

Can a Virtual Patient Help Physicians in Building Competency with Digital Therapeutics? –

A Design Research Approach

Although some countries have made reforms that integrate digital therapeutics into their health systems, most physicians still lack the competencies and experience needed for prescribing digital therapeutics. Virtual patients have received increasing attention in the education of medical professionals as a novel means for training diagnostic skills. This design research, therefore, aims to develop a virtual patient to help medical professionals build competencies for the indication, prescription, and application of digital therapeutics. This short paper describes the background, related work, and planned approach of this research in progress.

1. Introduction

Digital therapeutics are evidence-based mobile health applications that promise to close a gap in today's healthcare provision by providing patients with low-barrier access to clinically validated therapies for diverse areas, such as psychotherapeutical, orthopaedical, and endocrinological needs. Some countries have made progress with integrating digital therapeutics into their national health systems. Germany, for example, passed reforms that enable physicians and psychotherapists to prescribe digital therapeutics to patients with health insurance coverage (Gerke et al., 2020).

Yet, the acceptance of digital therapeutics among medical professionals is still lagging, also due to physician's lack of competencies and experience with these novel ways of treatment (Dahlhausen et al., 2021). Digitalization is generally neglected in medical education, both in terms of the curriculum and in terms of teaching methods (Aulenkamp et al., 2021; Kuhn et al., 2018). Virtual patients, however, have received increasing attention as a simulation-based learning technologies to train physicians' diagnostic skills (Kononowicz et al., 2019). Virtual patients are "[...] interactive computer simulations of real-life clinical scenarios for health professions training, education, or assessment." (Kononowicz et al., 2019).

Given the lagging acceptance of digital therapeutics among physicians on the one hand and the huge potential for virtual patients in the medical education on the other, this design research sets out to addresses the central question(s): *(How) can a virtual patient help medical professionals to build competencies for the indication, prescription, and application of digital therapeutics?* The remainder of

this paper provides an overview of the current research on digital therapeutics and virtual patients, before it describes our planned design research approach and closes with a brief outlook.

2. Related Work

Digital therapeutics (also: DTx) have been defined as “evidence-based therapeutic interventions that are driven by high-quality software programs to treat, manage, or prevent a disease or disorder” (Digital Therapeutics Alliance, 2022). In Germany, digital therapeutics are lower-risk medical devices primarily based on digital technologies to support disease care (Gerke et al, 2020). These applications must undergo an approval procedure and can then be prescribed by physicians and psychotherapists (ibid). Approved digital therapeutics are listed in a corresponding register by the German Federal Institute for Drugs and Medical Devices (ibid).

Digital therapeutics are met with a certain skepticism by the medical profession, as described before (Dahlhausen et al., 2022). Current research suggests that most of the medical profession do not want to prescribe digital therapeutics, are still unsure or do not know what digital therapeutics are. Only about a quarter of physicians and psychotherapists surveyed said they would prescribe digital therapeutics in the future, and a small proportion has already done so (Dahlhausen et al., 2021). Information deficits and technological uncertainties were cited as obstacles to prescribing digital therapeutics (Dahlhausen et al., 2021). Current research points to the need for adequate education, information, and training to increase the acceptance of digital therapeutics by the medical profession (Dahlhausen et al., 2022; Bratan et al., 2022; Greiner et al., 2022). Integrating digital therapeutics into the medical curriculum requires training in digital competencies by incorporating digital learning methods (Bratan et al., 2022).

For decades, medical education has used actors as the standard method for students to train the interview of patients in a controlled environment (Frangoudes et al., 2021). However, actors are time-consuming and costly for training institutions (Bosse et al., 2015). Virtual patients are a flexible and easily accessible option in medical education to improve students' health and medical-related skills (Kaur et al., 2021; Frangoudes et al., 2021). Such simulation-based learning technologies provide a technology-enabled and multimedia opportunity to practice clinical, problem-solving, and decision-

making skills in real-world situations without putting patients at risk (Sahu et al., 2019). Virtual patients have been used for cases in internal medicine, life support and critical care, but also for psychiatric or psychosocial nature, radiology, dermatology, cardiology, anaesthesia, and surgery (Kononowicz et al., 2019). Other fields such as orthopaedics, pharmacy triage, physiology, and physiotherapy were less represented in virtual patient applications (ibid).

Previous virtual patients in medical education have been implemented using conversational artificial intelligence (AI) technology and natural language understanding tools, with interaction primarily done via free text via the keyboard and speech input (Frangoudes et al., 2021). For example, Co et al. (2022) developed a virtual patient app using Dialogflow to train medical students' skills in taking medical history for different surgical specialities. Suárez et al. (2022) used a virtual patient to promote dental students' diagnostic skills, which was also developed with Dialogflow. Dolianiti et al. (2020) developed a conversational virtual patient using Rasa Open Source for a cardiology use case to train thromboembolism decision-making skills in medical students. Current research suggests that virtual patients can be at least as effective in improving skills such as clinical reasoning and procedural knowledge compared to traditional training (Kononowicz et al., 2019). Although current research points to the potential of virtual patients in medical education, the implementation of virtual patients is poorly researched, and only a few are used as an integral part of the curricula at European medical schools (Frangoudes et al., 2021). Recently, authors have called for further exploring the development of virtual patients to support the medical curriculum and increase the use and impact of digital technology in medical education (Kaur et al., 2021; Frangoudes et al., 2021). As our literature review provides, there is no related work that explored the potential of virtual patients in the context of digital therapeutics.

3. Design Science Approach

To address our research question of *whether and how a virtual patient can help medical professionals to build competencies with digital therapeutics*, this research takes a design science research (DSR) approach that addresses human-relevant problems using innovative artifacts and contributes new scientific knowledge (vom Brocke et al., 2020). We aim to develop design requirements for a virtual patient, iteratively build this artifact, and evaluate it with users to assess its fitness for use. Following

the six DSR steps of (1) identifying the problem and motivating, (2) defining the objectives of a solution, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication by Peffers et al. (2007), Table 1 shows the procedure for the iterative development of the virtual patient artefact.

Table 1: Research and development of the VP artefact according to DSR by Peffers et al. (2007)

<i>Process Step</i>	<i>Methods and Expected Results</i>
(1) Identify problem and motivate	Conduct a literature review (related work) and interviews with physicians and experts on DTx to gain knowledge of the problem's state.
(2) Define objectives of a solution	Conduct literature review and interviews with physicians and experts on DTx and VPs to derive objectives on how a VP can build competencies with DTx.
(3) Design & Development	Concept development including design requirements for the VP and patient personas with decision trees based on a literature review, medical guidelines, and interview results. Subsequent implementation of the VP with the help of a suitable conversational AI tool (e.g., Rasa or Dialogflow).
(4) Demonstration	Two demonstrations are planned: (1) The use of the VP artefact in an online experiment with the medical profession, and (2) the use of the VP artefact in medical education with medical students.
(5) Evaluation	As part of the demonstrations, evaluation of the developed VP artefact and investigate how the VP provide building physicians' competencies with DTx
(6) Communication	Communicate the research results to stakeholders (e.g., study participants) and especially to the scientific community through scientific publications as well as open-source deployment of the developed virtual patient artefact.

4. Summary and Outlook

Motivated by the lagging physicians' acceptance of digital therapeutics caused by missing digital competencies and the neglect of digitalization in medical education, this paper motivated and presented our planned research, which aims at designing a virtual patient that can help medical professionals build competencies for the indication, prescription, and application of digital therapeutics. At the time of writing this paper, the project is in the first two DSR steps, problem identification and objectives definition (see Table 1). We have started to conduct first interviews with physicians and review the literature on designing virtual patients and the medical guidelines to develop an initial concept for the virtual patient. At the Information Technology Symposium (HITS) of the ICIS 2022

conference in Copenhagen, we expect to be able present first results from the project and thus hope to gain feedback and inputs from the interaction with other workshop participants for further development and dissemination of our work.

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