ	2020	AMEE
Vervulling van psychologische behoeften van medische studenten die leren in verschillende MOOC-integratie ontwerpen	Hendriks RA, de Jong PGM , Admiraal WF, Reinders MEJ	2020	NVMO
Inzicht in medisch onderwijskundig onderzoek	Hendriks RA	2021	Invited lecture Honours College Medicine

Poster presentations

Scenario's voor het integreren van een Massive Open Online Course in regulier onderwijs.	de Jong PGM, Hendriks RA, Reinders MEJ	2017	NVMO
Different ways to blend a Massive Open Online Course (MOOC) into medical teaching	de Jong PGM, Hendriks RA, Reinders MEJ	2017	AMEE
Application of an integration framework for using a Massive Open Online Course in undergraduate classroom teaching	de Jong PGM, Hendriks RA, Reinders MEJ	2018	AMEE
Facilitation of Self-Regulated Online Learning: Goal Setting in Medical Massive Open Online Courses	de Jong PGM, Hendriks RA, Reinders MEJ	2018	EARLI SIG 8
Spaced learning in het medisch onderwijs: Is het tijd voor een instructionele revolutie?	Versteeg M, Hendriks RA, Timmer MCJ, Steendijk P	2018	NVMO
Spaced learning in medical education: Is it time for an instructional revolution?	Timmer MCJ, Versteeg M, Hendriks RA, Thomas A, Steendijk P	2019	AMEE
Using a Massive Open Online Course on Clinical Kidney, Pancreas and Islet Transplantation in different settings of transplant education	de Jong PGM, Luk F, Hendriks RA, Reinders MEJ	2019	Bootcongres - Nederlandse Transplantatie Vereniging
Use of a Massive Open Online Course on clinical kidney, pancreas and islet transplantation in campus education and an international course exchange program	Reinders MEJ, Hendriks RA, Luk F, de Jong PGM	2019	Coursera Partners Conference
Using a Massive Open Online Course on Clinical Kidney, Prancreas and Islet Transplantion in Different Settings of Transplant Education	de Jong PGM, Hendriks RA, Luk F, Reinders MEJ	2019	American Transplant Congress (ATC)

Workshops/round tables

Welke obstakels voor engagement ervaren studenten bij het volgen van online leeractiviteiten? (round table)	de Jong PGM, Hendriks RA, Reinders MEJ	2017	NVMO
Using open online course materials to innovate face to face teaching (round table)	de Jong PGM, Hendriks RA, Reinders MEJ	2017	The Generalists in Medical Education
Leren voor de toets? Zo 20ste eeuw! Inzetten op motivatie: hoe we het 'moeten' wat makkelijker kunnen maken (workshop)	Dubois E, Ommering BWC, Hendriks RA, van der Hoeven I, Bosman L	2018	LUMC onderwijs conferentie
Integratie van MOOCs in campusonderwijs (workshop)	Hendriks RA, de Jong PGM, Broersen P	2019	LUMC onderwijs conferentie
12 stappen voor de integratie van MOOCs in campusonderwijs (workshop)	de Jong PGM, Hendriks RA, Broersen PJA, Reinders MEJ	2019	NVMO
Obstakels bij gebruik van online leerdoelen door geneeskunde studenten (workshop)	Hendriks, RA	2019	NVMO promovendidag
Paradigma Workshop promovendi en begeleiders (workshop)	Hendriks RA, den Bakker CR	2020	NVMO promovendi estafette
Welcome to Medical Education (workshop)	Lupascu A, den Bakker CR, Firman D, van Wijk E, Disser J, Hendriks RA	2022	LUMC onderwijs conferentie
Self-regulated learning: van Buzzword naar Begrip (keynote paneldiscussie)	Hendriks RA, Norbart A, Pranger A, Roemer J	2022	LUMC onderwijs conferentie

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CURRICULUM VITAE

Renée Anne Hendriks was born on the 26th of April in 1990 in Amersfoort, the Netherlands. Together with her parents and sister she moved to Deventer, where she completed her secondary education at the Etty Hillesum Lyceum in 2008.

In 2013 she received her bachelor's degree in *Life Sciences and Technology* with a minor in *Psychology* and Major in *Biomedical Sciences* at the University of Groningen. During her years in university she tutored secondary education students in mathematics, chemistry, physics, biology and English, and assisted in teaching Biomedical Research skills to university students. During these teaching and training activities Renée was inspired by what motivates people to persevere and enjoy learning.

As a part of her Master in *Science Education and Communication* she developed a cross-curricular learning application for a local high school. Its goal was to explicitly connect subject content of various disciplines and simultaneously provide students with insight into their learning progress. As her graduation assignment, she designed and piloted an instructional design tool for primary school teachers that supported learning motivation, constructive alignment and use of Open Educational Resources. Renée graduated university in 2016, after which she moved to Leiden to start her PhD research in Technology Enhanced Learning at the Center for Innovation in Medical Education at Leiden University Medical Center. Under supervision of prof.dr. Marlies Reinders, prof.dr. Wilfried Admiraal and dr.ir. Peter de Jong she investigated the added value of integration of medical Massive Open Online Courses into the undergraduate campus curriculum. She presented her research at national and international conferences, and published articles together with fellow PhD students in addition to her own work.

During her time as PhD researcher, Renée joined the half minor Medical Education teaching team. From 2018 on she taught, coordinated and partly redesigned the research module of this course. In addition she wrote a grant proposal for a review study, advised in evaluations of educational innovations in the hospital, and joined in establishing the social activities committee of the Center for Innovation in Medical Education. After finishing her PhD in 2022 Renée continued to work at Leiden University Medical Center as an educational advisor, as well as working on the half minor Medical Education teaching team, the granted review study and new grant proposals.