Over the fence: Media-supported collaborative teaching and learning exemplified by diabetes prevention in an occupational setting

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Abstract

The rapid pace of digital transformation worldwide is also changing the education and science sectors. The Hamburg Open Online University (HOOU) is a multi-university development and innovation project, its comprehensive approach towards digital technologies is unique to date. The HOOU launched with a ‘lean’ infrastructure and early bird projects from the participating universities. Such an early bird project ‘Detection and prevention of prediabetes’ with the development of an online tool (app) to self-assess one’s own risk of developing type 2 diabetes, including individual recommendations on risk reduction is presented here. In contrast to the usual format of simply reiterating knowledge of studied topics on written exams, this project was a very motivating experience: The students were required to train self-organisation and teamwork, and to show presentation skills in a real company, while the teachers had to guide a very heterogeneous group to success for a period of over one year. The critical assessment of scientific literature and teamwork presented an unexpectedly great challenge to the students and should better and earlier be included in the curriculum. The lecturers not only have to develop and implement an appropriate didactic concept, but also require qualification in project management and leadership.

Keywords: student teamwork; digital challenge; Open Educational Resources (OER); Hamburg Open Online University (HOOU); diabetes; prevention; online app
Introduction

The rapid pace of digital transformation worldwide is also changing the education and science sectors. It is time to tap into the available digital media resources and their diverse potential for enhanced teaching and learning, and thus to overcome social educational barriers. To this end, the Hamburg Open Online University was founded in 2014 as a multi-university development and innovation project, involving all six state universities in Hamburg (Germany) including the University Medical Center Hamburg-Eppendorf, the Department of Science and Research, representatives of the Hamburg government, and the jointly founded company Multimedia Kontor Hamburg (MMKH). The HOOU itself is part of a big endeavour of the Senate of Hamburg to exploit technical innovations to advance the development of a ‘Digital City’ (Senatskanzlei Hamburg, 2015). The metropolitan region has a population of 5.3 million. The basic idea of this comprehensive endeavour is to incorporate the use of digital technologies into the universities’ teaching and learning strategies in a structured and sustainable manner. This will allow for a broad new development or adaptation of existing materials and concepts, and will encourage their use by the general public.

The concept of the HOOU is based on four principles: (1) Learner-orientation and collaboration: the learning scenarios are designed by the participating teachers from the perspective of the learners, i.e., the students’ goals, their information and communication behaviour, their individual competencies, and their learning strategies are the basis for collaborative learning groups from as diverse as possible HOOU-institutions and/or represented disciplines, or from the interested public. The primary aim of collaboration is to encourage a common learning and working process among the students and study teams to research and pursue new solutions and strategies (‘doing something together that is not achievable on one’s own’). Topics of interest and problems can also be suggested by students or interested citizens. (2) Scientific nature: teaching and learning are guided by the maxims of academic thought and careful scientific work. (3) An opening to new target groups and relevance to civil society: the HOOU project also strives to encourage new target groups beyond the participating universities to concern themselves with academic content. This broadening of perspectives and horizons is of particular interest when dealing with and finding solutions to issues relevant to civil society. (4) Openness: Open Education aims to make all learning materials available as Open Educational Resources (OER) through a common internet-based repository so that they can be discussed and further developed, or applied to other projects. This explicitly refers to both technological openness, through the use of open source software, and legal openness, through the use of open licenses (creative commons).

The HOOU project did not start as a fully-functioning program, but rather as a Minimum Viable Solution [see Glossary] (Patton, 2014) with pilot projects (Early Bird). The resulting organizational, conceptual, and technical knowledge gained will be processed and implemented according to the principles of ‘agile development’ [see Glossary] (Patton, 2014) for the main phase. The HOOU is organized to be lean [see Glossary], with a steering group of the represented institutions and three initial topic-based expert groups: (1) The Open Educational Resources group (OER) deals with the culture of sharing, with free licenses, open learning scenarios and the quality and strategy of openly accessible digital educational materials. (2) The Digital Qualification group wants to establish and certify sustainable media didactic competencies through workshops, FAQs and guides, and so-called communities of practice. (3) The aim of the Concept and Platform expert group is to condense the experience gained from the various projects into requirements for learning arrangements, to visualise them and to map them in an open architecture. There is an operative coordination and the heads of the three groups are members of the steering group and work together with the advisory board (HOOU, n.d.).

Lecturers from all participating institutions were invited to apply for early bird projects. Cooperation between universities and/or departments was expressly desired. The selected 60 projects, each received a budget. (Five of these also had a health care background.) In addition, the HOOU team was available to provide advice and technical
support. The project materials and results will be made publicly available on the platform in an OER repository. The central prerequisite is also the readiness of all participants to use, further develop, and provide solutions and tools as open source materials. The same applies to all content published under creative commons copyright licenses (CC, n.d.) in the repository (Mayrberger, 2017). Medical content comes under ‘CC BY NC ND’ which allows sharing but no modification to avoid medical advice not approved by the medical author (CC, n.d.).

The HOOU offer includes a platform for learning and trying out the programming language C, developed and maintained by three universities and open to all interested persons. It is not expected that all HOOU participants (and the students) will acquire programming knowledge, but all should use the expertise of HOOU members and sources for their projects if possible.

In this paper, we present our experiences with the Early Bird 'e-project: Diabetes Prevention' which was performed in an occupational context and reflect on the resulting challenges for both teachers and students.

Glossary

| Open Educational Resources (OER) |
|----------------------------------|
| "… are teaching, learning and research materials in any medium - digital or otherwise - that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions" (UNESCO, n.d.). |

| Agile project management (APM) |
|-------------------------------|
| … is an iterative development methodology that values human communication and feedback, adapting to changes, and producing working results. The method was originally developed for software development projects as a counter to the waterfall methodology (Beck et al., 2001a; Conrad, 2018). (The waterfall methodology features a sequential approach to projects, gathering all requirements before the work begins, scoping out the resources needed, establishing budgets and timelines, performing the actual work, testing and then delivering the project as a whole when all the work is completed.) Agile is iterative, meaning that it is done in pieces (iterations/ small sections/ ‘sprints’), with each sprint building and improving off the lessons learned from the previous sprint. Agile is an approach and a mind-set. It's not a textbook, or a list of instructions, or a certification. … The main benefit of Agile Project Management is its ability to respond to issues as they arise throughout the course of the project. Making a necessary change to a project at the right time can save resources and, ultimately, help deliver a successful project on time and within budget (Conrad, 2018; Beck et al., 2001b). Agile is an umbrella of values and principles for Scrum, Kanban, Lean etc. |

| Minimum viable product (MVP) or solution (MVS) |
|-----------------------------------------------|
| … is an iterative process based on continuous feedback obtained from the early adopters. It is a fundamental concept of the Lean Startup methodology. An MVP has three key characteristics: |
| • It has enough value/ just enough features that people are willing to use it or buy it or step in initially. |
| • It shows enough future benefits to interest early adopters. |
| • It has a feedback loop to guide the future development. A decisive element of this development technique is that it assumes that early adopters can see the vision or promise of the final product/ endeavor and that they are willing to provide the valuable feedback needed to guide developers forward (Lenarduzzi and Taibi, 2016; Ries, 2011). |

| Lean-start-up methodology |
|---------------------------|
| … seeks to eliminate wasteful practices so that start-ups can have a better chance of success without requiring large amounts of outside funding, elaborate business/project plans, or the perfect product. Customer feedback during product/project development is integral to the lean start-up process. Lean means meeting the demands using the least amount of resources possible (Ries, 2011). |
Objectives

**e-Project: Diabetes Prevention**

**The idea**

In Germany, approximately 5.8 million people are currently suffering from type 2 diabetes mellitus (Tamayo *et al.*, 2016) and the prevalence is increasing worldwide (WHO, 2016). Many of those affected are unaware of their condition. Diabetes as a single illness incurs some of the highest costs for the healthcare system and is not only associated with decreased performance and quality of life, but also with a significant increase in the risk for cardiovascular and cancer diseases. Although the manifestation of diabetes has been scientifically shown to be preventable through lifestyle changes, there is currently no comprehensive screening tool available for the early identification of those who may be affected, or for the communication of successful behavioural strategies applied to patients with existing insulin resistance. Already the status ‘prediabetes’ increases the risk for many chronic diseases and cancer. With regard to the prevention of chronic diseases, the physician has a pilot function, which can be particularly applied in a company setting.

Eighth-semester medical students taking an elective in ‘Preventive Medicine’ were invited to participate in a diabetes prevention project. They were expected to apply their previously gained knowledge of epidemiology, evidence-based adult check-up programs, workplace health promotion, and the importance of lifestyle for the prevention of chronic illness, as well as methodological skills in the use of scientific literature and office-based software, to a comprehensive e-project. They were assisted by two lecturers who had also applied to the HOOU with this project.

**Application for an early bird project**

The HOOU had defined requirements for a project application. In addition to the content-related goals, the educational objectives of student-centred teaching and possible networking were to be demonstrated. The type of (OER-compatible) content to be provided to the selected target groups was to be outlined, as well as whether the organizing teachers were either already sufficiently educated in media literacy or if they desired to take part in relevant training courses. The applicants for the project presented in this paper have backgrounds in the fields of occupational (physician) and preventive (nutritionist) medicine. At this stage of the process, students were not yet involved.

**Requirements for the students**

In the initial phase, the current, evidence-based literature on the topic was to be scanned and interpreted for the development of a tool with which employees within an occupational setting (and eventually also anyone interested) could determine their individual diabetes risk online (by computer and/or mobile device). The questions regarding body weight, diet, etc., were to be supplemented with explanatory illustrations, e.g., how to correctly measure the waist circumference with and without a tape measure. From the information provided by the user, the tool generates a risk score for the development of type 2 diabetes. Dependent upon this test result, individualized dietary and exercise recommendations are offered for the user to read and/or print. Furthermore, in addition to individual online use, the tool should be usable in primary care patient consultation. Following successful evaluation, the material/the application is to be made available to all health care professionals and the general public. Individual steps of content-related implementation were to be worked on and developed by the students within small teams. The result was to be evaluated as a learning achievement in the compulsory optional subject.
Results

The implementation

The participating twenty students worked in small self-selected and self-organized teams over the course of two semesters. First, they developed content modules concerning the key risk factors for diabetes development, as well as measures for diabetes prevention. Lecturers of internal, occupational and sports medicine, nutrition, and computational neuroscience were available for queries and support. In addition to research that was to be performed during the regular curriculum, extra project days were planned for and provided to the students.

In the following semester, they presented the results of their teamwork to a company (Hamburg City Cleaning, public agency, 2,700 employees) in form of a PowerPoint presentation. This also served as their exam for the elective subject. Tasks that went beyond the scope of the compulsory optional subject were given to student assistants (e.g., the technical merger of all presentations into one slideshow).

Milestones

- April 2016: creation of the list of topics for the student teams (lecturers).
- May 2016: formation of teams, assignment of topics, and project day.
- June - Nov. 2016: group work, parallel to regular course of studies (lecturers).
- Dec. 2016: project day, presentation of the results before decision-makers from the company (for formal grading).
- Dec. 2016 - March 2017: transformation of the idea into a sequence of explanations and questions for the online tool. Development of a rating score and formulation of individual user recommendations based on identified risk factors.
- March 2017: technical transformation into an online tool (by a computer scientist).
- July 2017: testing and evaluation of the pilot version regarding comprehensibility, time required to complete, etc.
- August-September 2017: revision according to evaluation results and implementation of the online version on the HOOU platform: http://elearning.uke.uni-hamburg.de/HOOU/IhrGesundheitscheck/story_html5.html
- September 2017: press conference - presentation of the diabetes tool to the public together with the online launch of several other HOOU projects.
- April 2019: Translation and graphic design of the tool into English and programming of a smartphone capable app (by a computer scientist).

Structure of the web application

An important goal of all HOOU activities is to bridge gaps between academic knowledge and the everyday needs of citizens with the help of digital technologies. Any app that is developed must therefore be linguistically and formally accessible/ understandable, informative, functional, and adequately attractive in function and appearance. Another group of students in an the elective course 'Medical Computer Science' at the University Hospital Hamburg-Eppendorf tried to implement a prototype of the tool with the well-established 'CASUS tool' and 'Articulate Storyline-2'. The outcome was that Storyline-2 could be adapted better than CASUS, which assumes the medical expert/user 'sits' in front of the tool and the (virtual) patient inside, while the need for this project is inverted: the (virtual) medical expert is inside the tool and the patient/user 'sits' in front of it. So the online tool was programmed
using the commercial ‘Articulate Storyline-2’ software (an earlier version of the current ‘Articulate 360’).

In the example described here, this goal was implemented to create a diabetes tool with introductory texts on the epidemiology of prediabetes (prevalence, number of unreported cases), the boundary between prediabetes and clinically manifest diabetes, as well as information on prediabetes and its sequelae. In addition, short explanatory texts for each question can be displayed via info buttons (see Figure 1). With the aid of a sliding ruler to be moved with the computer mouse, the user's values (e.g. number of days per week, consuming meat products) can be entered. For a few of the questions, (royalty-free) images were selected or photographed. The programming of the web application was done by computer scientist (Medical Computer Science group at the Institute of Computational Neuroscience) from the participating university hospital.

Figure 1. Example 'meat consumption' from the diabetes tool (translated).

The diabetes app encompasses the following screening parameters: age, gender (women are also asked regarding current or previous pregnancy: if currently pregnant, the test cannot be performed because of the high impact of waist circumference on the test result; a previous gestational diabetes is predictive), family history of diabetes, height/waistline (with measurement instructions)/ calculation of the ratio of the two parameters (BMI). Nutritional habits are assessed (How often do you eat vegetables, fruits, whole-grain bread per day? How often do you eat meat, sausage, milk, cheese? How often do you consume foods high in sugar?) as well, as the extent of regular exercise in everyday life, at home or at the workplace. From the individual answers, points and weights are assigned in the background of the app and merged in a score. The resulting current level of risk is displayed on a coloured scale in the form of a traffic light (e.g., Figure 2).

Figure 2. Example ‘Prevention recommendations for everyday activities’ (translated).
Based on the results of their answers, the users receive personalized advice regarding their risk, taken from recommendations of the various nutritional societies of Austria, Germany, and Switzerland (DGE, 2011; DGE, 2015a; DGE, 2015b; Hauner et al., 2018; Landgraf et al., 2018) The information is supplemented by a detailed bibliography including national and international references.

**Evaluation of the test version**

To this end, the two lecturers in charge developed a short questionnaire on comprehensibility and visual appearance. As part of a company health day, several occupational physicians and a medical-technical assistant evaluated the application experience with voluntary testers (52 employees from waste management) by interviewing them immediately after using the app. In addition, the handling of the app was observed/ noted and the time required to complete was recorded. The lecturers also recruited 73 medical students to test the application, however, in this case, the students were asked to fill out the evaluation questionnaire by themselves. All feedback was collected, discussed within the group, and considered in the preparation of the templates for the programming of the web application. The entire content of the tool has been revised several times by the developers to ensure for factual correctness and linguistic clarity. The goal was to keep the text brief yet informative.

**Students' experiences**

The ‘normal’ learning experience in medical studies usually includes timely performance assessments, generally in the form of multiple choice testing. Preparation for such examinations can be either done individually or in study groups. However, the performance is ultimately always that of the individual. The project described here required the students to develop and/or exercise other important qualities. The students were autonomous in their time management, only milestones were specified (e.g., the literature had to have been assessed by six months and the set
date of the presentation within the company). Because each team worked on different subtopics, they ultimately had to coordinate and merge the developed content into one presentation. Most of the teams worked well together and also had fun realizing the task with their own creative ideas. But some teams only functioned because of individual members who felt a high degree of responsibility for the group and for the task. These individuals motivated their team members to do their part in successfully completing the project.

Methods of scientific work were already taught during the early semesters of medical school. This knowledge and these skills now had to be applied. The students had to independently develop the scientific basis for their topic from the literature and critically evaluate and formulate the results for use in the project. Central references/sources were provided by the lecturers. It became apparent that the majority of students were inexperienced in the practical preparation of a presentation (for which they had been provided with a master slide). Furthermore, not all participants were satisfied with the given topic of ‘detection and prevention of prediabetes’.

However, those who welcomed these challenges felt greatly enriched by the experience: (1) they concisely formulated a very relevant and complex everyday medical topic for laypersons, made it comprehensible and visually appealing, and (2) they presented this to a target group (employees of a waste management facility), for which they (3) received positive feedback. At the same time, (4) the project gave the students a systemic insight into work-related health care and the complex interaction of eating and physical activity and health resp. illness. They therefore not only learned and reproduced what they had learned, but they (5) also contributed scientific content to the development of an online tool that can actually be implemented in everyday life, and will continue to be used in the future. Everyone was proud of that, particularly those who voluntarily participated in the final transformation of the concept to a functioning online tool. (The practical realization and integration was ultimately done by a computer scientist.)

Lecturers’ experiences

The motivation and commitment of the students varied greatly. The partially limited knowledge of scientific methods and skills was not anticipated by the lecturers and required a high degree of commitment and practical support. Not all students were able to research, critically review, summarize, and draw conclusions from medical literature. The majority were also unable/too inexperienced to conceptualize and design appropriate presentation slides. The work of two student assistants, who oversaw the summary and integration of the slides into a cohesive project and coached the five presenting students for a smooth presentation in the company, was very helpful to counteract these issues. This final presentation was evaluated as a form of exam, which put pressure on the teams to deliver a good result. Furthermore, the fact that the presentation took place in a ‘real-life’ setting off campus (i.e., within a company) was very motivating for some students.

Although it is an educational goal for physicians (NKLM, 2015), working in a group and as part of a team had been neither practiced nor required in medical school until then. As a result, there were some deficits in these skills that required intervention and guidance by the lecturers.

This kind of teaching required not only the usual impart of medical knowledge, but also project management of a group of people who were heterogeneous with regard to their previous experience and background knowledge (students, student assistants, residents, experienced physicians from varying backgrounds - occupational medicine, diabetology, nutrition -, and a computer scientist). It was therefore important to deploy the 23 project participants according to their individual skills, training, and motivation, keeping an eye on the schedule and financial resources. The two lead lecturers also came from different departments; they had to coordinate themselves and show leadership qualities. This resulted in a greater time and activity commitment than seen in other teaching units. Furthermore, the cooperation of a computer scientist as e-support proved vital to the final completion of the project (programming of the tool and making it available online).
Conclusions

The Hamburg Open Online University (HOOU, established 2014) is a joint project of all Hamburg universities to introduce teachers and students to the challenges of the digital era, to purposefully use digital technologies, and to become more accessible to the general public through these media. A special feature is that the HOOU itself also works with a management system that was adopted from IT project development (agile project management). The early-bird-project on ‘diabetes prevention’ presented here enabled a special involvement of the students. They had to work with scientific literature, which was particularly difficult for some. The theoretical knowledge had been offered and studied during the first semesters, however the introduction to the practical use of these core competencies came, as part of this project, relatively late in the curriculum. Furthermore, the students had to work together as a team, with some being more skilled in this aspect than others. The required presentation of the project results to a lay audience outside of the university turned out to be surprisingly motivating. This promotes growing into the future professional field, an essential goal in medical teaching (Taylor and Hamdy, 2013). In the further development of the HOOU it is intended that not an IT specialist, but students from other departments, for example, will develop and execute the programming of such an application.

Both the critical assessment of scientific literature and teamwork should be practiced earlier and more frequently over the course of medical school. Answering questions and explaining facts strengthens the knowledge acquisition and supports problem-solving competence (Quirk and Chumley, 2018). The lecturers not only have to develop and implement an appropriate didactic concept, but also require qualification in project management and leadership. A particular challenge in this regard is the heterogeneity of the groups (field of study, level of qualification, age, etc.). In addition, special skills are required for e-support, at least in the case of the development of an online tool. In our case, these skills were provided by an IT-specialist. The project presented here was relatively small but the benefit for all participants was great because it also made it possible to practice some foundational competencies for health professionals: Teaming, leadership, and systems thinking (Skochelak et al., 2016).

Take Home Messages

- Both the critical assessment of scientific literature and the teamwork presented an unexpectedly great challenge to the students and should better and earlier included in the curriculum.
- The lecturers not only have to develop and implement an appropriate didactic concept, but also require qualification in project management and leadership.
- A particular challenge in this regard is the heterogeneity of the groups (field of study, level of qualification, age, etc.).
- In addition, special skills are required for e-support, at least in the case of the development of an online tool.

Notes On Contributors

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Martin Riemer has been involved in introducing 3D virtual body models, made from tomographic data, to medical teaching, which subsequently got published as the VOXEL-MAN 3D-Navigator. He is currently involved in teaching medical students in both real and virtual environments and software engineering. Therefore he is familiar with pedagogical as well as technical aspects of eLearning.

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Appendices

None.

Declarations

*The author has declared that there are no conflicts of interest.*

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Ethics Statement

Not applicable. No personal data were collected. The described project was part of the regular teaching for the students.

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