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Leiden  
The Netherlands

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

Hendriks, R.A.

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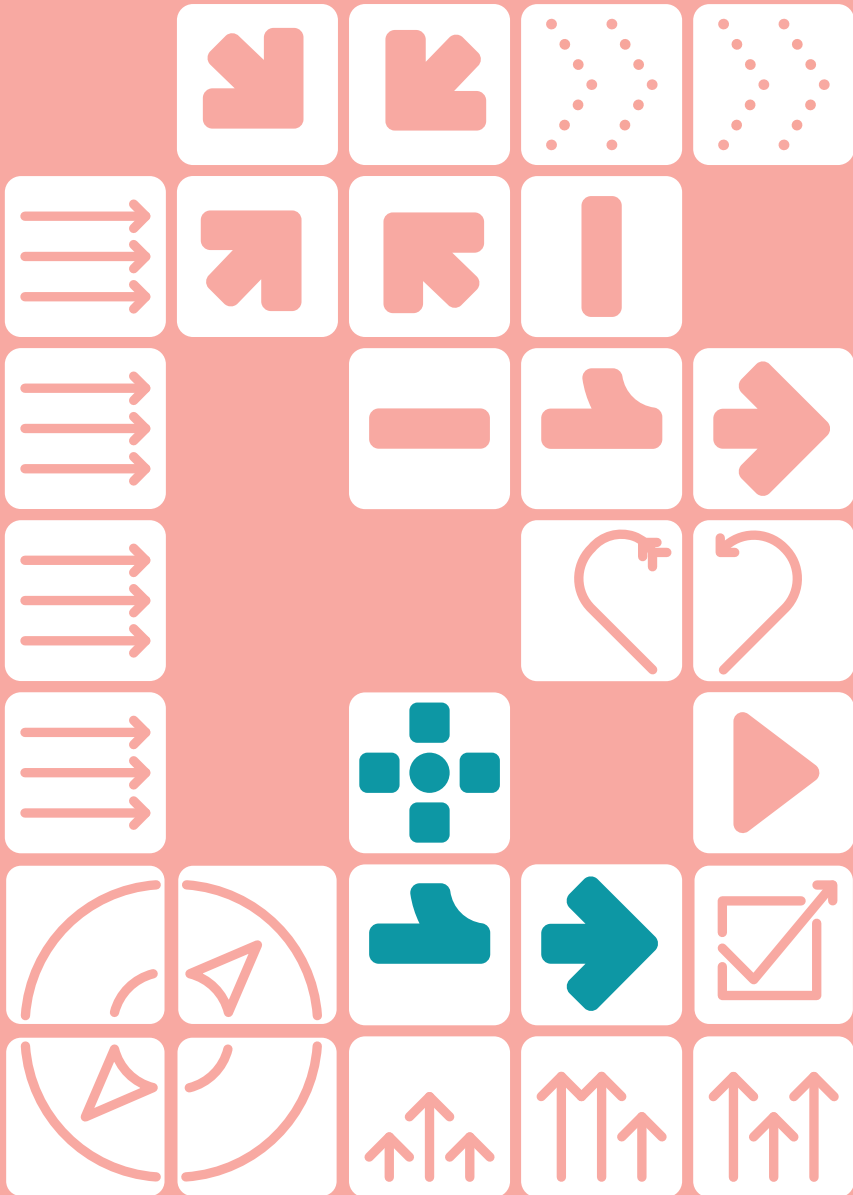
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# CHAPTER 4



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

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Peter G.M. de Jong  
Renée A. Hendriks  
Franka Luk  
Augusto Cesar Soares Dos Santos Jr  
Marlies E.J. Reinders

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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**

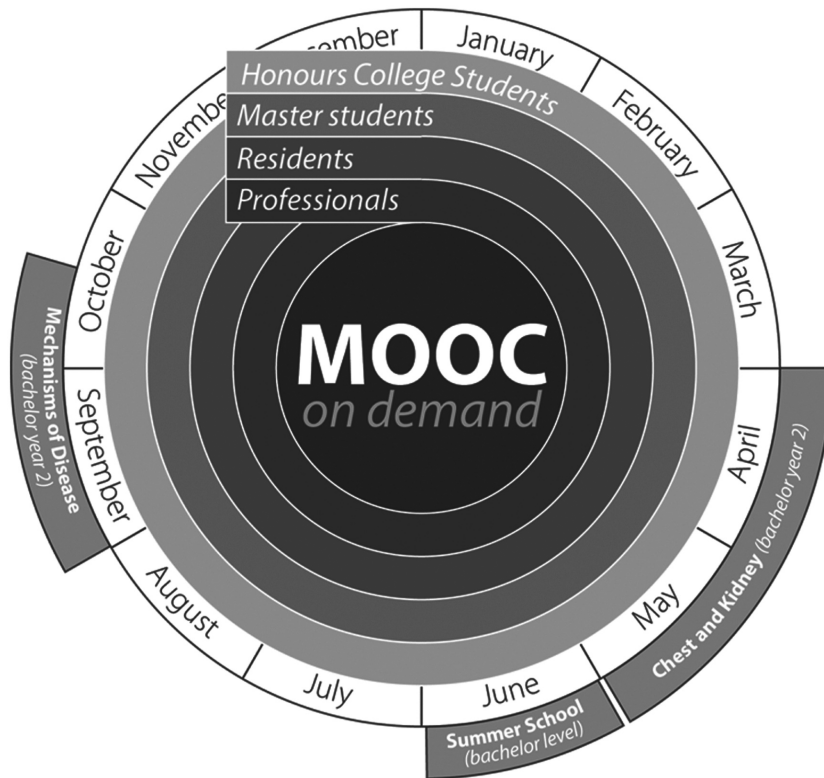
Starting January 2016, the MOOC is being offered to interested learners worldwide free of charge. After completion of the course, learners are invited to share their learner stories online on the MOOC platform, and an optional certificate of completion is available at a modest fee. Data from January 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).

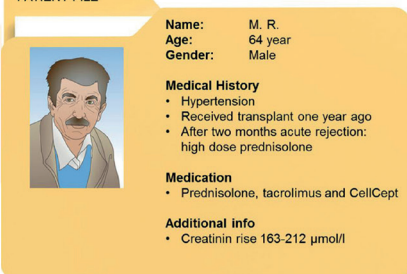
**A**

	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
Teaching mode profile	Amount	Amount HC	Amount	Amount HC	Amount	Amount HC	Amount	Amount HC	Amount
<b>Instruction</b>									
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
<b>Interaction</b>									
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	-	-	-	-	-	-	-	✓
<b>Assessment</b>									
Multiple Choice Questions	13	5	12	5	16	5	47	14	117
Peer reviewed open ended question with long answer	-	1	1	-	1	-	-	-	4
Open ended question with long answer	-	1	3	2	1	2	7	1	17
<b>Multifunctional</b>									
Virtual patient cases	2	1	5	3	4	1	6	1	23
Games	-	-	1	-	1	-	-	-	2

HC = optional Honors Content

**B**

PATIENT FILE



**Name:** M. R.  
**Age:** 64 year  
**Gender:** Male

**Medical History**

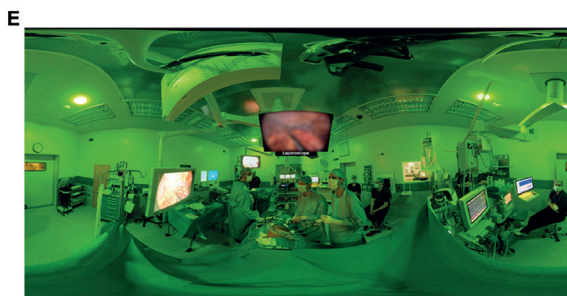
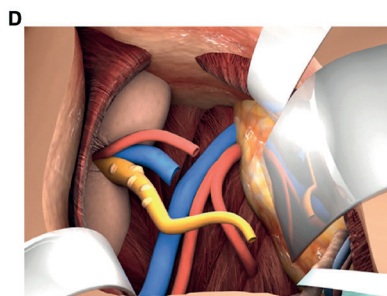
- Hypertension
- Received transplant one year ago
- After two months acute rejection: high dose prednisolone

**Medication**

- Prednisolone, tacrolimus and CellCept

**Additional info**

- Creatinin rise 163-212 µmol/l

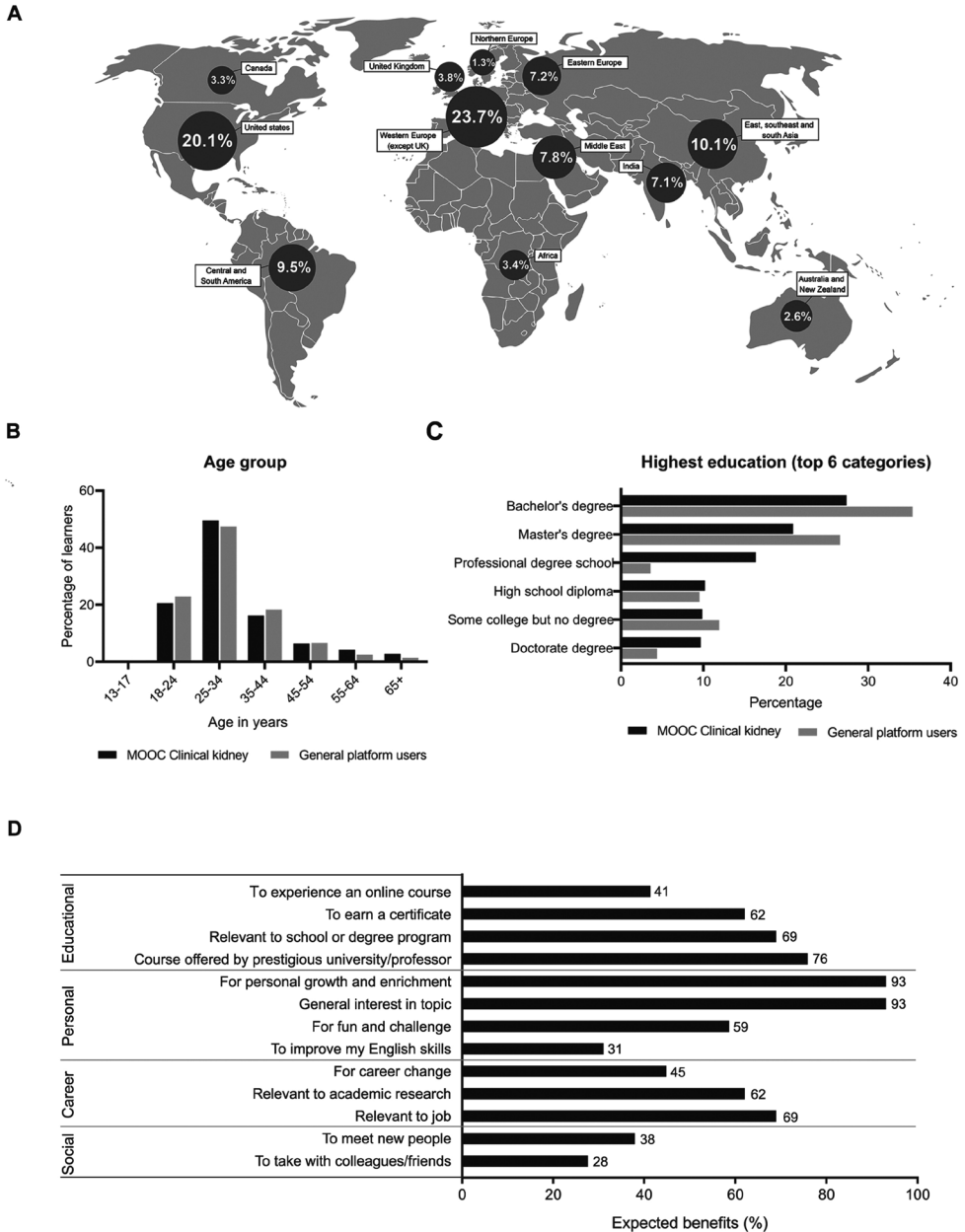


**Figure 2.** Different teaching modes in the MOOC on “Clinical Kidney, Pancreas and Islet Transplantation”. Different teaching modes in the MOOC are listed per module (A). For every module, the teaching modes are divided into the standard module and the optional Honours track. Examples of teaching modes 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.

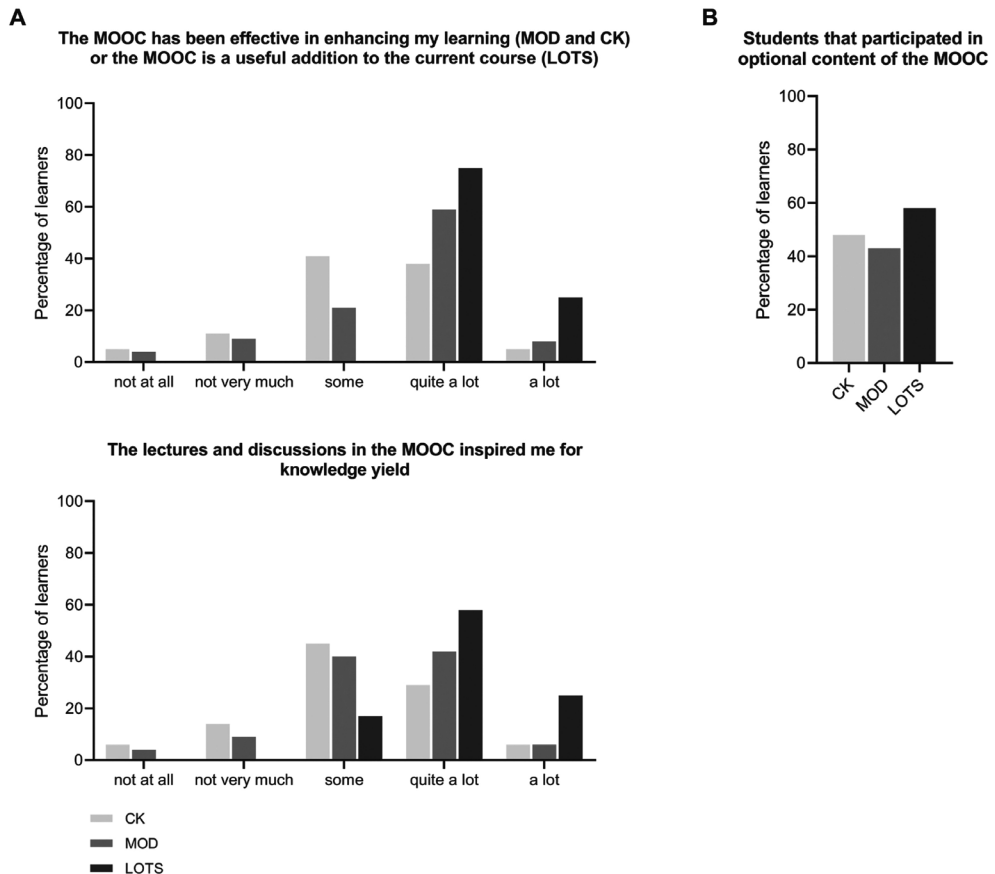
**Usage in the worldwide track**

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).

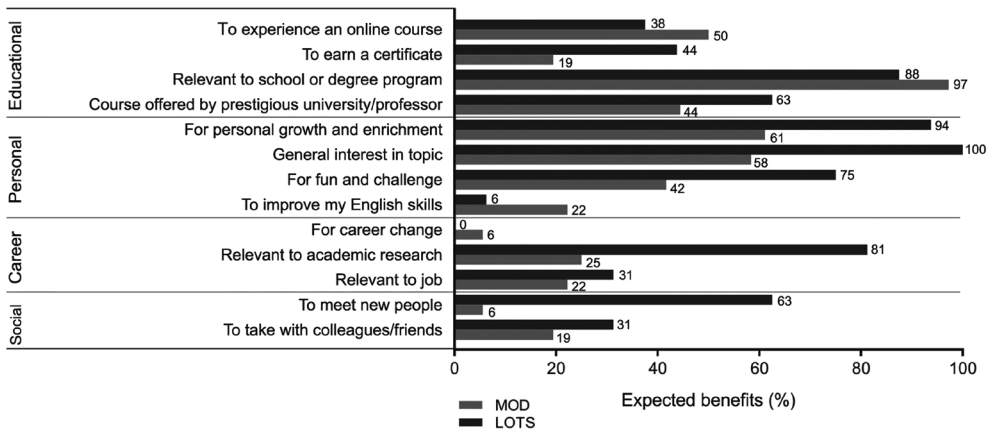


**Figure 4.** Student engagement of local curriculum students within the MOOC. Student engagement within the MOOC was assessed using an online questionnaire. (A) shows student responses to the question if the MOOC was effective in enhancing their learning (MOD and CK students) or if the MOOC was a useful 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).