

# Serious gaming in internal medicine education: do we know best or do we know last?

P.C. van Ooik<sup>1\*</sup>, F.N.J. Frakking<sup>2</sup>, M.E.W. Dankbaar<sup>3</sup>, J.J. Oosterheert<sup>1</sup>, H.A.H. Kaasjager<sup>1</sup>

Departments of <sup>1</sup>Internal Medicine, <sup>2</sup>Microbiology, University Medical Centre Utrecht, Utrecht, the Netherlands; <sup>3</sup>Department of Education, Erasmus University Medical Centre, Rotterdam, the Netherlands. \*Corresponding author: P.C.vanOoik-2@umcutrecht.nl

## KEYWORDS

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## ABSTRACT

The use of digital tools is indispensable in our daily lives. The medical world keeps up with this progress by implementing digital tools to facilitate and improve patient care, such as eConsults and self-care apps. Serious games are also becoming increasingly popular in healthcare education, particularly in surgical residency training and nursing education. However, gaming and digitisation of education have not been widely integrated in internal medicine residency education yet. Therefore, these programs are not yet modernised to meet the demands of the 21<sup>st</sup> century physician. In this article, we will explicate our view on digitisation of the internal medical education programme with special attention to serious gaming. We will discuss pros and cons of digitisation, describe challenges of development and implementation of games, and offer some examples of digital educational tools for practical use.

## INTRODUCTION

Digital serious games in healthcare education are becoming increasingly popular.<sup>1,2</sup> A serious game is an information technology (IT)-based modality designed to teach knowledge, skills, and behaviour, while integrating a score element, challenging goals, and appealing design.<sup>3,4</sup> Serious games appear in many shapes and forms. More sophisticated forms of serious games often involve high-tech IT solutions to generate two-dimensional (2D) computer games or three-dimensional (3D) virtual patients.<sup>2,5</sup> A serious game enables standardised repeated

practice to enhance knowledge and skills without interaction with real patients, and allow for trial-and-error learning without compromising patient safety.

In particular, surgical residency training and nursing education already widely use serious games to simulate realistic situations.<sup>1,2,6</sup> By practicing skills in a simulated environment, surgical residents are exposed to many hours of rehearsing specific situations and a diversity of possible scenarios to help them train essential techniques. Although the learning potential of gaming in surgical education is not yet fully investigated, a recent trial shows that adding a serious game to an existing curriculum can help residents to improve their problem-solving abilities in the operating room.<sup>7</sup> This trial demonstrates that technical skills can be acquired by this form of education and cautiously suggests that behavioural changes may also be promoted. Gamification, the use of gaming elements for educational purposes, is also more customary in nursing educational programs, as reported by numerous articles, which describe a broad range of effects, varying from knowledge acquisition to reducing anxiety in stressful situations.<sup>8-11</sup>

Internal medicine is the largest hospital-based specialty and a rapidly developing and broad field of expertise. We would expect that gaming and digitisation of education are important components for internal medicine, including its subspecialties. Residents in internal medicine must obtain a variety of diagnostic skills, train in therapeutic decision making, and gain knowledge about rare diseases not often encountered in daily patient care; therefore, online games may be a good approach. Surprisingly, gaming has not been widely integrated into internal medicine residency education.

An overview generated in 2016 on serious games in healthcare identified 42 serious games in 14 fields of medical expertise. Only two games, *InsuOnline* and a blood pressure management game, contained training in specific internal medicine topics, and teach players

about the management of diabetes and hypertension, respectively.<sup>2</sup> Remarkably, even these two games were designed to train primary care physicians and not internal medicine specialists. Although games from different medical specialties can benefit internal medicine residents, serious games developed specifically for internal medicine education are lacking. Based on a review by Gentry et al.<sup>6</sup> in 2019, we can conclude that this is still the case. We believe that internal medicine residents could benefit from a game-enhanced curriculum and would like to challenge our colleagues to take a critical look at their own curricula.

## DIGITAL EVOLUTION OF INTERNAL MEDICINE

### Knowledge and skills required of an internist

Specialists in internal medicine, internists, are classically thought of as doctors with endless knowledge attained from books.<sup>12-14</sup> However, in a rapidly developing digital age, this traditional method of attaining knowledge is severely inefficient since it is virtually impossible to keep up with rapid medical developments in the different aspects of internal medicine. As a result, digital medical magazines and search platforms, such as UpToDate and PubMed, are frequently used to quickly find contemporary answers to clinical questions. Over time, skills such as patient counselling, management, and communication skills, have become increasingly important in residency education.<sup>15</sup> Addition of new roles to that of the clinical physician require supplementary skills. Creative thinking, computational thinking (problem solving with vast amounts of information, variables, and computing power) and basic information and communications technology (ICT) skills, so called 21<sup>st</sup> century skills, are necessary to fulfil all the roles demanded of the modern internist. Surprisingly, internal medicine resident education has not transformed to meet the needs of our new generations of internists.

### Internists readily advocate patient digital tools

Remarkably, internists do urge their patients to use new technical solutions to increase their wellbeing. The strategic plan of the Netherlands Internists Association (NIV, Nederlandse Internisten Vereniging), a document describing the vision and ambitions of internists, encourages internists to inform their patients about new digital options in health education and to motivate patients to use apps for digital support in patient healthcare.<sup>16</sup>

Another example is the Dutch Society of Internal Medicine Innovation Platform that gives healthcare professionals an overview of digital medical applications.<sup>17</sup> The launch

of this platform of medical innovations and the existence of an E-health week underscores the importance of digitisation for our professional group.

### Digital tools and use of, are lacking in internal medicine education

Internists are progressive when it comes to digitisation of patient care and educators are inclined to use digital tools for medical students; thus, it remains unclear why the use of digital tools in internal medicine education is limited. One reason may be the restricted access to some of these digital tools. From our own experiences, internal medicine residency program directors are reluctant to adapt new digital tools into their curricula, which may be explained by a reluctance to adopt unknown elements. As stated by three medical information science professors, there is too little education on digitisation in the current medical curricula, and doctors are usually not actively involved in the process of developing new educational tools.<sup>18</sup> As a result, using new technology becomes difficult due to the lack of technical training and support from the medical world to implement these tools. In contrast to other, more technically supported medical specialties such as surgery or intensive care medicine, most internists do not regularly work with technical equipment. This unfamiliarity with extensive technical equipment may also contribute to hesitation in implementing digital educational tools. Lastly, in patient care, internists are trained to think about all possible solutions for a problem, explore them thoroughly before making a well-considered, preferably evidence-based, choice. Since there is no unambiguous evidence on the working mechanisms of gaming, an evidence-based decision is difficult to make in this context.

## SERIOUS GAMING IN INTERNAL MEDICINE EDUCATION

### Current state of education technology

Despite the lack of games, a few apps are available that enable internal medicine residents to practice clinical cases. The app *Prognosis*<sup>19</sup> offers players short cases in all medical fields. With a limited number of choice options and a large quantity of text explaining what (should have) happened to the patient, this app can be used to gain more background information on specific illnesses. Players can choose which specialty they want to practice, thus making this app suitable for all physicians. The *Clinical Sense*<sup>20</sup> app offers predominantly the same features. Both apps are the result of an international collaboration and are freely accessible. Unfortunately, reports on the goals and the effect the apps have on achieving these goals are lacking.

In the Netherlands, a few internal medicine residents have developed podcasts and apps to educate their colleagues. Examples include *Medische Snippers*<sup>21</sup>, which offers 10-minute audio fragments containing background information on a topic to be discussed later that week in an analogue group meeting; and the *Internal Medicine Knowledge Test App*<sup>22</sup>, which presents the player with numerous knowledge questions in preparation for the annual mandatory knowledge test for internal medicine residents in the Netherlands. Two serious games were developed in collaboration with Dutch internists, the *abcdeSim*<sup>23</sup> and *Geriatric*<sup>24</sup>. Although internists played an important role in developing these games, again, its content is not primarily aimed at internists. The *abcdeSim* app trains the player to stabilise patients in the emergency department in a specific, structured way, the Airway, Breathing, Circulation, Disability, Exposure (ABCDE) method.<sup>23</sup> This method is universally accepted as a valid approach to address acutely ill patients, but is not confined to internal medicine alone. A study on the effectiveness of the *abcdeSim* app showed that game-playing residents scored higher on objectively-measured and self-assessed clinical competencies.<sup>25</sup> The *Geriatric* app was developed by an internist specialising in geriatric medicine and aims to teach the player about desirable treatment options in older patients with multiple medical problems; it also teaches students about cost effectiveness. A randomised controlled trial on the effectiveness of the game demonstrated higher self-perceived competence in medical students on all described learning goals.<sup>26</sup>

#### Advantages of serious gaming

While the medical world is rapidly evolving, financial cutbacks have mandated the shortening of training for Dutch internists and other specialists.<sup>27</sup> As a result, residents are expected to obtain more knowledge in less time, while simultaneously gaining insights into new developments. Digital forms of education may be a solution. With digital education, residency program directors can offer their residents exposure to every disease without having to wait for the right patient to visit the emergency room or outpatient clinic. All residents can therefore acquire the same level of knowledge independent of their particular practical training or internship. Moreover, digital forms of education can be used for testing purposes, to keep track of a resident's progress, or used as a self-assessment tool for residents to monitor their own knowledge or skills.

Digital forms of education can also ensure uniform acquisition of basic skills for residents in all sub-areas in internal medicine, and can be customised for individual learning needs. As stated in a policy document in 2016 by the Royal Dutch Medical Association, every resident in the Netherlands should be able to receive a personalised

curriculum.<sup>28</sup> Though reasonably difficult to realise such demands when using analogue education, digital education can be adapted to every personal need. Depending on the design and content of the educational tool, residents would be able to train in various skills in a more compact and efficient way. Ultimately, residents can be exposed to much more repetition using digital forms of education in comparison with traditional forms of education. Repetition is associated with improved knowledge retention.<sup>29</sup> Luckily, the modality in which repetition is offered to residents seems to make no difference on learning potential,<sup>30</sup> serious gaming and other forms of digital education appear to be an acceptable alternative form of education.

Serious games stimulate active learning, which is encouraged more and more in medical curricula<sup>31</sup>, and games promote this by offering challenging tasks and a story. Games also allow for flexible learning, which helps residents better incorporate learning tasks into their very busy schedules. Although promising in its possibilities, games are not likely to take over a complete curriculum. More research is needed to determine in what context and in what form a game should be used in current resident education.

#### Working mechanisms of serious gaming

Although the exact mechanisms of learning through playing games in medical residency education are not yet fully understood, there is increasing evidence on elements contributing to learning through gaming. A few key features in learning through gaming include application of knowledge, usability, the extent to which players accept the game, and learning by exploration.<sup>32</sup> Application of knowledge means that players have to apply previously acquired knowledge into the game, thus testing themselves on previously acquired knowledge and skills. Usability relates to the way players feel about becoming familiar with the game: If players feel like they are mastering a game, they become more involved and more motivated. They then continue to use the game and therefore learn from it. Exploration relates to the feasibility to investigate the possibilities within the game, make mistakes, and learn from them by trying again. This implicates that a game should be easy to use and relate to daily practice when used for training purposes.

Apart from these three principles, game design is important. There is no unambiguous evidence which design principles best promote learning. For example, one issue in designing games is the fidelity of the game, how the game situation resembles real life. Fidelity can be subdivided into two forms: structural fidelity, which describes to what extent the game and personas in the game look like real surroundings and people; and functional fidelity, which describes to what extent a functional task within the game resembles real life.

For example, the popular video game *Assassins Creed*<sup>®</sup>, in which an historical figure is sent on a mission to slay opponents, has high structural fidelity (buildings look like everyday structures and characters are lifelike), but low functional fidelity given that most of us are not murderers. In contrast to what one might think, high structural fidelity games do not necessarily lead to increased learning. Although earlier reports questioned the relationship between fidelity and learning potential,<sup>33</sup> recent literature describes that high functional fidelity, rather than high structural fidelity, facilitated learning in simulation-based education.<sup>34</sup> However, medical students who engaged in a game with high-level structural and functional fidelity cases, did not demonstrate better procedural skills than students who used an online program with low-fidelity cases.<sup>35</sup> This study suggests that the efficacy of fidelity is dependent on the level of expertise of the player. In inexperienced players, high structural fidelity can create cognitive overload and thus diminish learning effects.<sup>35</sup> From this, we conclude that functional fidelity should be aligned to the intended user's expert level of using digital tools, or at least offer an excellent tutorial, and that structural fidelity should resemble daily functional tasks.

#### Challenges to developing and implementing serious games

The main challenges of creating and implementing games are to generate financial support and to continuously engage a multidisciplinary team with medical, educational, and IT experts during the development process. Although digital games are often more expensive to develop than traditional, analogue methods of education, the enhanced learning potential and amplification of skills beyond knowledge<sup>6</sup> is too valuable to ignore. Serious games have the potential to deliver highly-qualified doctors with a well-rounded education.

In order to implement a serious game into the curriculum, it is crucial to connect it to the learning goals and assessments, or other educational tools that may already exist. Unfortunately, even well-designed serious games are underused after delivery due to a lack of urgency among the target group to play. In addition, serious games require more support than traditional educational methods. A serious game requires continuous IT support to host and maintain a well-functioning game, including regular updates. Providing expertise for updating medical content regularly might even be more challenging. Medical professionals have to gain experience with the functionality of the game and keep up with new developments, including new guidelines, to regularly adjust the content of the game. Lastly, support and research from an educational perspective is required to provide the latest educational insights on serious gaming.

#### Dutch Society of Simulation in Healthcare

It is understandable that residency program directors may find it difficult to know where to start when thinking of using a game in their curriculum or to develop a game themselves. Recently, the Dutch Society of Simulation in Healthcare (DSSH) launched a quality assessment to evaluate the validity of serious games in healthcare.<sup>36</sup> Developers of serious games can submit their projects for evaluation at the DSSH quality committee of volunteer experts. The committee will review the submitted game with special attention to nine characteristics. Safe storage of data, gaming elements, collaboration with relevant experts, and validation of working mechanisms are some of the criteria which will be assessed. Evaluated games will receive one to five stars, with five stars being the maximum rating for games with validated working mechanisms. These criteria can also be used as guideline for future game development.

#### CONCLUSION

In summary, internal medicine is a rapidly developing field of medical expertise, with increasing emphasis on 21<sup>st</sup> century skills. Resident medical education can, and must be, adjusted to facilitate these learning demands. Serious games would be a way to improve current curricula to meet these demands. The DSSH could be a good reference for more information on how to develop a game, or as a contact to experienced development teams for advice. Other medical disciplines, such as surgery and nursing educational programs, have already made attempts to improve their curricula through gamification. We urge the internal medicine specialty to offer its residents a game-enhanced curriculum to promote active learning and create flexibility. By investigating these digital interventions on their effectiveness, design principles, gaming elements, and learning capacities, we can advance from knowing last to knowing best.

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