Digital transformation of medicine – experiences with a course to prepare students to seize opportunities and minimize risks

Digitale Transformation der Medizin – Erfahrungen mit einem Kurs, um die Handlungsfähigkeit Studierender in der digitalen Welt zu fördern

Abstract

Digital transformation has a major impact on the healthcare system and sometimes leads to disruption. Therefore, the medical environment we see today may be very different from what we see in the future. The aim of the present study was to investigate how medical students can be prepared for a medical environment that is currently not fully predictable. For this purpose, a course has been created at Witten/Herdecke University in the fundamental studies, which deals with the digital transformation of the healthcare system. Students can take part both in presence and synchronously online. Over the past five semesters of the event, there has been massive demand (up to 365 course assignments), an interactive discussion with internal and external experts, and a very high acceptance of the topic and methodology. The digital transformation of the health system will be a major focus of the new model curriculum at Witten/Herdecke University, whereby the synergies with the courses of the other faculties should always be used to train multiprofessional interface competences.

Zusammenfassung

Die digitale Transformation hat erhebliche Auswirkungen auf das Gesundheitssystem und kann sogar zu disruptiven Prozessen führen. Daher unterscheidet sich das heutige medizinische Umfeld voraussichtlich stark von den zukünftigen Bedingungen im Gesundheitswesen. Ziel der vorliegenden Studie war es, zu untersuchen, wie Medizinstudierende auf Umstände im Gesundheitssystem vorbereitet werden können, die derzeit nicht vollständig vorhersehbar sind. Zu diesem Zweck wurde an der Universität Witten/Herdecke im Studium fundamentale ein Seminar implementiert, das sich mit der digitalen Transformation des Gesundheitswesens beschäftigt. Die Studierenden können sowohl in Präsenz als auch online synchron teilnehmen. In den letzten fünf Semestern der Veranstaltung gab es eine große Nachfrage (bis zu 365 Anmeldungen), eine interaktive Diskussion mit internen und externen Experten und eine sehr hohe Akzeptanz des Themas und der Methodik. Die digitale Transformation des Gesundheitssystems wird ein Schwerpunkt des neuen Modellstudiengangs der Universität Witten/Herdecke sein, wobei die Synergien mit den Lehrveranstaltungen der anderen Fakultäten immer zur Ausbildung multiprofessioneller Schnittstellenkompetenzen genutzt werden sollen.

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Introduction

The digital transformation of medicine as a supporting measure began in the 1980s with the first electronic documentation systems and digital imaging [22], [31]. The DaVinci robot has also been used in operations for more than 20 years [20]. Yet we have been reading, hearing, and seeing recently in various media that this digital transformation of the healthcare sector is increasingly gaining momentum and revealing its disruptive character [28], [1]. Hermann et al. [13] compared healthcare providers and their business models, and found a disruptive process in a way that more and more new e.g. technological companies were becoming important in the field of medicine or the medical industry. For instance, the three big technology giants Apple, Amazon and Google have already put themselves at place with major investments and are willing to reshape the medical market [24].

Although the progress made so far with the development of artificial intelligence [16] has not yet reached the levels of a superintelligence [7] that will develop any further invention for humanity, we can see a significant increase in technological and digital development in recent years challenging existing medical knowledge.

Telemedicine is already part of everyday life in Australia [26] and is now increasingly being introduced in Germany [12]. Apps support many patients in the management of their illnesses and the associated therapies [3] via smartphone or help directly to stay healthy. With Verb Surgical, a joint project between Google and Johnson & Johnson, a completely new robot-assisted surgery is being prepared, which provides advice to the physician during the surgery [23]. In addition, patients organize and inform themselves in social media [5]. In the pharmaceutical industry research is currently performed on the use of digital endpoints [6], and software is able to make diagnoses based on images and text to provide decision support to the physician about therapies [19]. Simplified gene sequencing and the use of big data as well as "machine learning" allow for an individualized "precision medicine" [9].

Medicine and the entire healthcare sector are subject to rapid change and an immensely fast evolution. A fear that machines and software might replace doctors is not completely unfounded: radiology predictions [10] clearly show that the medical community is not sufficiently prepared for this development. The corresponding skills need to be taught in education and continuing training in order to be able to act responsibly in the digital transformation of the health system [25].

For our educational research group at Witten/Herdecke University, the following research questions arose:

- Is it possible to create a transdisciplinary course in the fundamental studies to prepare students for the digital transformation in the field of health?
- Is it possible to use the "webinar" format at a model-university with problem-based learning and small-group culture? How will this course concept be accepted by the students?

Methods

To answer this question, in the winter term 2016/17 we initially offered the course "Digital Medicine – how to change the way we treat" in the fundamental studies (Studium fundamentale) of Witten/Herdecke University for the first time (1 ECTS, blocked, every two weeks, 6–8 pm). Afterwards this course was offered each term. From the winter term 2018/19, the scope was increased to 2 ECTS (weekly, 6–8 pm). In fundamental studies, students of all three faculties (1. Health with the Departments of Human Medicine, Nursing, Dentistry and Psychology, 2. Economics and 3. Cultural Reflection) choose courses in the areas of reflection, communication, and culture for 10% of their study achievement apart from their actual studies to work interdisciplinarily on their personality development [30]. The medical digitization course should not only allow discussions from a medical perspective, but also consider economic or ethical issues. The interdisciplinarity of the participants of this course should promote the interface competences required in a digitized world [2]. It also seemed necessary not only to understand digitization as a content of the course, but also to use it methodically. For this purpose, the course was carried out both at the university as a face-to-face lecture as well as via live stream into a virtual classroom, using Adobe Connect [17]. In the live stream, students outside the W/HU were able to hear and see what was happening in the seminar room, following the presentation and actively participate in the discussions via text or audio chat. By a name registration in the virtual classroom, the presence was documented. In addition, individual events were recorded and the videos afterwards made available to the students (see Figure 1).

Initially designed as a journal club, the participants should engage in discussions through previously sent publications and impulse lectures at the beginning of the event given by internal and external experts about topics regarding digital transformation of the healthcare system like fostering adherence by apps and wearables or professional behavior in social networks.

In addition, at least one field visit to an actor in the digital transformation of health care was carried out each semester (Figure 2).

From semester to semester, more external experts were recruited, who reported on their work on digital transformation in the healthcare sector and discussed it with the students (e.g. clinic, practice, research). Students have also given impulse talks on their own experiences (such as programming and marketing an own health app, nursing robots or a digital patient curve) or topics related to their bachelor/master theses (e.g. online psychotherapy or ethical effects of digitization). In summer 18 and

Figure 1: Example of a virtual classroom based on a recording (Source: https://www.youtube.com/watch?v=KWoLgmi9-cM)

"Digital Medicine – How will data change the way we treat"
Summer 2019

11.04.2019	Welcome and Formalities (Jan Ehlers, UW/H)
	Influencers in Fitness Social Media (Katharina Pilgrim, UW/H)
18.04.2019	Digital Medicine (Philip Böhme, UW/H)
25.04.2019	Who makes opinions? (Kristine Schmidt, RTL)
02.05.2019	Health Apps & Young Talents (Julia Zink, SBKK)
09.05.2019	Serious Health Games (Markus Gennat, Uni Münster)
	Robots in Elderly Care (Sven Kernebeck, UW/H)
16.05.2019	Tele Emergency Doctors (J. Sattelberger, GKH)
	7Mind (M. Ronnefeldt, UWH)
	Robotic Surgery (U. Bork, Dresden)
23.05.2019	Online Psychotherapy (P. Doose, UWH)
	Cyber Mental Health (M. Schnürer, BWI)
06.06.2019	Site visit Cardio-Vasculary Research Labs (Bayer, Wuppertal)
13.06.2019	Sex with Robots– Ethics & Law (Iris Phan, Hannover)
27.06.2019	Digitalen Start-ups in Healthcare (M. Herrmann, UW/H)
11.07.2019	FutureMedTalk (T. Thranbehrend, BertelsmannStiftung)

Figure 2: Schedule of the course in summer 2019 with online sessions and site visit

winter 18/19 there was an appointment for the project "The Digital Patient" [27] of the Bertelsmann Foundation with well-known experts on the topics "HealthApps – The Pill of the Future?" and "How much doctor do we need?". These events were open to all interested parties, including outside the university.

To answer the research question, the number of participants at the on-site and online events was documented and a feedback interview was held at the end of the course and an online questionnaire was activated. In addition to a few socio-demographic questions, the survey included the following statements to rate with Likert scales (1=poor – 5=very good):

- The format of the course (journal club with impulse and discussion) seems to me very appropriate.
- The technique of the course (presence + online) is very good.
- The contents of the course were well coordinated.
- The quality of the mailings (article, paper) was very appropriate.
- The organization of the course was very good.
- I would like to have a recording (video clip) of the events.
- I will recommend the course.

In addition, it was possible to write down free text: what was felt to be particularly good, what could be improved and other comments. The quantitative part of the questionnaire was statistically evaluated with SPSS, the qualitative part categorized by content analysis with MAXQDA® 13.

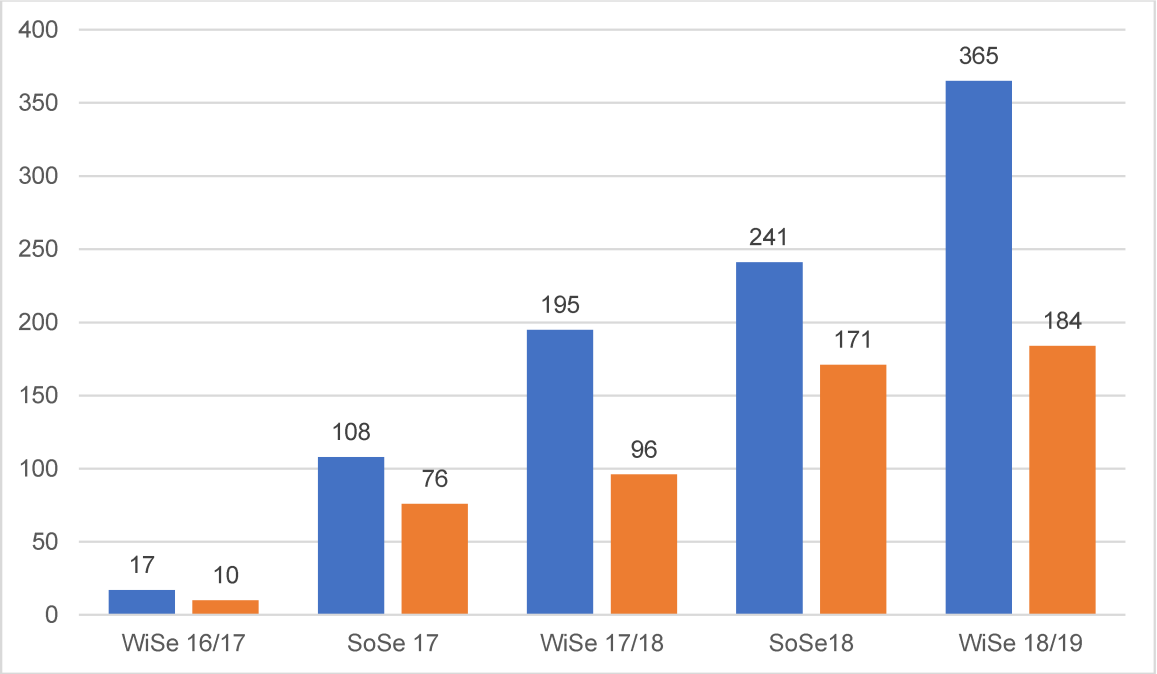

Figure 3: Registrations (blue|left) and completed courses with attained certificate (orange|right) for the course in the last five semesters

Results

The course "Digital Medicine – How to change the way we treat" was well received from the beginning and students from all faculties and departments took part in the course. In the first semester (winter 16/17) it was chosen by 17 students, in the winter semester 18/19 already by 365 students (Figure 3). About 50–70% of the students who chose the course were able to complete the course and obtain a certificate. Partly there was no chance to register all enrolled students for the course due to late registration or other offers in time competition, so that not enough course participation could be realized for the certification of individual participants.

While the ratio of presence to online participation in the first course was still about 50 to 50, it developed over the time that online participation became the preferred form with well over 90%.

The "site visits" were held each semester at Bayer AG in Wuppertal to experience the use of digital technologies along the pharmaceutical value chain. In addition to the identification of new lead structures in the HTS procedure, the use of portable and implantable biosensors [21] and the handling of big data in cardiology research were demonstrated. In addition, in winter 17/18 an excursion to Hamburg to Johnson & Johnson Medical GmbH and Google could be realized. These "site visits" were one of the highlights of each semester for the students (Table 1). Up to 400 people took part in the public online events with "The Digital Patient".

Of the 537 students who successfully completed the course, 183 (34.1%, 144 complete sheets=26.8%) answered the online questionnaire. The socio-demographic data showed that students from all faculties and departments participated in the evaluation as well as in the course itself (see Figure 4).

The descriptive analysis of the evaluation questions showed that the students were very satisfied with the course format (4.5, SD 0.6, Table 2), that they were enthusiastic about the technique (4.3, SD 0.7) and that the content was well-coordinated (4.3, SD 0.8). However, the material for course preparation was not always suitable (4.0, SD 0.9), but the organization of the course was very good (4.5, SD 0.6). There was no consensus among the interviewees about the benefit of a video (3.7, SD 1.2), but that they would recommend the course (4.9, SD 0.3). The fact that this has been put into practice can be seen both in the increasing number of participants as well as in the renewed choice of the course in the following semester of many participants.

In the closing discussions of the course and in the qualitative feedback of the online questionnaires, many positive comments were noted (n=119 comments). The focus was on the interesting choice of topics, interactive didactics, interdisciplinary cooperation and the possibility of online participation (Table 1).

> *"A great event that should continue to be offered in this form! Due to the "digital" participation very contemporary and practical for e.g. commuting students."*

Likewise, many suggestions for improvement (n=91) could be collected for the course. These mainly concerned the technique to be improved and the approach of the participating students in terms of structure, choice of topics, and presentation as well as the critical examination of the topic (Table 3). Many points could be taken in each case for the new semester, for example, especially the audio technology was constantly improved and the

Table 1: Qualitative evaluation of the free-text comments on the question of what was received particularly positively on the course

n	Category	Typical quote
71	Choice of topics	"Multiperspective view of an important topic of today"
38	Technical implementation	"Not having to sit on uncomfortable chairs, but to be able to participate from the sofa."
34	Interactive didactics	"Interactive work, direct response to questions."
30	Interdisciplinary cooperation	"The contributions of various companies/organizations; the possibility of participation of non-medical students"
13	"Site visits"	"The visit to the Bayer Research Center"

n=91 comments, multiple answers possible

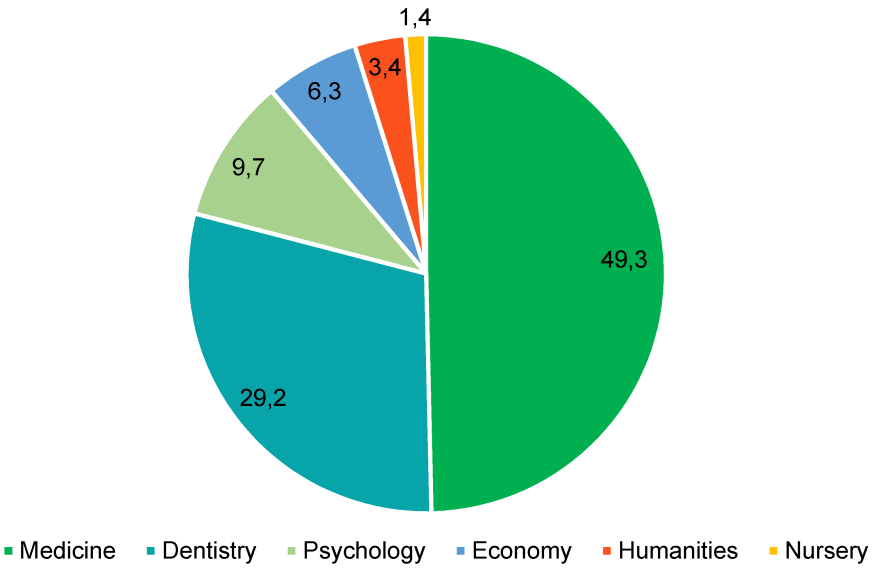

Figure 4: Distribution of students according to departments and faculties in the final evaluation (n=144)

Table 2: Quantitative evaluation of acceptance of the new course by the students

Statement	Mean value	Standard deviation (SD)
I am satisfied with the course format.	4.5	0.6
I like the technology of the virtual classroom.	4.3	0.7
The content was well coordinated.	4.3	0.8
The material for course preparation was good.	4.0	0.9
The organization of the course was good.	4.5	0.6
I would like to have video recordings of the session.	3.7	1.2
I will recommend the course to my friends.	4.9	0.3

Likert scales 1= "no, not at all" to 5= "yes, absolutely", n=144

Table 3: Qualitative evaluation of the free-text comments on the question of what can be improved on the course

n	Category	Typical quote
50	Technical implementation	"Camera/sound/internet connectivity is essential to online attendees and could be a little better"
35	Approach, structure and discussion	"Lecturers could sometimes better prepare for their audience. Language and vocabulary maybe so adapt that less "pitch-talk"/"business" language, but also unexplained medical terminology is used."
8	Critical discourse	"Critical lectures on digital developments would have been exciting."
3	Higher frequency	"Frequency of the event (weekly instead of two-week)."
2	Recording	"Eventually recordings of lectures"

n=91 comments, multiple answers possible

common thread between the topics and speakers was worked on.

> *"The readiness for critical discussion has not been enough for me personally; video transmission is not working 100%."*

In the other 35 comments, the participants only expressed their gratitude for the course and their motivation to continue.

> *"All in all, one of my best StuFu [fundamental studies] courses. Exciting presented, up-to-date, practical with exciting visions."*

Discussion

The purpose of this study was to create a course to prepare students for the digital transformation of the healthcare sector and to evaluate its acceptance and the online format. Courses and curricula are also being implemented at other universities that deal with digitization and want to empower students to act in the digital age [18]. Even if the German Government's Master Plan for Medical Studies 2020 [8] does not explicitly address digitization, medical students [15], medical educators, and computer scientists [11] demand an essential consideration both in terms of content and methodology in medical studies.

Because of the implementation of the fundamental studies (Studium fundamentale), Witten/Herdecke University has the opportunity to offer and credit such a course for the digitization of medicine for students of different faculties interdisciplinary and multi-professionally. Thus, the often cited "view beyond the box" can be achieved and the discussions revolve not only around medically possible technology, but also, for example, the economic, legal, and social aspects of the digital transformation. For example, the risk of "desolidarization" [4] was often discussed e.g. through a bonus system for health insurance costs when using fitness trackers. Especially in such discussions, the strength of the multi-professional approach became apparent.

While Witten/Herdecke University's (WHU) is didactically oriented towards small group seminars with intensive student participation, the concept of offering a course online was new and well received by the students. A comparison with the evaluation of other WHU courses was not possible as this is the online course offered. The online participants demanded and promoted the interaction familiar from the presence seminars. Many students, in addition to internal and external experts, became active as drivers of certain aspects of digitization. Especially this variety should have been expanded further, so that in the last semester (WiSe 18/19) not only a doubling of the course dates was scheduled but also other impulses for example from the fields of midwifery, dentistry, medical engineering, nursing, and general medicine were included.

A dropout rate between 30 and 50% seems enormously high at first glance, but has to do above all with the problematic choice of courses in fundamental studies. Many students are unable to take the courses they have chosen in the first place because of overlaps. In addition, the attendance check for this first online course at the university was deliberately very strict in order not to damage the format. This also meant that some students could not get the credits.

In the course of the semesters, it became apparent that an ever-increasing proportion of students preferred the possibility of online participation to attendance. This could be a sign of increased acceptance of the online format. In addition, this format offers students participating in external blocks the opportunity to acquire credits in a course of fundamental studies.

However, it remains a great challenge to maintain the interaction with the meanwhile very large numbers of participants, which is why we are now working with several moderators in addition to the initiators. In the next step the experts, educationalists, and alumni to compare this to the student's view will evaluate the course.

The success of this course and format also has an impact on the curriculum of the new model program in human medicine at Witten/Herdecke University [14]. Especially in sections where students cannot all be in one place, such as in the phases of clinical rotations, virtual classrooms will offer the possibility for joint seminars. The subject of digitization will also form a new focus of study. In the teaching of scientific methods in the first four semesters, medical informatics will play an important role. In addition, the two scientific papers to be prepared can be selected from the field of "Digital Transformation of Medicine", as well as the specialization on a 3x4 week track in the semesters 7 to 9. Since the course presented here made it clear how important an interdisciplinary and multi-professional approach is, the students of the "Digital Medicine" track will work closely with the students of the recently accredited "Digital Transformation and Social Responsibility" Master's Program [29]. Students of both curricula will work on projects together and exchange ideas in seminars.

In our opinion, the discussion of whether the digital transformation becomes reality and if it will also include the health system makes little sense based on the rapid progress and the many new opportunities, likewise a discussion whether the digitization is "good or bad". Nevertheless, it is important to discuss, how these changes are happening, and it is up to the medical community to minimize risk and maximize opportunities. For this, it is essential that students in their studies and doctors in the training and continuing education are able to act and shape. This is a clear mandate for medical societies, self-governing bodies and universities.

Notes

Survey language

Originally, online questionnaire and feedback interview were in German. Answers and comments taken from them have been translated for this article.

Competing interests

The authors declare that they have no competing interests.

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