Why so serious?

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Why So Serious?

State of the art and future directions for game-based learning in health profession education

Anne E. J. van Gaalen

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Why so serious? Game-based learning in health profession education: State of the art and future directions

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Why so serious?

Game-based learning in health profession education: State of the art and future directions

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"My soul, sit thou a patient looker-on; Judge not the play before the play is done: Her plot hath many changes; every day speaks a new scene;
the last act crowns the play"
~ Francis Quarles

1

Foreplay

(General introduction)

1

Preface (onboarding[1])

In preparation for the introduction of this thesis, I read many of my colleagues' PhD theses. While doing so, I could not help but notice that many introductions started with defining terms and general concepts to aid the readers understanding of the subject. PhD theses on cancer start with explaining that cancer cells develop from healthy cells in which DNA is damaged, theses on delirium begin naming a neuropsychiatric disorder in which there is an altered mental status, and theses on self-directed learning explain how individuals can identify and direct their own learning needs. Hence, to start a thesis about game-based learning, one might begin to explain what game-based learning is. In our case, such a beginning would directly portray the difficulty and ambiguity swathed within game-based learning research and its implementation. It is this very characteristic of game-based learning that provides a leitmotif[2] for this thesis. Each chapter in this thesis will bring us closer to understanding game-based learning, yet each consecutive chapter will also show us that the quintessence of game-based learning might be dynamic, inter-individual/context depended and, maybe, even, utopic.

I am well aware that there are few things as serious as (the defence of) a PhD thesis. Yet, in the words of renowned Dutch historian and play scholar Johan Huizinga (who, coincidentally, was born in Groningen): "the contrast between play and seriousness is always fluid, neither conclusive nor fixed" [1]. *Although some of the chosen words and titles in this thesis might be considered somewhat unfamiliar, exotic or, even, unconventional, we will learn that even this can be seen as playful for that "word and ideas are not born of scientific or logical thinking but of creative language"* [1] *and that "creativity is an integral part of playfulness"* [2]. *To let the reader enter the playground, and join the exiting realm of game-based learning research, such words received a superscript with an explanation at the bottom of the page in the footnote. Lastly, but importantly, this PhD thesis is about game-based learning in medical education. However, after each act[3] (i.e. chapter) we might begin to ponder whether play might be more entailing than earlier foreseen. In fact, in the final scene (i.e. the discussion) I will argue that play is more deeply rooted in human behaviour and goes beyond medical education, game-based learning and, possibly, even, culture and time itself.*

1 A game-element, used to get people acquainted with how something works and what can be expected in a game.
2 Any sort of recurring theme; origin: a "short, constantly recurring musical phrase".
3 An act is a major division of a theatre work, including a play, film, opera, or musical theatre, consisting of one or more scenes.

General introduction

This general introduction is aimed to aid the readers' understanding as to why (and why now) medical education might be in need for game-based learning, what game-based learning is, what fields helped to construct game-based strategies, and, importantly, why all these features attribute to the current challenges existing in game-based learning for medical education.

Health Professions Education

Probably more than in many other higher education domains, the education and training of health professionals like physicians, dentists, veterinarians, physical therapists and nurses is characterized by the need to acquire both professional competencies and a considerable amount of knowledge. This challenge is intensified by the fact that biomedical knowledge expands and changes at a rapid pace [3]. This is not only pertinent for (under)graduate students. Post-graduates need to pursue of lifelong learning [4], even with a decrease in work hours and increase in duty demands [5]. Due to these challenges, health professions education (HPE) has moved from a "know all" to "know how" basis, with an emphasis on active learning, problem solving and a student-centred instead of a teacher-centred orientation[6,7]. Based on well-grounded theories (such as self-regulated learning, self-determination theory, achievement goal theory and workplace affordances [4]), this means a "anywhere/anytime" asynchronous way of learning in which there is room for individualized instruction in combination with small-group interactions [8].

The pedagogical changes of the last three decades were accompanied by concurrent digital innovations such as the development of e-learning, virtual patients and simulations that helped revolutionize medical education. Such innovations grant learning opportunities that enhance collaborative learning (working together), create adaptive learning (individualized to a student) while ensuring the opportunity to apply distance learning and "flip" the classroom (learn at home, work on problem-solving during class time) [9]. The recent COVID-19 pandemic only highlights the importance of such concepts in times where medical schools may not be physically accessible to ensure social distancing and (part of the) teaching instead takes place from a distance, at home. This global pandemic will, possibly, forever change how future health care professionals are educated [8]. Medical schools have transitioned pre-clerkship curricula to online formats, group sessions now convene online and even exams are brought online; a strategy seemingly befitting the digital native student (individuals surrounded by technology from their birth) now entering medical schools [10]. By combining the aforementioned pedagogical changes (e.g. distance learning and self-regulated learning) and innovative educational technologies (like e-learning and simulations), institutes attempt to transfer knowledge

as effectively and efficiently as possible [3,11][6].

In these changing times, new challenges arise. Student motivation is known to be one of the most important predictors of academic achievement, influencing effort and time spent on tasks [25–27]. But, when using new (digital) learning strategies, it often seems difficult to motivate learners [12].

E-learnings offer the flexibility necessary to self-regulate learning and work from a distance, but suffer from high drop-out rates (25-40%), general dissatisfaction and low motivation to the extent that students do not even start the module [13–15]. Hence, new (digitalized) pedagogical approaches do not automatically lead to engaging, challenging and motivating learning environments. The quality of the instructional content is important, yet the attitude and the behaviour that result from the instructional content is vital to start and continue learning. This is especially relevant in order to divert possible clinical consequences [16] (see for an example box 1).

Box 1. Medical teaching in times of change: The example of Anatomy teaching

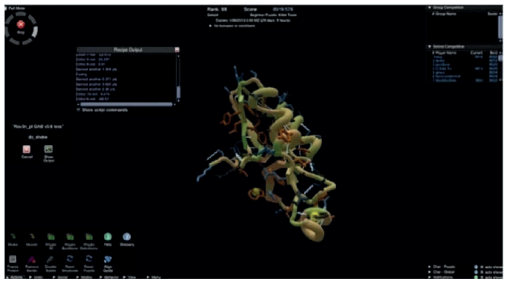
In medical curricula across the world there has been a steady decline in scheduled anatomy teaching hours due to expanding knowledge in different medical fields [17]. Nevertheless, the next generation of medical specialists will need to use anatomical expertise in their daily routine. For instance, surgeons must be able to accurately localize anatomical landmarks to perform minimal invasive surgery or endoscopic operations. Not understanding the conceptual context of such anatomical landmarks (e.g. landmarks that minimize the risk of nerve damage) might lead to medical errors. It is well known that the implementation of minimal invasive surgery produced a new generation of surgeons with little exposure to open surgical therapies during training [17]. Hence, when conversion to open surgery is needed, theoretical anatomical knowledge must play the role of strengthening scarce practical experience. Current exposure to anatomy teaching in medical curricula - an estimated 80% reduction in anatomy teaching hours - may be insufficient for anatomy knowledge to carry this role [17]. There is moreover evidence that the decline of anatomy knowledge may be associated with adverse psychological effects (uncertainty about one's own medical skills), with an increased likelihood of medico-legal claims and, in general, decreased patient safety[17–20].

Reduced working hours (and thus less time for experiential learning) and increased (administrative) workload have decreased the opportunity to learn (anatomy) on the work floor [5]. Digital innovations (e.g. 3D visualization technologies and surgical simulations) may deliver options for distance learning or self-regulated learning to increase anatomy knowledge. Simulators use highly sophisticated technology and are known (in research settings) to improve clinical skills, knowledge and confidence among residents [21,22]. Yet, in real-life, when placed on medical wards, simulators often remain unused even in circumstances when time and availability should be no issue. This suggests the behaviour/attitude towards the instructional content may be even more critical than the anatomy content [5,12,23].

Game-based learning

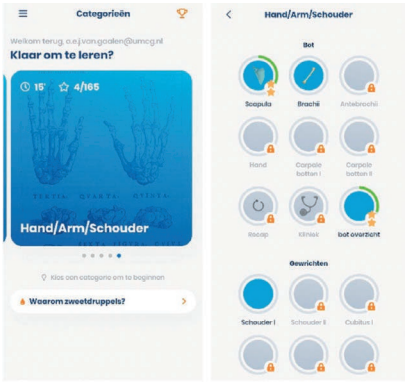
GBL is a learning strategy that aims to facilitate learning by taking inspiration from games [24]. It has the aim to resolve challenges in learning attitudes and learning behaviour by embracing the persuasive and motivational power of play [16,25]. There are two different types of GBL: serious games and gamification. Serious games can be defined as *games* in which education is the primary goal [26]. Here, GBL looks and feels very much like a game but has a serious touch due to the learning-aspect (e.g. box-2). This can be in contrast with gamification. In gamification, the 'play-atmosphere' is less evident and the learning task itself is clearly at hand (e.g. box-3). Gamification can be defined as the use of game-elements (e.g. the use of rewards and/or leader boards) *without* creating a game [27]. Hence, the characteristic difference between serious games and gamification is whether or not there is a *game(-atmosphere).* For instance, box 2 can be seen as an example of a serious game (since it is puzzle), while box-3 can be viewed as gamification since there are rewards (drops of sweat) and there is a leader board but the learning task is close at hand, clearly visible and the used strategy is not a game. Although often designed for computers and mobile phones, neither type of GBL needs to be digital.

Box 2. Foldit.



In cells, proteins have a folded configuration that determines their functionality. Hence, knowing the folding configuration of proteins is essential to enable biological innovations to target specific protein folds causing disease. In the online puzzle game "foldit" the objective is to optimally fold a protein using tools provided in the game. Subsequently, researchers determine which solution scores and could be functional in a real-world setting. As a result, in a matter of only 10 days and through the efforts of its players, the game succeeded in deciphering a protein fold that had remained unsolved for 15 years. [76]

Box 3. The Anatomy Gym.



Current challenges in teaching anatomy (Box 1) resulted in the development of UMCG Anatomy Gym. I developed this app in collaboration with the UMCG anatomy department and it was made possible thanks to an educational innovation grant provided by the UMCG. UMCG Anatomy Gym is an educational game in which players learn anatomy facts and can compete against other players while doing so. Players earn virtual drops of sweat for every question answered correctly. The application includes several level-ups that can be achieved when sufficient effort is made which is highlighted by earned stars.

The Connection between Play and GBL

By adding play to something as serious as medical education, one might come across as being frivol or trivializing the seriousness of a situation [25]. Yet, play is to be taken very seriously in this regard for at least two reasons: 1) its prominent role in contemporary society, and 2) its close relation with learning.

Playfulness (e.g. playful behaviour and objects) has increasingly a central role in our culture [28]. The popularity of (online) digital gaming is a striking example. Digital gaming is one of the most popular leisure activities worldwide, outgrowing the Hollywood movie industry by a factor ten just on the basis of economic value [29]. Worldwide, a staggering three billion hours is estimated to be spent on digital games on a weekly basis, and by the age of twenty-one the average teenagers have spent more than ten thousand hours playing computer and video games according to an American survey [30]. Although digital gaming portrays a large contribution of the playfulness in our culture, there are many other manifestations, which are not only applicable to teenagers. Countdown timers in traffic lights, the use of mobile phones (with e.g. mobile games or texting with emoticons) and even cars that can make "fart-sounds" can be seen as one of the many examples that attribute to the ludification[4] of culture [28,31].

In line with the increasing playfulness in our culture (ludification), evidence that play has a functional purpose is accumulating. Far preceding the time of gamification, simulations and serious games, the great philosopher Plato (427 BCE) already philosophised that play can be purposed for other things than merely leisure [32]. In ancient Greek civilization, play (*paidia*) was recognized to influence children (*paides*) in the way they developed as adults and, consequently, education (*paideia*) developed in the classical age (500-300 BCE) [32]. Despite this ancient notion, play and games mainly remained to be seen as something to be curtailed in children for a long period of time [33]. It was not until the Age of Enlightenment (17th and 18th century, Europe), philosophers began to consider play as a right of childhood [34] and play was recognized as a purposeful activity [33]. Since then, many renowned educationalists (e.g. Montessori, Frobel), play-philosophers (e.g. Huizinga, Caillois), neuroscientists (e.g. Panksepp) and psychologists (e.g. Piaget, Vygotsky) followed the logic that play has function and, thus, can be purposed. Indeed, subsequent experimental research in young and adult animals and developmental psychological research in children supported claims that play positively influences the learning of problem solving [35,36], creativity [37,38], and self-regulatory skills [39]. Hence, 'play' is considered a vital process for learning, at least at young age.

4 Raessens [28] uses the word ludification to denote the construct of increasing playful behaviour and fun objects

The ludification of culture, together with a growing understanding of the function of play, seem to drive a growing interest for using games as learning strategy. Jane McGonigal, a renowned game developer and (computer) game researcher, argues that games teach users to have "urgent optimism" (something is always worth trying since there is always a chance to succeed), that gamers have "social fabric" (in playing [multiplayer] games, gamers need to trust in and cooperate with other players to achieve a common goal which, as result, creates stronger social bonds), that gamers have "blissful productivity" (gamers are happy to work hard and produce something in a game, instead of relaxing), and that gamers pursue "epic meaning" (gamers love to be attached to grand and inspiring meanings) [29,30]. If games can harness such emotions, why not, in the words of McGonigal, "use them for real-world problems?" [29]. Essentially, this idea lies at the heart of GBL.

What is play?

If we should take play seriously and play is an important part of GBL, than what is 'play' actually? Many scholars have aimed to define *play* [1,40–42]. Others suggest that it is the nature of play to never be precisely defined [43]. Play can be a broad and, at times, a vague subject [44]. It can be free – ungoverned by anything, as a child uses a swing to spin oneself dizzy – or fixed and rule-bound when a chess-player needs to submit to certain rules to move a chess-piece. Play can be found in acting and dancing in theatres, in jokes and pranks between colleagues, it can be done solitary with a pack of cards or in large groups connected with each other over the internet. In 1938, Johan Huizinga suggested that play has five characteristics that defines it: play is voluntary, play is rule bound, play is different from the ordinary life, play is not useful, and there is a 'magic circle' (play has its own time and place) [1]. Although considered "the most influential modernist exposition of play" [28], one might see the difficulty with the compatibility of Huizinga's definition and that of GBL. If play is considered *not* to be part of everyday life how can it be compatible with academic learning, as this learning *must be* part of everyday life (especially for lifelong learning physicians)? If play is *not useful* but play is utilized to make learning more engaging or motivating, doesn't that make play *useful*? If play is *voluntary*, but a medical student needs to do a GBL assignment to pass an exam, doesn't that make play *mandatory*? Building on theories from Huizinga, but troubled by his one dimensional view of play, Caillois introduced a distinction between playing (or "paidia") and gaming (or "ludus") as two poles of play activities [40]. Paidia comprising an improvisational, expressive, free form of behaviour, whereas ludus betokens a more structured kind of play with rules. Different kinds of play probably have different amounts of ludus and paidia, but none can be on one end of the spectrum; i.e. each type of play has ludus and paidia. For instance, in chess there are many rules that state how a chess-piece can be moved (ludus), but the player is free to choose the direction of a chess piece (paidia).

Considering the paidia and ludus elements of play, and the historically performed research on play and learning, the weight of the research on learning and play seem to be on the paidic aspect of play. In all likelihood, this can be attributed to children being the predominant studied populations - and child's play is predominantly paidic [45]. Moreover, the digital age with a great use of computers, mobile phones, games, serious games and gamification emerged fairly recently. New digital media is more ludus orientated and is increasingly focusing on adults [45]. This shift from child's play to adult play and concomitant shift from paidic to ludic play seem to be in need for a new, or at least further, scientific exploration if we want to advance the knowledge about play and learning at a later age.

State of the art and challenges in GBL research.

In recent years scientific interest in GBL in higher education settings has increased substantially [46]. Several systematic analyses have been composed that review possible impacts of GBL on educational outcome in such settings [47–52]. Although never made explicit, the new kind of research on GBL seemed to be based on the ludic part of play and directed to (young) adults. Thus, whereas research on play-learning interaction used to be performed primarily in the context of paidic play in children, this emerging interest in GBL now enables us to learn how a different type of play (i.e. ludus) - targeted at a different age group - might interact with learning. Unfortunately, a conceptual understanding of when, how and why to apply GBL in medical education remains in a rudimentary state [53], which seems mainly due to a lack of awareness to involve play theory and research in GBL research. For instance, well-accomplished terminology from play research such as ludus and paidia is rarely mentioned or used in study conceptualization. Game-elements such as leader boards, points and badges are widely introduced to pre-existing learning strategies with the rather vague intention to "enhance engagement" [54]. While some argue that engagement is a way to generate behaviour change [54], others grant behavioural effects to novelty and argue that engagement will eventually decrease over time [55].

Being part of GBL, serious games has a longer standing (research) history as compared to gamification [56]. Many systematic reviews showed the positive learning effects of serious games[e.g. 59,60]. Learning theories and motivational theories applied in serious gaming research clarified why serious games might deliver benefits [e.g. 61]. Others identified game-elements [53,60] as building block towards a successful serious game design. Yet, as we will learn below, the liking of play and its elements might differ considerably between individuals and using theory in a "one size fits all approach" might be a too limited approach.

Educational scientists express worries that game-based learning may be fun to play, but run the risk of being a hit-or miss when it comes to educational goals and outcomes.

On the other hand, game-designers argue that the lack of understanding of the culture, art and science of games by academics, creates a hit-or-miss situation in regard to playability and outcomes of game-based learning strategies [61,62]. Although the idea of using game-based learning for medical education seems attractive, the dearth of quality research makes it too complex to provide informed decision on when, how and for whom GBL should be implemented. With this thesis, I attempt to merge educational science and game science, to come to a more fundamental understanding of the role of "game-based" in "game-based learning". The benefit of such an approach is that it can greatly facilitate investigations into how and under what circumstances games (or game-elements) can help (future) health care professionals thrive in their learning quests.

The personal preference in play for personalized education

One of the first and most fundamental questions we should ask is perhaps: why do people play? Is it merely because play, and by extension games, are fun? Surely games can also be frustrating or even cause pain [25,29,30]. There are heaps of games available, and what is a fun or a favourite game for one, can be boring for the other [63]. Indeed, playfulness seems to be an individual predisposition [64]. Findings show that games and game-elements can motivate some players/learners but demotivate others [65–67]. Hence, game-preference might be a crucial element for the motivation to continue play for an individual [68–71]. If this is really the case, how can we design GBL if everybody likes play differently?

If GBL intends to motivate learners towards a certain behaviour using game-elements (with the aim to ultimately increase learning) we need to understand how users differ from one another in being motivated for and liking those game-elements. In this way, we may motivate each student (or student group) optimally and avert possible discouragement in others. Therefore, being able to articulate and cluster personal play preferences that motivate students could provide the foundation for a conceptual framework that can guide future GBL design. Such an approach will provide the means to explore and quantify how motivations of play relate to e.g. age, gender and study direction. These findings could highlight or even predict optimal GBL designs for specific studies and might help future educators understand whether researched GBL-design are applicable for their specific learning situation.

Outline of this thesis

From the introduction provided above it becomes clear that medical education is changing at a rapid pace. Pedagogical changes and digitalization in times of change do not always lead to desired learning behaviour. GBL could help resolve these issues, but

research seem to be in rudimentary state especially regarding theoretical background and conceptual knowledge. Motivation to (continue) play seem to be based on play preferences of an individual. Although this liking is possibly vital for the design of GBL-strategies - since this might ensure (continued) use/learning - whether such preferences exist (and what these preferences are) have not been thoroughly investigated yet. This thesis therefore aims to provide the start of a conceptual understanding of personal preferences in play in medical education. Such an understanding could guide future studies and future game-based designs to design their learning strategies in an optimal and scientific manner.

This thesis provides studies that continue to build upon each other. First, in **Chapter 2** (The Opening Act[5]), we examined the current state of gamification research. The highest quality of evidence that can be obtained for a comprehensive understanding of the use and applicability of GBL is a systematic review. Problematic in current reviews (and many GBL studies [72–78]) is the vocabular confusion in the used terminology of serious games, gamification, simulations and play [46]. Researchers and readers might not agree to what strategy is used or might think of another strategy than assumed. This leads to difficult/erroneous conclusions to which strategy is best suited for a learning situation. We therefore aimed to elucidate the confusion between serious games, gamification and simulations. After this, we reviewed the current literature (and checked the quality of the studies) on how developers implemented gamification in medical education and what types of design/game-elements seem to increase attitudes/behaviour/learning in which learning situation (e.g. digital or analogue). Lastly, we systematically investigated whether researchers used a theoretical or conceptual framework that could clarify why gamification should work. Due to the level of complexity, the great variety in different types of GBL-design and lack of conceptual knowledge and high-quality evidence, we took inspiration from play research as a first step towards a conceptual framework to help design future GBL strategies. In **Chapter 3** (The Second Act) we aimed to articulate play preferences by exploring medical and dentistry students' perceptions of what constitutes play, examining what a play-learning interaction meant to students, and how and when GBL material should be designed and implemented in health professions education to foster their learning.

After noticing recurrent themes in game-preferences, we aimed to investigate whether patterns in play preferences could be identified and what the most important play preferences are according to medical students in **Chapter 4** (The Headliner[6]). To investigate whether patterns in play preferences can be generalized to a larger population

5 The Opening Act is an entertainment act that is performed (at a concert) before the "headliner".
6 The Headliner is the main act in a theatre, music, or comedy performance.

we performed the study in **Chapter 5** (The Last Act). We explored whether patterns in play preferences can be found in national cohort of Dutch medical students and investigated whether variables (e.g. age, study, gender) could explain (or foretell) possible preferences for play in such a way that it could aid future GBL-designers in the construction of their GBL-strategy in a scientific way.

In **Chapter 6** (The Final Scene), the general discussion, we provide a summary of our findings and their implications for medical education are discussed.

References

1. Huizinga J. *Homo Ludens: A Study of the Play-Element in Culture*.; 1938. doi:10.4324/9781315824161
2. Proyer RT, Tandler N, Brauer K. Playfulness and creativity : A selective review. In: *Creativity and Humor*. ; 2018. doi:10.1016/B978-0-12-813802-1.00002-8
3. Jones R, Higgs R, De Angelis C, Prideaux D. Changing face of medical curricula. *Lancet*. Published online 2001. doi:10.1016/S0140-6736(00)04134-9
4. Berkhout JJ, Helmich E, Teunissen PW, van der Vleuten CPM, Jaarsma ADC. Context matters when striving to promote active and lifelong learning in medical education. *Med Educ*. Published online 2018. doi:10.1111/medu.13463
5. Petrucci AM, Kaneva P, Lebedeva E, Feldman LS, Fried GM, Vassiliou MC. You have a message! Social networking as a motivator for FLS training. *J Surg Educ*. 2015;72(3):542-548. doi:10.1016/j.jsurg.2014.10.007
6. Jones R, Higgs R, De Angelis C, Prideaux D. Changing face of medical curricula. *Lancet*. 2001;357(9257):699-703. doi:10.1016/S0140-6736(00)04134-9
7. Ross RH, Fineberg H V. Medical students' evaluations of curriculum innovations at ten north american medical schools. *Acad Med*. Published online 1998. doi:10.1097/00001888-199803000-00013
8. Rose S. Medical Student Education in the Time of COVID-19. *JAMA - J Am Med Assoc*. Published online 2020. doi:10.1001/jama.2020.5227
9. Ruiz JG, Mintzer MJ, Leipzig RM. The impact of e-learning in medical education. *Acad Med*. Published online 2006. doi:10.1097/00001888-200603000-00002
10. Prensky M. H. sapiens digital: From digital immigrants and digital natives to digital wisdom. *Innov J Online Educ*. Published online 2009.
11. Crisp N, Gawanas B, Sharp I. Training the health workforce: scaling up, saving lives. *Lancet*. 2008;371(9613):689-691. doi:10.1016/S0140-6736(08)60309-8
12. Chang L, Petros J, Hess DT, Rotondi C, Babineau TJ. Integrating simulation into a surgical residency program: Is voluntary participation effective? *Surg Endosc Other Interv Tech*. Published online 2007. doi:10.1007/s00464-006-9051-5
13. Parker a. Identifying predictors of academic persistence in distance education. *United States Distance Learn Assoc J*. Published online 2003.
14. Clark D. Psychological myths in e-learning. *Med Teach*. Published online 2002. doi:10.1080/0142159021000063916
15. Pierrakeas C, Xenos M, Panagiotakopoulos C, Vergidis D. A comparative study of dropout rates and causes for two different distance education courses. *Int Rev Res Open Distance Learn*. Published online 2004. doi:10.19173/irrodl.v5i2.183
16. Landers RN. Developing a Theory of Gamified Learning: Linking Serious Games and Gamification of Learning. *Simul Gaming*. Published online 2014. doi:10.1177/1046878114563660
17. Yammine K. The Current Status of Anatomy Knowledge: Where Are We Now? Where Do We Need to Go and How Do We Get There? *Teach Learn Med*. Published online 2014. doi:10.1080/10401334.2014.883985

18. Fitzgerald JEF, White MJ, Tang SW, Maxwell-Armstrong CA, James DK. Are we teaching sufficient anatomy at medical school? The opinions of newly qualified doctors. *Clin Anat*. Published online 2008. doi:10.1002/ca.20662
19. Sugand K, Abrahams P, Khurana A. The anatomy of anatomy: A review for its modernization. *Anat Sci Educ*. Published online 2010. doi:10.1002/ase.139
20. Sharma G, Aycart MA, Najjar PA, et al. A cadaveric procedural anatomy course enhances operative competence. *J Surg Res*. Published online 2016. doi:10.1016/j.jss.2015.09.037
21. Doughty CB, Kessler DO, Zuckerbraun NS, et al. Simulation in pediatric emergency medicine fellowships. *Pediatrics*. Published online 2015. doi:10.1542/peds.2014-4158
22. Blackmore C, Austin J, Lopushinsky SR, Donnon T. Effects of Postgraduate Medical Education "Boot Camps" on Clinical Skills, Knowledge, and Confidence: A Meta-Analysis. *J Grad Med Educ*. Published online 2014. doi:10.4300/jgme-d-13-00373.1
23. Van Dongen KW, Van Der Wal WA, Rinkes IHMB, Schijven MP, Broeders IAMJ. Virtual reality training for endoscopic surgery: Voluntary or obligatory? *Surg Endosc Other Interv Tech*. Published online 2008. doi:10.1007/s00464-007-9456-9
24. Lujan HL, DiCarlo SE. Too much teaching, not enough learning: What is the solution? *Am J Physiol - Adv Physiol Educ*. Published online 2006. doi:10.1152/advan.00061.2005
25. McDougall A. When I say … gamification. *Med Educ*. Published online 2018. doi:10.1111/medu.13481
26. Susi T, Johannesson M, Backlund P. Serious Games – An Overview. *Tech Rep HS- IKI -TR-07-001, Sch Humanit Informatics, Univ Skövde, Sweden*. 2007;73(10):28. doi:10.1.1.105.7828
27. Deterding S, Dixon D, Khaled R, Nacke L. From game design elements to gamefulness: Defining gamification. *Proc 15th Int Acad MindTrek Conf Envisioning Futur Media Environ - MindTrek '11*. Published online 2011:9-11. doi:10.1145/2181037.2181040
28. Raessens J. The Ludification of Culture. In: *Rethinking Gamification*. ; 2014.
29. McGonigal J. *Reality Is Broken: Why Games Make Us Better and How They Can Change the World*. Penguin Press; 2011.
30. J. McGonigal. Jane McGonigal: Gaming can make a better world | TED Talk | TED.com.
31. Tesla's new Boombox feature will let car owners fart at unsuspecting neighbors - The Verge. Accessed December 22, 2021. https://www.theverge.com/2020/12/25/22199963/tesla-holiday-update-fart-sound-horn-goat-boombox
32. D'Angour A. Plato and Play: Taking Education Seriously in Ancient Greece. *Am J Play*. Published online 2013.
33. Wilkinson P. Brief history of serious games. In: *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. ; 2016. doi:10.1007/978-3-319-46152-6_2
34. Cohen D. *The Development of Play: Third Edition*.; 2006. doi:10.4324/9780203634295
35. Smith PK, Dutton S. Play and Training in Direct and Innovative Problem Solving. *Child Dev*. Published online 1979. doi:10.2307/1128950
36. Pellegrini AD, Gustafson K. Boys' and Girls' Uses of Objects for Exploration, Play, and Tools in Early Childhood. In: *The Nature of Play: Great Apes and Humans*. ; 2004.

37. Dansky JL. Make-Believe: A Mediator of the Relationship between Play and Associative Fluency. *Child Dev*. Published online 1980. doi:10.2307/1129296
38. Lieberman JN. *PLayfulness. Its Relationship to Imagination Akd Creativity*.; 1977. doi:10.1037/h0071291
39. Whitebread D, Coltman P, Jameson H, Lander R. Play, cognition and self-regulation: What exactly are children learning when they learn through play? *Educ Child Psychol*. Published online 2009.
40. Caillois R. *Man , Play , and Games*.; 1961.
41. Suits B. *The Grasshopper: Games, Life and Utopia, Bernard Suits*.; 1978. doi:10.1073/pnas.0703993104
42. Sutton-Smith B. *The Ambiguity of Play*. Harvard University Press; 2001.
43. De Koven B. *The Well-Played Game*.; 1978. doi:10.7551/mitpress/9722.001.0001
44. Eberle SG. The Elements of Play Toward a Philosophy and a Definition of Play. *Am J Play*. Published online 2014.
45. MacLean M, Russell W, Ryall E. *Philosophical Perspectives on Play*.; 2015. doi:10.4324/9781315732213
46. van Gaalen AEJ, Brouwer J, Schönrock-Adema J, Bouwkamp-Timmer T, Jaarsma ADC, Georgiadis JR. Gamification of health professions education: a systematic review. *Adv Heal Sci Educ*. Published online 2020. doi:10.1007/s10459-020-10000-3
47. Nah FFH, Zeng Q, Telaprolu VR, Ayyappa AP, Eschenbrenner B. Gamification of education: A review of literature. In: *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. ; 2014. doi:10.1007/978-3-319-07293-7_39
48. Caponetto I, Earp J, Ott M. Gamification and education: A literature review. In: *Proceedings of the European Conference on Games-Based Learning*. ; 2014.
49. Dicheva D, Dichev C, Agre G, Angelova G. Gamification in education: A systematic mapping study. *Educ Technol Soc*. Published online 2015.
50. Dichev C, Dicheva D. Gamifying education: what is known, what is believed and what remains uncertain: a critical review. *Int J Educ Technol High Educ*. Published online 2017. doi:10.1186/s41239-017-0042-5
51. De Sousa Borges S, Durelli VHS, Reis HM, Isotani S. A systematic mapping on gamification applied to education. In: *Proceedings of the ACM Symposium on Applied Computing*. ; 2014. doi:10.1145/2554850.2554956
52. Subhash S, Cudney EA. Gamified learning in higher education: A systematic review of the literature. *Comput Human Behav*. Published online 2018. doi:10.1016/j.chb.2018.05.028
53. Bedwell WL, Pavlas D, Heyne K, Lazzara EH, Salas E. Toward a taxonomy linking game attributes to learning: An empirical study. *Simul Gaming*. Published online 2012. doi:10.1177/1046878112439444
54. Landers RN, Bauer KN, Callan RC, Armstrong MB. Psychological theory and the gamification of learning. In: *Gamification in Education and Business*. ; 2015:165-186. doi:10.1007/978-3-319-10208-5_9
55. Hanus MD, Fox J. Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Comput Educ*. 2015;80:152-161. doi:10.1016/j.compedu.2014.08.019
56. Abt, Clark C. Serious Games. New York: Viking, 1970, 176 pp., $5.95, L.C. 79-83234. *Am Behav Sci*. Published online 1970. doi:10.1177/000276427001400113
57. Connolly TM, Boyle EA, MacArthur E, Hainey T, Boyle JM. A systematic literature review of empirical evidence on computer games and serious games. *Comput Educ*. Published online 2012. doi:10.1016/j.

compedu.2012.03.004

58. Gorbanev I, Agudelo-Londono S, Gonzalez RA, et al. A systematic review of serious games in medical education: quality of evidence and pedagogical strategy. *Med Educ Online*. 2018;23(1):1438718. doi:10.1080/10872981.2018.1438718
59. Krath J, Schürmann L, von Korflesch HFO. Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning. *Comput Human Behav*. Published online 2021. doi:10.1016/j.chb.2021.106963
60. Ravyse WS, Seugnet Blignaut A, Leendertz V, Woolner A. Success factors for serious games to enhance learning: a systematic review. *Virtual Real*. Published online 2017. doi:10.1007/s10055-016-0298-4
61. Van Eck R. Digital Game-Based Learning : It ' s Not Just the Digital Natives Who Are Restless …. *Educ Rev*. Published online 2006. doi:10.1145/950566.950596
62. Papert S. Does Easy Do It? Children, Games, and Learning. *Game Dev*. Published online 1998:88.
63. Women Prefer Candy Crush While Men Love PUBG, Suggests Report. Accessed December 10, 2021. https://fossbytes.com/women-prefer-candy-crush-while-men-love-pubg-report/
64. Glynn MA, Webster J. The Adult Playfulness Scale: An Initial Assessment. *Psychol Rep*. Published online 1992. doi:10.2466/pr0.1992.71.1.83
65. Monterrat B, Lavoué É, George S. Adaptation of Gaming Features for Motivating Learners. *Simul Gaming*. Published online 2017. doi:10.1177/1046878117712632
66. Harviainen J. Critical challenges to gamifying education: A review of central concept. In: *Proceedings of the Game On! Conference.* ; 2014.
67. Burgers C, Eden A, Van Engelenburg MD, Buningh S. How feedback boosts motivation and play in a brain-training game. *Comput Human Behav*. Published online 2015. doi:10.1016/j.chb.2015.01.038
68. Chen C-Y, Chang S-L. An Exploration of the Tendency to Online Game Addiction Due to User's Liking of Design Features. *Asian J Heal Inf Sci*. Published online 2008.
69. Robinson MJF, Fischer AM, Ahuja A, Lesser EN, Maniates H. Roles of "wanting" and "liking" in motivating behavior: Gambling, food, and drug addictions. *Curr Top Behav Neurosci*. Published online 2016. doi:10.1007/7854_2015_387
70. Yee N. Motivations of Play in Online Games. *J CyberPsychology Behav*. 2007;9:772-775. doi:10.1089/cpb.2006.9.772
71. Bartle R. Hearts, clubs, diamonds, spades: Players who suit MUDs. *J MUD Res*. 1996;1:1-22.
72. Lim ECH, Seet RCS. Using an online neurological localisation game. *Med Educ*. Published online 2008. doi:10.1111/j.1365-2923.2008.03188.x
73. Chen AMH, Kiersma ME, Yehle KS, Plake KS. Impact of the Geriatric Medication Game® on nursing students' empathy and attitudes toward older adults. *Nurse Educ Today*. 2015;35(1):38-43. doi:10.1016/j.nedt.2014.05.005
74. Chan WY, Qin J, Chui YP, Heng PA. A serious game for learning ultrasound-guided needle placement skills. *IEEE Trans Inf Technol Biomed*. Published online 2012. doi:10.1109/TITB.2012.2204406
75. Amer RS, Denehy GE, Cobb DS, Dawson D V, Cunningham-Ford MA, Bergeron C. Development and evaluation of an interactive dental video game to teach dentin bonding. *J Dent Educ*. 2011;75(6):823-831.
76. Frederick HJ, Corvetto MA, Hobbs GW, Taekman J. The "Simulation Roulette" game. *Simul Healthc*.

2011;6(4):244-249. doi:10.1097/SIH.0b013e31820e0094

77. Gerard JM, Scalzo AJ, Borgman MA, et al. Validity Evidence for a Serious Game to Assess Performance on Critical Pediatric Emergency Medicine Scenarios. *Simul Healthc*. Published online January 2018. doi:10.1097/SIH.0000000000000283

78. Stanley D, Latimer K. "The Ward": a simulation game for nursing students. *Nurse Educ Pract*. 2011;11(1):20-25. doi:10.1016/j.nepr.2010.05.010

We stand upon the precipice of change. The world fears the inevitable plummet into the abyss. Watch for that moment... and when it comes, do not hesitate to leap. It is only when you fall that you learn whether you can fly.

~ Flemeth; Dragon Age II. 2011.

2

The Opening Act

Gamification of Health Professions Education: A Systematic Review

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Abstract

Gamification refers to using game attributes in a non-gaming context. Health professions educators increasingly turn to gamification to optimize students' learning outcomes. However, little is known about the concept of gamification and its possible working mechanisms. This review focused on empirical evidence for the effectiveness of gamification approaches and theoretical rationales for applying the chosen game attributes. We systematically searched multiple databases, and included all empirical studies evaluating the use of game attributes in health professions education. Of 5044 articles initially identified, 44 met the inclusion criteria. Negative outcomes for using gamification were not reported. Almost all studies included assessment attributes (n=40), mostly in combination with conflict/challenge attributes (n=27). Eight studies revealed that this specific combination had increased the use of the learning material, sometimes leading to improved learning outcomes. A relatively small number of studies was performed to explain mechanisms underlying the use of game attributes (n=7). Our findings suggest that it is possible to improve learning outcomes in health professions education by using gamification, especially when employing game attributes that improve learning behaviours and attitudes towards learning. However, most studies lacked well-defined control groups and did not apply and/or report theory to understand underlying processes. Future research should clarify mechanisms underlying gamified educational interventions and explore theories that could explain the effects of these interventions on learning outcomes, using well-defined control groups, in a longitudinal way. In doing so, we can build on existing theories and gain a practical and comprehensive understanding of how to select the right game elements for the right educational context and the right type of student.

Introduction

Gamification is rapidly becoming a trend in health professions education. This is at least suggested by the number of peer-reviewed scientific publications on gamification in this field, which has increased almost tenfold over the past five years. At the same time, there seems to be little shared understanding of what constitutes gamification and how this concept differs from other, related concepts. Furthermore, according to business and education literature, there is still no clear understanding of when and why gamification can be an appropriate learning and instructional tool [1,2]. The purpose of this systematic review was to provide a comprehensive overview of the use and effectiveness of gamification in health professions education and to add to the existing research on gamification in several ways. To this end, we first clearly and carefully distinguished gamification studies from studies investigating other types of game-based learning. Then, we summarized the contexts in which the gamification interventions took place and their underlying theories. Finally, we analysed the effects of individual game elements by using a conceptual framework that was originally developed by Landers et al. to structure game elements in other, non-educational domains [3].

What is (or is not) gamification?

The use of game design elements to enhance academic performance (e.g., learning attitudes, learning behaviours and learning outcomes) is known as gamification or 'gamified learning' [4]. Due to the rapidly growing body of information and proliferation of different types of game-based learning (e.g. serious games), authors tend to use different terms for the same concept, or the same term for different concepts (for examples see (Amer et al., 2011; Borro-Escribano et al., 2013; Chan et al., 2012; Chen et al., 2015; Frederick et al., 2011; Gerard et al., 2018; Lim et al., 2008; Stanley et al., 2011; Webb et al., 2017)). In part, this indiscriminate use of terms may be caused by the fact that in the literature of play and gaming there is neither consensus on what a 'game' is conceptually [14–20], nor on what the essential elements of a game are [21,22].

Since there was a lack of uniformity in the definitions of the main forms of game-based learning – gamification, serious games, and simulations – we chose well-known, academically accepted definitions to distinguish among the three concepts that guided the search strategy and enabled selection of articles relevant for this systematic review. First, although various definitions of *gamification* can be found in various fields of literature such as business, education and information technology [23–39], a commonly applied definition is that of Deterding et al. [2,4,40–44]. He and his colleagues define gamification as the use of game elements (e.g. points, leader boards, prizes) in non-gaming contexts (Deterding et al., 2011). This implies that, even though game elements are used in a certain context (such as education), there should be *no intention of creating a game.*

Second, this intention is different from the intention in serious games, which are defined as *games* (in their various forms) in which education is the primary goal, rather than entertainment [45]. Serious games address real-world topics in a gameplay context. In contrast to gamification, serious game designers' *intention is to create a game*. Therefore, the characteristic difference between gamification and serious games lies in their design intention. Third, a simulation can be defined as a situation in which a particular set of conditions is created artificially in order to study or experience something that could exist in reality [46]. Simulations provide instant feedback on performance, which is delivered as accurate and realistic as possible in a safe environment [47,48]. Simulations do not need game elements like a scoring system and a win/lose condition. However, game-design techniques and solutions can be employed to create the simulated reality and the experience of something real [48,49]. Simulations are therefore best seen as learning activities that necessarily carry some game intention, but do not use game elements. By explicitly adding the designers' intentions to the chosen definitions for these three types of game-based learning, we established criteria for distinguishing between them and guiding study inclusion and analysis in this systematic review.

Game elements and game attributes

In academic literature, various game elements have been proposed to improve the learning experience in gamification, e.g. rewards, leader boards and social elements [50,51]. In addition, grey literature also lists vast amounts of different types of game elements (Marczewski, 2017), which – though lacking an academic framework or basis – have been used in previous research [52]. Different terminology is used for the same type of game-elements; for example, badges [53], donuts [54] and iPads (Kerfoot et al., 2014a) are all types of rewards. In a recent systematic review on serious games (and gamification), Gorbanev et al. ascertained a lack of consensus regarding terminology used in games and welcomed any effort to reduce this terminological variety [56]. Therefore, to make the results of gamification research in health professions education more comprehensive and transferable with regard to the game elements involved, we applied a conceptual framework of aggregated game elements that was originally proposed by Bedwell et al. and Wilson et al. [22,57], and later modified by Landers [3]. This framework posits that all existing game elements can be described and structured into nine attributes, while avoiding significant overlap between these attributes [22]. The following game attributes are included in the framework: action language, assessment, conflict/challenge, control, environment, game fiction, human interaction, immersion and rule/goals. Instead of only focusing on specific game elements, we chose to use this framework to identify whether there is a *class* of game elements that hold the highest promise of improving health professions education. In doing so, we added a new perspective to existing reviews on gamification in higher [2,32,58–62] and health professions education [63,64]. In addition, we attempted to uncover the theory underpinning the gamified interventions

reported in this systematic review. In doing so, we responded to the call for more theory-driven medical education research (Bligh et al., 1999; Bligh et al., 2002; Cook et al., 2008), which we felt should also apply to research on game-based learning in general and gamification in particular [32,58,59,62–64].

This study, therefore, was intended to contribute to the literature (including existing systematic reviews) in several ways: (1) by creating a sharper distinction between gamification and other forms of game-based learning; (2) by using a more generic way to structure game elements; and (3) by responding to the call for more theory-driven medical education research.

In sum, this systematic review aimed to provide teachers and researchers with a comprehensive overview of the current state of gamification in health professions education, with a particular focus on the effects of gamification elements on learning, the underlying mechanisms and considerations for future research.

We formulated five principal research questions that guided this systematic review:

1. What are the contexts in which game elements are used in health sciences education?
2. What game elements are tested and what attributes do they represent?
3. Is there empirical evidence for the effectiveness of gamified learning in health professions education?
4. What is the quality of existing research on gamified learning in health professions education?
5. What is the theoretical rationale for implementing gamified learning in health professions education?

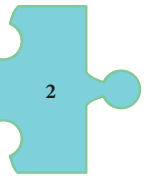
Methods

We conducted a systematic review in accordance with the guidelines of the Associations for Medical Education in Europe (AMEE) [68].

Search strategy

We systematically searched the literature for publications on the use of game elements in health professions education. First, we consulted two information specialists with expertise in systematic reviews to assist in developing the search strategy. Together, we identified keywords, key phrases, synonyms and alternative keywords for gamification as well as game elements and attributes that were derived from a list of 52 game elements and Landers' framework. Some of the 52 game elements and attributes were omitted from the search as they were too broad and generated a huge amount of hits (e.g., 'environment',

'scarcity', 'consequences'), irrelevant hits or as they did not generate any hits (e.g. 'Easter eggs'). Based on these main keywords we formulated the search strategy for PubMed.



The first author (AvG) translated the PubMed search strategy for use in other databases and then systematically searched eight databases: Academic Search Premier; CINAHL; EMBASE; ERIC; Psychology and Behavior Sciences Collection; PsychINFO, PubMed and the Cochrane Library. The search was performed in April 2018. We used the following search terms: (gamif* OR gameplay* OR game OR games OR gamelike OR gamebased OR gaming OR videogam* OR edugam* OR flow-theor* OR "social network*" OR scoreboard* OR leveling OR levelling OR contest OR contests OR badgification) AND (medical educat* OR medical train* OR medical field training OR medical school* OR medical Intern* OR medical residen* OR medical student* OR dental student* OR nursing student* OR pharmacy student* OR veterinary student* OR clinical education* OR clinical train* OR clinical Intern* OR clinical residen* OR clinical clerk* OR teaching round* OR dental education* OR pharmacy education* OR pharmacy residen* OR nursing education* OR paramedics education* OR paramedic education* OR paramedical education* OR physiotherapy education* OR physiotherapist education* OR emergency medical services educat* OR curricul* OR veterinary education OR allied health personnel)

Inclusion criteria

We included peer-reviewed journal articles on the use of gamification or game elements in education for (future) health professionals. We defined health professionals as individuals oriented towards providing curative, preventive and rehabilitative health care for humans as well as animals (e.g. individuals working in the fields of medicine, nursery, pharmacology and veterinary medicine). Real-life contexts (e.g. lectures and practicals) as well as digital contexts (e.g. mobile applications or computer software) were eligible for inclusion if they incorporated gamified learning to improve (future) health professionals' (bio)medical knowledge or skills. We included quantitative as well as mixed-method studies.

Exclusion criteria

We excluded articles that (a) only described the development of gamified learning activities in educational contexts without reporting the effects of their interventions, (b) only focused on qualitative data, (c) focused on serious games, (d) focused on patient education, (e) focused on simulations, except when the focus was on the effects of gamification in simulations (gamified simulations), (f) described adapted environments such as game-shows (e.g., "jeopardy" or "who wants to be a millionaire") and board-games (e.g., "monopoly" or "trivial pursuit") which we considered to be game contexts, and (g) were not written in Dutch or English.

Although the term "gamification" has been used since 2008 (Deterding et al., 2011; Szyma, 2014), we did not set a timeframe for our search since individual game elements were used in a non-game context long before the term "gamification" was coined and appeared in scientific literature.

Study selection

After retrieving the search results from different databases, AvG removed the duplicates and uploaded the remaining articles to Rayyan, a mobile and web-based application developed for systematic reviews [70]. Then, AvG and JB independently screened all titles and abstracts for preliminary eligibility. In case of uncertainty, the articles in question were retained. Subsequently, AvG read the full text of all retained articles to determine eligibility for inclusion in this systematic review. In case of uncertainty, articles were marked for discussion and independently screened by all researchers. To ensure consistency in the application of selection criteria, we undertook double screening on a 10% random sample of the excluded articles as a form of triangulation. The researchers met at a regular basis to discuss challenges, uncertainties and conflicts with respect to article selection. Disagreement between researchers was resolved by discussion.
In addition, we hand-searched the reference lists of included articles and citations for additional articles.

Data extraction and quality assessment processes

We extracted the following data from the included articles using the extraction methods described in the AMEE guideline [68]:

1. General information (e.g., author, title and publication year), participant characteristics (including demographics and sample size) and characteristics of the educational content (including topic and the context in which the topic is presented, e.g. digital or analogue and type of study or profession);
2. Intervention (type of game element(s) and game attributes used);
3. Study outcomes (including satisfaction, attitudes, perceptions, opinions, knowledge, behaviour and patient outcomes);
4. Study quality (see below);
5. Theoretical frameworks used to design or evaluate gamified educational programs.

We used the Medical Education Research Study Quality Instrument (MERSQI) to measure the methodological quality of the selected studies [71]. MERSQI is designed for measuring the quality of experimental, quasi-experimental and observational studies and consists of ten items covering six domains (study design, sampling, type of data, validity of evaluation instrument, data analysis, and outcomes). The maximum score for each domain is three. Five domains have a minimum score of one, resulting in a range of 5–18 points. We calculated individual total MERSQI scores, mean scores and standard deviations.

To provide a clear overview of the current state of studies on gamification in health sciences education, we used the framework for classifying the purposes of research in medical education proposed by Cook et al. [67]. They distinguished studies as focusing on description, justification and clarification. Description studies make no comparison, focus on observation and describe what was done. Justification studies make comparisons between interventions, generally lack or do not present a conceptual framework or a predictive model and describe whether the new intervention worked. Clarification studies apply a theoretical framework to understand and possibly explain the processes underlying the observed effects, describe why and how interventions (i.e. gamification) work and illuminate paths of future directions [67].

We classified all included studies as descriptive, justification or clarification.

Results

The study selection process is shown in Figure 1. Our search identified 5044 articles, of which 38 met the inclusion criteria on the basis of full-text screening. Uncertainty about inclusion or exclusion of 20 other articles (Bigdeli et al., 2017; Boysen et al., 2016; Campbell, 1967; Courtier et al., 2016; Creutzfel dt et al., 2013; Dankbaar et al., 2016, 2017; Hudon et al., 2016; Inangil, 2017; Kaylor, 2016; Leach et al., 2016; Lim et al., 2008; Mishori et al., 2017; Montrezor, 2016; Patton et al., 2016; Richey Smith et al., 2016; Sabri et al., 2010) were resolved by consensus discussion among all members of the research team, which yielded three additional studies. Of the 17 studies excluded in this step, one was excluded because no consensus could be reached [89], the others did not meet the inclusion criteria. Hand search of references and citations yielded three additional studies. A total of 44 studies were eligible for inclusion in our systematic review (Table 2).

As a form of triangulation and to assess the level of agreement between the researchers, a random sample of 10% of the excluded articles was double screened by the other members of the team. The overall agreement between JB, JSA, DJ and JRG was 94%. The disagreements about the remaining 6% were resolved by discussion, which led to the conclusion that all studies in the sample had rightly been excluded from the review.

Educational context & student characteristics

The majority of the studies were conducted in the USA (n=20) or Canada (n=8). Most studies involved undergraduate (n=15) and postgraduate medical students (e.g. residency) (n=15), followed by nursing (n=7), dental (n=1), pharmacy (n=1), osteopathic (n=1), allied health (n=1), speech language and hearing pathology students (n=1) or a mix of students of different professional courses (n=3) (Table 2). From the gamification

studies in post-graduate medical education, the number of studies in surgical specialties (n=6) equalled the number of studies in other medical specialties (n=6). Compared to analogue gamified learning activities (n=14), twice as many digital learning activities (n=28) were identified. An example of gamification in a digital environment was a web-based platform where gamification elements were inspired by the Tetris game [90]. The goal of that pilot study was to collect validity evidence for a gaming platform as training and assessment tool for surgical decision making of general residents. An example of an analogue gamified learning activity was the use of a board game for undergraduate medical students. The game consisted of a board depicting a mitochondrion and cards representing components of the mitochondrial electron transport chain that had to be put in the right order. The goal of that study was to assess the effect of this active learning activity [91].

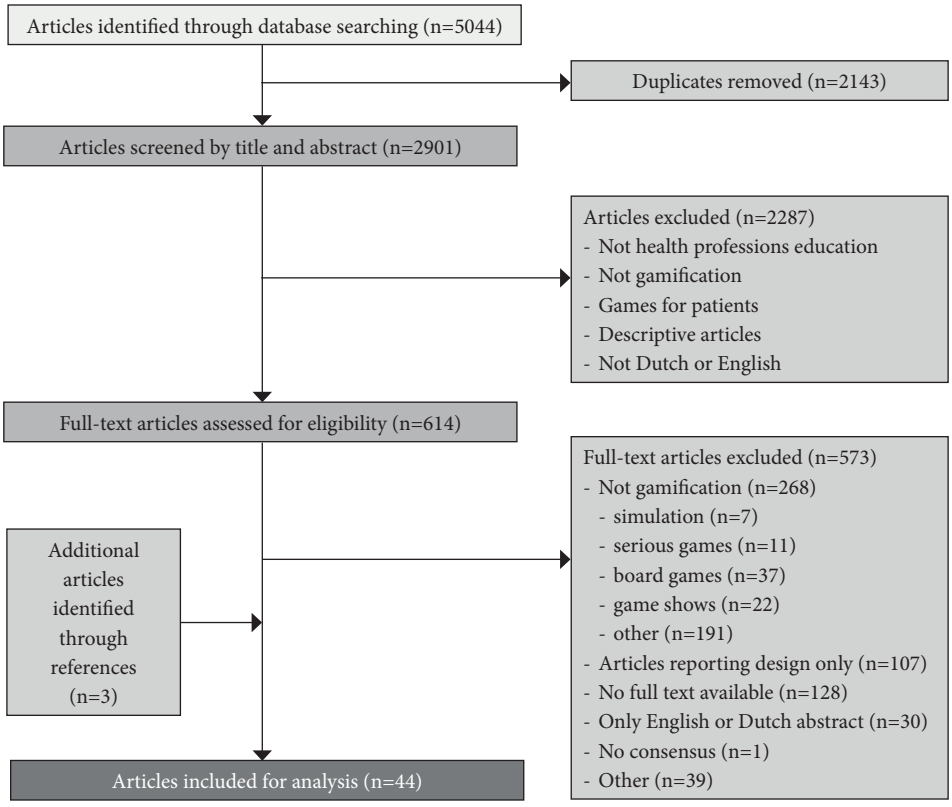


Figure 1. Flow chart of the article selection process.

Table 2. Summary of gamified learning studies, categorized into purpose (description, justification, clarification).

Cat	Source	Population	Game attribute	Game-elements	Learning Focus	MERSQI score	Digital / Analogue	Outcome
D (n=25)	Ballon et al., 2004	Residents (n=173)	Assessment, human Interaction	Puzzle, role play	Psychiatric diagnoses	6	Analogue	It was fun
	Bhaskar, 2014	Medical students (n=?)	Assessment, environment, immersion, rules/goals	Achievements, missions	Blood groups	6	Digital / Analogue	It was fun
	Chia, 2013	Nursing (n=161)	Assessment, conflict/ challenge, rules/goals	Avatars, levels, quiz, rewards, signposting	COPD treatment	7	Digital	Relevant for learning needs
	Davidson et al., 2016	Nursing (n=30)	Assessment, rules/goals	Badges, levelling, quests, scoring	Evidence–based practice learning	7	Digital / Analogue	High engagement and increased knowledge.
	Forni et al., 2017	Medical students (n=118)	Assessment	Puzzle	Biochemistry	6.5	Analogue	High satisfaction
	Henry et al., 2007	Allied health students (n=156)	Human-interaction	Role playing	Attitudes towards aging	13	Analogue	Improved attitudes
	Janssen et al., 2016	Residents (n=35)	Assessment, conflict/ challenge, control	Scoring, competition, spaced-learning	Oncology	11.5	Digital	Overall satisfying and engaging
	Kalin, 2016	Medical students (n=97)	Action language, assessment, conflict/challenge	Scoring, competition	Obstetrics	5	Digital	Students felt prepared
	Kerfoot et al., 2012	Residents (n=931)	Assessment, conflict/ challenge, control	Scoring, competition, spaced learning,	Urology	12.5	Digital	Increased knowledge
	Kow et al., 2016	Medical students (n=221)	Action language, assessment, conflict/challenge	Scoring, competition	Patient safety	11.5	Digital	Helpful learning aid
	Lamb et al., 2017	Residents (n=46)	Assessment, conflict/ challenge, human interaction	Scoring, competition, social network	General surgery learning	9.5	Digital	Increased use, enhanced knowledge
	Leach et al., 2016	Specialists (n=?)	Assessment	Awards	Prescription	8	Analogue	Increased knowledge
	Lin et al, 2015	Medicine (mixed) (n=49)	Assessment, conflict/ challenge, environment, rules/ goals	Levelling, scoring, time	Emergency medicine	7	Digital	Helpful learning aid
	Lobo et al., 2017	Specialists (n=16)	Assessment, conflict/ challenge, human interaction	Scoring, competition, teams	Ultrasound training	7.5	Analogue	Overall satisfaction
	Longmuir, 2013	Medical students (n=106)	Assessment	Scoring	Physiology	9	Digital	High satisfaction
	Mallon et al., 2016	Specialists (n=117)	Assessment, conflict/ challenge, control	Rewards, competition, spaced-learning, teams	Guidelines	8	Digital	Overall satisfaction and increased knowledge

Table 2 CONTINUED.

Cat	Source	Population	Game attribute	Game-elements	Learning Focus	MERSQI score	Digital / Analogue	Outcome
	Nemer et al., 2016	Medical students (n=79)	Assessment, conflict/challenge	Scoring, competition	Gynaecology clerkship preparation	8.5	Analogue	Enjoyable and educational
	Nevin et al., 2014	Residents (n=92)	Assessment, conflict/challenge	Badges, scoring, competition	Internal medicine	13	Digital	Highly engaging, increased knowledge
	Pacala et al., 2006	Medical students (n=1500)	Game-fiction, human interaction	Role playing	Enhancing attitudes towards elderly	6	Analogue	Overall satisfaction
	Pettit et al., 2015	Osteopathic students (n=106)	Assessment, conflict/ challenge, control, human interaction,	Chance, scoring, mystery character, surprise, teams, time	Microbiology learning	7	Digital	Engaging
	Roubidoux et al., 2002	Medical students (n=42)	Assessment, conflict/challenge	Competition, scoring	Breast imaging	7	Digital	Overall satisfaction
	Snyder et al., 2013'	Residents (n=169)	Assessment, conflict/challenge	Rewards, competition, surprise, time	Internal medicine	8	Digital	Overall satisfaction, increased knowledge
	Shah et al., 2010	Pharmacy students (n=172)	Assessment, rules/goals	Crossword puzzle	Pharmaceuticals	7.5	Analogue	Helpful learning aid
	Stanley et al., 2011	Nursery (n=96)	Assessment, game fiction, human interaction, rules/ goals	Scoring, role playing, teams, time	Learning critical thinking	7	Analogue	Enjoyable
	Varkey et al., 2006	Medical students (n=84)	Control, environment, immersion	Role playing	Attitudes towards aging	9	Analogue	Increased attitudes towards aging
J (n=12)	Adami et al., 2014	Medical students (n=260)	Assessment, rules/goals	Crossword puzzle	Resuscitation principles	11	Analogue	Increased knowledge*
	Cook et al., 2012	Nursing (n=34)	Assessment, rules/goals	Scoring, Levelling, time, signposting	Life-support training	13.5	Digital	Enjoying but no difference in outcome*
	Dongen et al., 2008	Residents (n=22)	Action language, assessment, conflict/challenge, environment, immersion	Rewards, scoring, competition	Surgery (simulator)	10	Digital	Increased use
	El-Beheiry et al., 2016	Residents (n=49)	Action language, assessment, conflict/challenge, environment, immersion	Scoring, competition	Surgery (simulator)	13	Digital	Increased use, faster completion time

Table 2 CONTINUED.

Cat	Source	Population	Game attribute	Game-elements	Learning Focus	MERSQI score	Digital / Analogue	Outcome
	Finley et al., 2012	Medical students (n=36)	Assessment, rules/goals	Scoring, levelling	Auscultatory skills	9	Digital	Increased knowledge*
	Kerfoot et al., 2014	Primary care physicians (n=111)	Action language, assessment, conflict/challenge, immersion	Rewards, scoring, competition,	Surgery (simulator)	9.5	Digital	Increased use
	Kerfoot et al., 2014	Residents (n=141)	Assessment, conflict/ challenge, control	Scoring, competition, spaced-learning	Hypertension treatment	17	Digital	Increased use/knowledge, and changed prescription behaviour
	Lameris et al., 2015	Medical students (n=461)	Action language, assessment, conflict/challenge, rules/goals	Avatar, curiosity, rewards, time	Physiology	12	Digital	Increased use, enhanced knowledge*
	Rondon et al., 2013	Speech-Language and Hearing Science (n=29)	Assessment	Rewards	Anatomy & physiology	14.5	Digital	No difference with non-gamified version*
	Petrucci et al., 2015	Residents (n=14)	Conflict/challenge	Competition, progress, social network	Surgery (simulator)	11	Digital	Increased use, no difference in outcome
	Scales et al., 2016	Residents (n=422)	Assessment, conflict/challenge	Game-mechanics, rewards competition	Learning about quality improvement	12.5	Digital	Increased use, enhanced knowledge
	Worm et al., 2014	Medical students (n=121)	Assessment, conflict/challenge	Scoring, competition	Biology	14.5	Digital	Increased use, enhanced knowledge
C (n=7)	Butt et al., 2017	Nursery (n=20)	Assessment, conflict/ challenge, immersion	Scoring, time	Urine catheterization	12	Digital	Highly engaged, no difference in outcome*
	Chen et al., 2017	Medicine (mixed) (n=60)	Assessment, conflict/challenge	Rewards (points and colours), time	Radiology	6	Digital	Helpful learning aid
	el Tantawi et al., 2018	Dentistry (n=98)	Assessment, conflict/ challenge, game fiction, human interaction	Scoring, boss battles, competition, quests, story-telling	Scientific writing	14	Analogue	Modest satisfaction, increased knowledge
	Fleiszer et al., 1997	Medicine (mixed) (n=25)	Assessment	Award, quiz	Critical care surgery	7	Analogue	High satisfaction

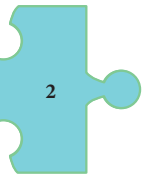
Table 2 CONTINUED.

Cat	Source	Population	Game attribute	Game-elements	Learning Focus	MERSQI score	Digital / Analogue	Outcome
	Koivisto et al., 2014	Nursing (n=166)	Assessment, conflict/challenge	Scoring, competition	Clinical reasoning	11	Digital	Overall satisfaction
	van Nuland et al., 2014	Medical students (n=67)	Assessment, conflict/ challenge, human interaction	Scoring, competition	Anatomy learning	12	Digital	High motivation, increased knowledge
	Verkuyl et al., 2017	Nursery (n=47)	Assessment	Scoring	Paediatric knowledge	15.5	Digital	High satisfaction, increased knowledge*

*Note. The first column (Cat) contains categories for research purpose of gamification studies. Description studies (D) make no comparison, focus on observation and describe what was done. Justification (J) studies make comparisons between interventions, generally lack a conceptual framework or a predictive model and describe whether the new intervention worked. Clarification studies (C) apply a theoretical framework to understand and possibly explain the processes underlying the observed effects, describe why and how interventions (i.e. gamification) work and illuminate paths for future investigation. Question marks in study population indicates unknown or unmentioned number of participants. MERSQI= Medical Education Research Study Quality Instrument, *= confounded comparison group*

Game attributes

We categorized the identified game elements into the game attributes for learning of Landers' framework [3].



In most studies, the game attributes "assessment" (n=40) and/or "conflict/challenge" (n=27) (Table 2) were embedded in the learning environment. Intervention studies with assessment attributes particularly used scoring (n=26) and rewards (n=10). Scoring mostly entailed keeping record of points earned for completing a certain task or answering a question correctly. Rewards varied considerably and included digital trophies, donuts, iPads and money. Intervention studies with the conflict/challenge attribute particularly used competition (n=21).

Combinations of game attributes were most common in our review (n=36). Assessment and conflict/challenge attributes were often applied together (n=24), predominantly in the form of leader boards displaying rank orders of participants, thus enabling comparison of students' achievements. Compared to the other attributes, assessment attributes were more often examined separately (n=6), followed by "conflict/challenge" (n=1) and "human-interaction" (n=1). The other attributes were always studied in combination with other game attributes (Table 2).

Effects of gamified learning interventions

We did not find any negative outcome of the use of gamification in health professions education. All studies reported positive results compared to a control group not using gamification, or similar results for both groups (Table 2).

Multiple studies reported that the (frequently used) combination of assessment and conflict/challenge game attributes could increase the use of gamified learning materials (n= 8), strengthen satisfaction (n=16) or improve learning outcomes (n=11) (Table 2). Whether or not increased use ensured improved learning remained uncertain. For instance, two comparable studies using assessment and conflict/challenge attributes each reported increased use of simulators, but did not investigate or report learning outcomes (Kerfoot et al, 2014a; Van Dongen et al., 2008). Two different studies in which the same gamified elements were used also found that the use of simulators had increased [51,92], but only one study found improved performance [92].

One study focused on the level of health care outcome (Kerfoot et al., 2014b). This randomized controlled trial had the highest MERSQI score and investigated whether gamification in an online learning activity could improve primary care clinicians' hypertension management. The intervention group participated in a gamified, spaced learning activity comprising three game elements: competition, space-learning and

scoring. The control group received the same spaced education through online postings. The gamification intervention was associated with a modest reduction in numbers of days to reach the target blood pressure in a subgroup of already hypertensive patients. That study did not uncover the underlying mechanisms of how gamification supported these positive patient outcomes. A proper theory was also lacking or not presented. Because of the study design, we were not able to disentangle whether competition, spaced learning, scoring, or a combination of them had caused the effect. In fact, adopting and testing a combination of game elements without being able to disentangle their individual effects on learning is a quite general phenomenon in gamification research in health professions education.

Contextual differences and effects of game attributes

We found that certain game attributes were more often applied to a particular context. For instance, a combination of conflict and challenge attributes was relatively more often applied to digital contexts (24 out of 28 digital studies) than to analogue contexts (3 out of 14 analogue studies). A combination of conflict and challenge attributes was also more often chosen by researchers from Europe (6 out of 8 European studies) and the USA (17 out of 21 USA studies) than by researchers from Canada (3 out of 8 Canadian studies). We found differences in use of a combination of conflict and challenge attributes between undergraduate and postgraduate settings (9 out of 15 undergraduate studies and 14 out of 15 postgraduate studies used such a combination). Yet, we could not find a direct indication that the effects of game attributes were dependent on these contextual factors.

Quality of the current gamified learning research

The total MERSQI scores of the 44 studies included in our review ranged between 5 and 17 points (mean 9.8 points, SD 3.1; see Table 2).

Descriptive studies

Most of the included studies (n=25; Table 2) were descriptive in nature in such sense that they focused on observation and described what was done, without using comparison groups. These descriptive studies were typically low in MERSQI scores (mean 8.3, SD 2.3) and only contained post-intervention measurements.

Justification studies

In twelve studies (Table 2), groups involved in gamified learning sessions were compared with control groups to investigate whether gamification enhances learning outcomes. Almost half of these justification studies were confounded in such a way that the outcomes could not be attributed to the gamification intervention under study, because the groups not only differed in treatment, but also with respect to other aspects (Table 2; marked with asterisks). Comparing a group of participants who took part in a gamified learning

activity with a group of participants who did not take part in any learning activity is an example of a confounded comparison [94]. The remaining seven justification studies, which were without confounds, showed an average MERSQI score of 12.5 (SD 2.6), which was the highest study quality in our sample.

Clarification studies

In seven studies, theoretical assumptions were affirmed or refuted, based on the results of the study (Table 2). Three of these studies had a design with a control group (Butt et al., 2018; Van Nuland et al., 2015; Verkuyl et al., 2017b), out of which two were confounded by poor design (Table 2; asterisks). The other four studies did not include control groups. With an average MERSQI score of 11.1 (SD 3.5), the seven clarification studies were of medium quality.

The use of theory

The hallmark of clarification studies is the use of theory to explain the processes that underlie observed effects [67]. In most studies (n=5), multiple game attributes were related to a chosen theory. In three out of the seven clarification studies, the authors referred to Experiential Learning Theory [97–99] and in each of the remaining four studies the authors referred to a different theory: Reinforcement Learning Theory (Chen et al., 2017), Social Comparison Theory (Van Nuland et al., 2015), Self-Directed Learning [54] and Deliberate Practice Theory [96]. Each theory will be discussed briefly below, with specific attention to how these theories can be linked to game elements.

Experiential Learning Theory states that concrete experience provides information that serves as a basis for reflection. After this reflection, learners think of ways to improve themselves and, after this abstract conceptualization, they will try to improve their behaviours accordingly [101,102]. Some researchers assumed that by gamifying their courses, students' experiences and, consequently, their understanding (through reflection and conceptualization) might be enhanced. For instance, dentistry students' experiences of being a part of an exciting narrative in an academic writing course, including game elements like role-playing, feedback, points, badges, leader boards and a clear storyline, were assumed to improve their performance [98].

Self-Directed Learning is the process of diagnosing one's own learning needs, formulating one's own learning goals and planning one's own learning trajectory. The increased autonomy in the pursuit of knowledge is assumed to result in higher motivation [103]. Gamification that was inspired by Self-Directed Learning involved quizzes that were fully developed by small groups of medical students or residents about a self-chosen subject of their surgical intensive care unit rotation, right answers were rewarded with donuts [54].

Deliberate Practice Theory is based on engaging already motivated students to become experts via well-defined goals, real world tasks and immediate and informative feedback [96,104]. Deliberate Practice Theory was applied to develop an educational tool using game-elements (such as points and time constrains) and virtual reality to practice urinary catheterization in nursing education [96].

Two studies stood out for the way in which they used theory to explain the effect of a single game attribute. Van Nuland et al. used social comparison theory to explain the effect of competition (Van Nuland et al., 2015) and Chen et al. used Reinforcement Learning Theory to explain the effect of direct feedback in digital learning (Chen et al., 2017).

According to the Social Comparison Theory, social comparison is a fundamental mechanism for modifying judgment and behaviour through the inner drive individuals have to gain accurate self-evaluations [105,106]. Gamification based on Social Comparison Theory involved the introduction of leader boards. According to Van Nuland et al., improved performance would be achieved by letting students identify discrepancies in their knowledge through upward comparison or validate their assumptions on knowledge through downward comparison (Van Nuland et al., 2015).
Reinforcement Learning Theory relates to a form of behavioural learning that is dependent on rewards and punishments [107]. If a desired behaviour or action is followed by a reward, individuals' tendency to perform that action will increase. Punishment will decrease individuals' tendency to perform that action. The gamification study based on this theory assumed that rewards and punishments (e.g. receiving points or negative, red-coloured responses, respectively) would improve the subjective learning experience and help learners acquire implicit skills in radiology (Chen et al., 2017).

Although different theories predicted the effectiveness of different mechanisms to improve performance, a common assumption seemed to be that the use of game attributes would improve learning outcomes by changing learning behaviours or attitudes towards learning.

Discussion

The purpose of this systematic review was to investigate the current evidence for using gamification in health profession education and understand which mechanism are involved and how they can explain the observed effects.

The majority of the included studies – only quantitative and mixed-methods studies – were performed in medical schools in the USA and Canada, and used digital technologies

to develop and implement gamified teaching and learning. No negative effects of using gamification were observed. Almost all interventions included assessment game attributes, mostly in combination with conflict/challenge attributes. Especially this combination of attributes was found to increase the use of learning materials, sometimes leading to improved learning outcomes. Our review revealed a relatively small number of studies involving high-quality control groups, which limited recommendations for evidence-based teaching practice. In addition, high-quality clarification studies on how underlying mechanisms could explain the observed effects are uncommon in gamified learning research. In most studies, an explicit theory of learning was not presented and an appropriate control group was lacking. Of the few studies that did refer to theory, most researchers essentially proposed that the game element(s) under study would strengthen attitudes or behaviours towards learning, which in turn might positively influence the learning outcomes.

Empirical evidence for using gamification

At first glance, it may seem that improved or unchanged academic performance (e.g. learning behaviours, attitudes towards learning or learning outcomes) can justify the use of gamification in health professions education. However, caution should be taken in drawing strong conclusions, because most studies were descriptive, (confounded) justification or (confounded) clarification studies, or clarification studies that did not include control groups (total n=36). In sum, despite the apparent encouraging early results, it remains unclear whether the reported effects on academic performance can be solely attributed to the gamified interventions due to the absence of (non-confounded) control-groups. The remaining eight studied included in our study were well-controlled studies using assessment and conflict/challenge attributes, so these study results could be interpreted with more confidence. The use of the learning material was increased in all intervention groups compared to their control groups (El-Beheiry et al., 2017; Kerfoot et al., 2014a; Kerfoot et al., 2014b; Petrucci et al., 2015; Scales et al., 2016; Van Dongen et al., 2008; Van Nuland et al., 2015; Worm et al., 2014), often in combination with improved learning outcomes (El-Beheiry et al., 2017; Kerfoot et al., 2014b; Scales et al., 2016; Van Nuland et al., 2015; Worm et al., 2014). Using conflict/challenge and assessment attributes, especially competition and scoring, therefore seemed to positively influence learning. The apparently consistent effect of gamification is promising but also warrants further investigation. First, gamification research is still much in its infancy, it should be recognized that positive results may have been overreported due to a publication bias [110,111] and that negative results remain un- or underreported. Second, so far, mainly small-scale and pilot studies have been conducted, which is not just typical of health professions education but also applies to areas where gamification is already more often used, such as computer sciences [2]. Third, it is important to realise that gamification can also have unexpected or unwanted effects [112]. Competition, which is one of the

most frequently used game elements in this review, is particularly interesting in that regard. In theory, competition can hamper learning by turning projects into a race to the finish line. In this case, participating in a gamified learning activity might diminish learning: winning becomes more important than the internalisation of knowledge and/or skills. This shift in attention from task to competition might, therefore, come at the expense of students' performance and even their intrinsic motivation to learn [113]. For example, in our review, four studies involving simulators showed that competition leads to increased use of the simulators (e.g., for a longer time and more frequently) (El-Beheiry et al., 2017; Kerfoot et al., 2014b; Petrucci et al., 2015; Van Dongen et al., 2008). However, only one of these studies reported improved learning outcomes [92]. That this outcome was not found in the other three studies might be attributed to a shift in attention as explained before. Increased use of learning material generally indicated repetition, which is one of the most powerful variables to affect memory, leading to improved learning outcomes and retention [114–117]. However, as a corollary from using gamification in learning, repetition may become less effective when students' attention shifts from the learning task to, for instance, competition. So even though repetition is vital for knowledge retention, increased repetition of the learning material in gamified interventions might not necessarily benefit learning, especially when students get distracted by game elements. Similarly, shifts of motivation may occur with different game attributes. In interventions applying the game attribute assessment, for example, the elements scoring and rewards are frequently used. However, giving rewards for a previously unrewarded activity can lead to a shift from intrinsic to extrinsic motivation and even loss of interest in the activity when the rewards are no longer given. This is also called the over-justification effect (Deci et al., 2001; Deci et al., 1999; Hanus et al., 2015; Landers et al., 2015; Lepper et al., 1973). In such cases, students' motivation might shift from being internally driven to learn to being externally driven by gamification, possibly ending with amotivation when the gamified activities are over.

We did not find a direct indication that the effects of game attributes were dependent on contextual factors, since all included studies reported positive results. However, we did find that a combination of conflict and challenge attributes was more often used in the context of postgraduate education and in digital modalities. Whether this implies that opting for digital modalities is better suited to postgraduate courses or whether digital modalities are better suited for a combination of conflict and challenge attributes remains uncertain. Future research should investigate whether other game attributes and/or modalities are also applicable to postgraduate students. In addition, researchers might focus on identifying reasons for choosing specific (combinations of) attributes in a specific context.

The use of a conceptual framework

The conceptual framework we used in this study originated from serious games. It

was altered by Landers (2014) for gamification purposes and was now – at least to our knowledge – used for the first time to systematically structure gamification studies. It was not the aim of this study to evaluate this method, however, future researchers may want to re-evaluate before applying it to systematic analyses. Coding was relatively easy which may imply that game-elements are over-generalized. For instance, points, badges, iPads and money are kinds of rewards and, therefore, confirmed as assessment attributes. However, the timing of the rewards (e.g., immediate versus delayed rewards) as well as the context of the rewards (e.g., negative or positive feedback) might have a different impact on the outcomes [122–124]. Consequently, the claim that assessment attributes can increase or improve learning is insufficiently substantiated, or at least incomplete. Besides, some attributes appeared to have much overlap: immersion and environment attributes were almost always implemented in conjunction. This conceptual framework was helpful in guiding our review and interpreting the results, although some work is needed to refine its contents.

Theory-driven gamification

The purpose of theory is to generate hypotheses, predict (learning) outcomes and explain underlying mechanisms. Unfortunately, most identified studies on gamification in health professions education were not based on theory, or theoretical considerations were not included or not yet elaborated. Our review showed that researchers who did use theory hypothesized that effective gamified learning might strengthen students' learning behaviours or positive attitudes towards learning, which in turn might improve their learning outcomes. For instance, in studies referring to ELT [97–99], it was assumed that incorporating gamification into courses could enhance students' experience and, therefore, their reflection on and conceptualization of that experience [101]. For example, El Tantawi et al. (2018) used story-telling and game-terminology (together with other game-elements) to improve students' attitudes towards academic writing. This way, the researchers intended to modify students' perceptions of a task and made it seem like an exciting adventure, with a story built around a fictitious organisation. Next to changing attitudes, the aim of studies that applied theory was also to change behaviours. For example, reinforcement learning theory was applied to increase repetition by reinforcing right answers (Chen et al., 2017). Although all theories we identified in this review were useful in clarifying research findings in the field of gamification of education and learning, it remains difficult to explain on the basis of these theories why specific game attributes or combinations of them should be preferred over others. For instance, Van Nuland et al. (2015) used social comparison theory to develop a digital, competition-based learning environment and explain research outcomes. Social comparison theory poses that individuals compare their performances to those of others to evaluate their abilities and seek self-enhancement [125,126]. Van Nuland et al. (2015) aimed to trigger social comparison in an intervention group by using leader

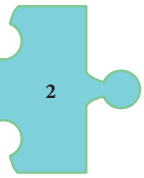
boards with peer-to-peer competition in a tournament environment. They found that the intervention group outperformed their noncompeting peers on the second term test. Here, the use of social comparison theory helped clarify this effect through the *comparative* element underlying the *competitive* features of gamified learning that may have increased participants' motivation to excel. However, because scientific theories are general statements describing or explaining causes or effects of phenomena, it remains unclear which *specific* game element has the highest potential of triggering social comparison and whether competition should be the most viable option. Although the use of leader boards appears to be a valid choice, it can also hamper learning when it (1) shifts attention from learning to competition (see earlier), (2) is not liked by all students and (3) is not the only game attribute that triggers social comparison. Perhaps less competitive game elements (e.g., upgrading avatars, receiving badges, building things) or even different game attributes (e.g., control, game-fiction or human-interaction) could also trigger social comparison.

Theoretical and Practical Implications

Based on the scarcity of high-quality studies on processes underlying the effects of gamified educational interventions, we urgently call for more high-quality clarification research. Clarification studies could provide researchers with an understanding of the mechanisms that are involved in gamified learning (and illuminate paths for future research) [67] and teachers with evidence-based information on how to implement gamification in a meaningful way. Based on our findings, future clarification studies should use and validate existing learning theories in the context of gamification. The theories we identified in this review could, among others, serve as a basis for this research [1,3]. Because theories are general ideas, researchers should focus on (separate) specific game elements to identify the most promising game attributes in relation to a specific theory. Important negative results should be reported as well. In addition, realist evaluation can help provide a deeper understanding by identifying what works for whom, in what circumstances, in what respects and how [127]. The finding that (a combination of) game attributes may enhance learning outcomes by strengthening learning behaviours and attitudes towards learning could be used as a starting point for such an approach.

In addition, we would like to emphasize the need for design-based research using well-defined controlled groups to find out whether gamified interventions work (justification research). Although justification research hardly allows for disentangling underlying processes, there should always be room for innovative ideas and interventions (e.g., applying infrequently used game attributes) to inform future research [67]. Furthermore, design-based research on gamification can shed more light on learning outcomes. For instance, further research could illuminate whether increased repetition results in less

positive learning outcomes when students' attention is distracted from their learning task by one or more game attributes. We would also like to encourage design-based research for interventions that combine different outcome measures, such as learning outcomes and frequency of using gamified educational interventions.



Finally, most studies in this review showed promising results for implementing gamification in health professions education. This opens new ways for educators to carefully experiment with the way they teach and implement gamified learning in their curricula. First, they need to determine whether there are behavioural or attitudinal problems that need attention and can be resolved by integrating game elements into the non-gaming learning environment. Subsequently, they have to determine which game attribute or combination of game attributes and matching game elements may help prevent consolidation of undesirable behaviours and/or attitudes. In this sense, gamification could be seen as an experimental educational tool to resolve behavioural or attitudinal problems towards learning which, therefore, may improve learning outcomes.

Strengths and Limitations

The literature in this review represents a broad spectrum of gamified applications, investigated across the health professions education continuum. The strengths of our systematic review are the comprehensive search strategy using multiple databases, the use of explicit in- and exclusion criteria and the transparent approach to collecting data. Furthermore, our study offers a unique analysis approach implying a combination of four core elements – namely (a) an alternative way to distinguish gamification from other forms of game-based learning, (b) structuring game elements in a comprehensive way, (c) uncovering theories underpinning gamified intervention and (d) assessing study quality – which sets our study apart from existing systematic reviews on gamification. Using such an approach, we were better able to make a distinction between the three forms of game-based learning (gamification, serious games and simulations) and, therefore, to make an accurate selection of gamification studies. In doing so, we added a new perspective to literature reviews in health professions education by applying a conceptual framework and using a more generic way of structuring individual game elements into overarching game attributes to investigate whether there is a (combination of) game attribute(s) that holds the highest promise of improving health professions education.

This study had several limitations. First, although we took a systematic approach to identifying relevant articles, it is possible that we unintentionally overlooked some articles that explored the same phenomenon using different keywords. We also may have missed some articles while we had to exclude keywords that were too general and resulted in too many irrelevant articles. Yet, we tried to include as many relevant articles as possible

by basing our search on a list of 52 game elements and Lander's framework [3,128]. We kept our search as comprehensive as possible while critically evaluating the output. In addition, we did not set a timeframe for our search since individual game elements were used in a non-game context long before the term "gamification" was coined.

Second, we are aware that other scholars may have different views of what constitutes (serious) games or gamified learning, since there is no consensus on the definition of "game"' and, therefore, "gamification" and "serious games" [14–17]. Since we explicitly added "game-intention" to our definitions of gamification, serious games and simulations, there may have been subjectivity in our decision-making process for inclusion/exclusion of studies. Views of designers, participating students, teachers and scholars can differ as to whether something is a game or not, because meanings are constructed on the basis of historical, cultural and social circumstances through specific discourse of games or acts of gameplay. This means that even though designers, researchers and teachers may have the intention to *not* create a game and to only use game-elements, a participants' view of whether it actually *is* a game can be quite different, depending on his or her background. For instance, some students or researchers may interpret the inclusion of a leader board as a game element in a non-gaming context, while others may interpret it as a game. So, although the intention of creating a game is the characteristic difference between gamification and serious games, the interpretation of gamified interventions is prone to subjectivity due to a lack of consensus of what the word 'game' refers to. This, in turn, suggests that our study selection process may also be prone to subjectivity. However, the distinction we made between the three forms of game-based learning proved to be quite straightforward and we used a form of triangulation to overcome this limitation. Although we underline the need for clarification of terms like (serious) game and gamification, we do feel that our research method was appropriate for this study. A third limitation may be that only one researcher (AvG) was involved in screening the full texts to confirm the eligibility of each study on the basis of our in- and exclusion criteria. However, in case of uncertainties, the entire team was involved in the decision-making process and we undertook double screening on a 10% random sample of the excluded articles as a form of triangulation. Additionally, all researchers independently reviewed full texts during the process and engaged in joint discussions to resolve uncertainties and reach consensus, when necessary. The fourth limitation is that we included mixed methods studies, but ranked the included studies using MERSQI only. MERSQI is an instrument for assessing the methodological quality of experimental, quasi-experimental and observational studies in medical education, so it does not assess the qualitative parts of mixed methods studies. Although using the MERSQI enabled comparison between all studies included in our study, we realize that our outcomes neglected the quality of the qualitative parts of these studies and may not reflect the quality of each mixed-methods study in its entirety. We acknowledge, however, that the qualitative components of the

mixed-methods studies may be very valuable. Fifth, although the applied conceptual framework enabled us to generalize our findings, at times, generalization might have caused too much information loss since the framework could use more refinement. Sixth and finally, we only included articles written in English and Dutch, so there is the potential for language and culture bias, since studies with positive results are more likely to be published in English-language journals [129].

Conclusion

Gamification seems a promising tool to improve learning outcomes by strengthening learning behaviours and attitudes towards learning. Satisfaction rates are generally high and positive changes in behaviour and learning have been reported. However, most of the included studies were descriptive in nature and rarely explained what was meant by gamification and how it worked in health professions education. Consequently, the current research status is too limited to provide educators with evidence-based recommendations on when and how specific game elements should be applied. Future clarification research should explore theories that could explain positive or negative effects of gamified interventions with well-defined control groups in a longitudinal way. In this way, we can build on existing theories and gain a practical and comprehensive understanding of how to select the right game elements for the right educational context and the right type of student.

References

1. Landers RN, Bauer KN, Callan RC, Armstrong MB. Psychological theory and the gamification of learning. In: Gamification in Education and Business. ; 2015:165-186. doi:10.1007/978-3-319-10208-5_9
2. Dicheva D, Dichev C, Agre G, Angelova G. Gamification in education: A systematic mapping study. Educ Technol Soc. Published online 2015.
3. Landers RN. Developing a Theory of Gamified Learning: Linking Serious Games and Gamification of Learning. Simul Gaming. Published online 2014. doi:10.1177/1046878114563660
4. Deterding S, Khaled R, Nacke L, Dixon D. Gamification: toward a definition. Chi 2011. Published online 2011:12-15. doi:978-1-4503-0268-5/11/0
5. Lim ECH, Seet RCS. Using an online neurological localisation game. Med Educ. Published online 2008. doi:10.1111/j.1365-2923.2008.03188.x
6. Chen AMH, Kiersma ME, Yehle KS, Plake KS. Impact of the Geriatric Medication Game® on nursing students' empathy and attitudes toward older adults. Nurse Educ Today. 2015;35(1):38-43. doi:10.1016/j.nedt.2014.05.005
7. Chan WY, Qin J, Chui YP, Heng PA. A serious game for learning ultrasound-guided needle placement skills. IEEE Trans Inf Technol Biomed. Published online 2012. doi:10.1109/TITB.2012.2204406
8. B. B-E, I. M-A, A.D. B, J. T, B. F-M, R. M. Application of game-like simulations in the Spanish Transplant National Organization. Transplant Proc. 2013;45(10):3564-3565. doi:10.1016/j.transproceed.2013.09.017
9. Amer RS, Denehy GE, Cobb DS, Dawson D V, Cunningham-Ford MA, Bergeron C. Development and evaluation of an interactive dental video game to teach dentin bonding. J Dent Educ. 2011;75(6):823-831.
10. Frederick HJ, Corvetto MA, Hobbs GW, Taekman J. The "Simulation Roulette" game. Simul Healthc. 2011;6(4):244-249. doi:10.1097/SIH.0b013e31820e0094
11. Gerard JM, Scalzo AJ, Borgman MA, et al. Validity Evidence for a Serious Game to Assess Performance on Critical Pediatric Emergency Medicine Scenarios. Simul Healthc. Published online January 2018. doi:10.1097/SIH.0000000000000283
12. Stanley D, Latimer K. "The Ward": a simulation game for nursing students. Nurse Educ Pract. 2011;11(1):20-25. doi:10.1016/j.nepr.2010.05.010
13. M. W, B. H. Gamification: Student feedback and creation of bespoke board games. Arch Dis Child. 2017;102:A24. doi:10.1136/archdischild-2017-313087.56
14. Suits B. The Grasshopper: Games, Life and Utopia, Bernard Suits.; 1978. doi:10.1073/pnas.0703993104
15. Salen K, Zimmerman E. Rules of Play: Game Design Fundamentals.; 2004.
16. Arjoranta J. Game definitions: A wittgensteinian approach. Game Stud. Published online 2014.
17. Ramsey FP. Tractatus Logico-Philosophicus. By Ludwig Wittgenstein. Mind. Published online 1923.
18. Wein E, Sutton-Smith B. The Ambiguity of Play. J Am Folk. Published online 2000. doi:10.2307/541295
19. Caillois R. Man , Play , and Games.; 1961.
20. Huizinga J. Homo Ludens: A Study of the Play Element in Culture.; 1955. doi:10.1007/s13398-014-0173-7.2
21. Klabbers JHG. Terminological ambiguity: Game and Simulation. Simul Gaming. Published online 2009. doi:10.1177/1046878108325500

22. Bedwell WL, Pavlas D, Heyne K, Lazzara EH, Salas E. Toward a taxonomy linking game attributes to learning: An empirical study. Simul Gaming. Published online 2012. doi:10.1177/1046878112439444
23. Perrotta C, Featherstone G, Aston H, Houghton E. Game-Based Learning: Latest Evidence and Future Directions.; 2013.
24. Simões J, Redondo RD, Vilas AF. A social gamification framework for a K-6 learning platform. Comput Human Behav. Published online 2013. doi:10.1016/j.chb.2012.06.007
25. Robson K, Plangger K, Kietzmann JH, McCarthy I, Pitt L. Is it all a game? Understanding the principles of gamification. Bus Horiz. Published online 2015. doi:10.1016/j.bushor.2015.03.006
26. Muntean CCI. Raising engagement in e-learning through gamification. 6th Int Conf Virtual Learn ICVL 2011. 2011;(1):323-329.
27. Gaggioli A. CyberSightings. Cyberpsychology, Behav Soc Netw. Published online 2016. doi:10.1089/cyber.2016.29057.csi
28. Huotari K, Hamari J. A definition for gamification: anchoring gamification in the service marketing literature. Electron Mark. Published online 2017. doi:10.1007/s12525-015-0212-z
29. Zuk R. Get in the game: How communicators can leverage gamification. Public Relations Tactics. Published online 2012.
30. Blohm I, Leimeister JM. Gamification: Design of IT-based enhancing services for motivational support and behavioral change. Bus Inf Syst Eng. Published online 2013. doi:10.1007/s12599-013-0273-5
31. Burkey DD, Anastasio DD, Suresh A. Improving student attitudes toward the capstone laboratory course using gamification. In: ASEE Annual Conference and Exposition, Conference Proceedings. ; 2013.
32. De Sousa Borges S, Durelli VHS, Reis HM, Isotani S. A systematic mapping on gamification applied to education. In: Proceedings of the ACM Symposium on Applied Computing. ; 2014. doi:10.1145/2554850.2554956
33. Huotari K, Hamari J. Defining gamification - A service marketing perspective. In: Proceedings of the 16th International Academic MindTrek Conference 2012: "Envisioning Future Media Environments", MindTrek 2012. ; 2012. doi:10.1145/2393132.2393137
34. Warmelink H, Koivisto J, Mayer I, Vesa M, Hamari J. Gamification of the work floor: A literature review of gamifying production and logistics operations. In: Proceedings of the 51st Hawaii International Conference on System Sciences. ; 2018. doi:10.24251/hicss.2018.139
35. Domínguez A, Saenz-De-Navarrete J, De-Marcos L, Fernández-Sanz L, Pagés C, Martínez-Herráiz JJ. Gamifying learning experiences: Practical implications and outcomes. Comput Educ. Published online 2013. doi:10.1016/j.compedu.2012.12.020
36. Hsu SH, Chang J-W, Lee C-C. Designing Attractive Gamification Features for Collaborative Storytelling Websites. Cyberpsychology, Behav Soc Netw. 2013;16(6):428-435. doi:10.1089/cyber.2012.0492
37. Kumar J. Gamification at work: Designing engaging business software. In: Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). ; 2013. doi:10.1007/978-3-642-39241-2-58
38. Burke B. Gartner Redefines Gamification. Gartner. doi:10.1002/jtr.1958
39. Hamari J, Koivisto J, Sarsa H. Does gamification work? - A literature review of empirical studies on gamification. In: Proceedings of the Annual Hawaii International Conference on System Sciences. ; 2014.

doi:10.1109/HICSS.2014.377

40. Seaborn K, Fels DI. Gamification in theory and action: A survey. Int J Hum Comput Stud. Published online 2015. doi:10.1016/j.ijhcs.2014.09.006
41. De-Marcos L, Domínguez A, Saenz-De-Navarrete J, Pagés C. An empirical study comparing gamification and social networking on e-learning. Comput Educ. Published online 2014. doi:10.1016/j.compedu.2014.01.012
42. Sailer M, Hense JU, Mayr SK, Mandl H. How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. Comput Human Behav. Published online 2017. doi:10.1016/j.chb.2016.12.033
43. Mekler ED, Brühlmann F, Tuch AN, Opwis K. Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. Comput Human Behav. Published online 2017. doi:10.1016/j.chb.2015.08.048
44. Lister C, West JH, Cannon B, Sax T, Brodegard D. Just a fad? Gamification in health and fitness apps. J Med Internet Res. Published online 2014. doi:10.2196/games.3413
45. Susi T, Johannesson M, Backlund P. Serious Games – An Overview. Tech Rep HS- IKI -TR-07-001, Sch Humanit Informatics, Univ Skövde, Sweden. 2007;73(10):28. doi:10.1.1.105.7828
46. Oxford English Dictionary. Oxford English Dictionary Online. Oxford English Dictionary.
47. Vallverdú J. What are Simulations? An Epistemological Approach. Procedia Technol. Published online 2014. doi:10.1016/j.protcy.2014.02.003
48. Alessi SM. Fidelity in the design of instructional simulations. J Comput Instr. Published online 1988.
49. Jacobs JW, Dempsey J V. Simulation and gaming: Fidelity, feedback, and motivation. Published 1993. Accessed June 16, 2020. https://books.google.nl/books?hl=nl&lr=&id=ss3fz-5WC6gC&oi=fnd&pg=PA197&dq=simulation+definition+feedback&ots=uz6FpwL6I6&sig=H3NWYp1ne1LFoS65mxRy--Bgowc#v=onepage&q&f=false
50. Van Dongen KW, Van Der Wal WA, Rinkes IHMB, Schijven MP, Broeders IAMJ. Virtual reality training for endoscopic surgery: Voluntary or obligatory? Surg Endosc Other Interv Tech. 2008;22(3):664-667. doi:10.1007/s00464-007-9456-9
51. Petrucci AM, Kaneva P, Lebedeva E, Feldman LS, Fried GM, Vassiliou MC. You have a message! Social networking as a motivator for FLS training. J Surg Educ. 2015;72(3):542-548. doi:10.1016/j.jsurg.2014.10.007
52. Wells L. Energy explorer : a theory-informed design for a serious game with the purpose of promoting energy conservation behaviours. Published online 2018. doi:10.25959
53. Davidson SJ, Candy L. Teaching EBP Using Game-Based Learning: Improving the Student Experience. Worldviews evidence-based Nurs. 2016;13(4):285-293. doi:10.1111/wvn.12152
54. Fleiszer D, Fleiszer T, Russell R. Doughnut Rounds: A self-directed learning approach to teaching critical care in surgery. Med Teach. 1997;19(3):190-193. doi:10.3109/01421599709019380
55. Kerfoot BP, Kissane N. The use of gamification to boost residents' engagement in simulation training. JAMA Surg. 2014;149(11):1208-1209. doi:10.1001/jamasurg.2014.1779
56. Gorbanev I, Agudelo-Londono S, Gonzalez RA, et al. A systematic review of serious games in medical education: quality of evidence and pedagogical strategy. Med Educ Online. 2018;23(1):1438718. doi:10.1

080/10872981.2018.1438718

57. Wilson KA, Bedwell WL, Lazzara E, et al. Relationships between game attributes and learning outcomes: Review and research proposals. Simul Gaming. Published online 2009. doi:10.1177/1046878108321866
58. Nah FFH, Zeng Q, Telaprolu VR, Ayyappa AP, Eschenbrenner B. Gamification of education: A review of literature. In: Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). ; 2014. doi:10.1007/978-3-319-07293-7_39
59. Caponetto I, Earp J, Ott M. Gamification and education: A literature review. In: Proceedings of the European Conference on Games-Based Learning. ; 2014.
60. Dichev C, Dicheva D. Gamifying education: what is known, what is believed and what remains uncertain: a critical review. Int J Educ Technol High Educ. Published online 2017. doi:10.1186/s41239-017-0042-5
61. Subhash S, Cudney EA. Gamified learning in higher education: A systematic review of the literature. Comput Human Behav. Published online 2018. doi:10.1016/j.chb.2018.05.028
62. Faiella F, Ricciardi M. Gamification and learning: A review of issues and research. J E-Learning Knowl Soc. Published online 2015.
63. McCoy L, Lewis JH, Dalton D. Gamification and Multimedia for Medical Education: A Landscape Review. J Am Osteopath Assoc. 2016;116(1):22. doi:10.7556/jaoa.2016.003
64. Gentry S, L'Estrade Ehrstrom B, Gauthier A, et al. Serious Gaming and Gamification interventions for health professional education. Cochrane Database Syst Rev. 2016;2016(6). doi:10.1002/14651858.CD012209
65. Bligh J, Parsell G. Research in medical education: Finding its place. Med Educ. Published online 1999. doi:10.1046/j.1365-2923.1999.0389a.x
66. Bligh J, Prideaux D. Research in medical education: Asking the right questions. Med Educ. Published online 2002. doi:10.1046/j.1365-2923.2002.01411.x
67. Cook DA, Bordage G, Schmidt HG. Description, justification and clarification: A framework for classifying the purposes of research in medical education. Med Educ. Published online 2008. doi:10.1111/j.1365-2923.2007.02974.x
68. Sharma R, Gordon M, Dharamsi S, Gibbs T. Systematic reviews in medical education: A practical approach: AMEE Guide 94. Med Teach. Published online 2015. doi:10.3109/0142159X.2014.970996
69. Szyma M. Who coined the term "gamification"? - Quora.
70. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Syst Rev. 2016;5(1):210. doi:10.1186/s13643-016-0384-4
71. Reed DA, Cook DA, Beckman TJ, Levine RB, Kern DE, Wright SM. Association between funding and quality of published medical education research. J Am Med Assoc. Published online 2007. doi:10.1001/jama.298.9.1002
72. Sabri H, Cowan B, Kapralos B, Porte M, Backstein D, Dubrowskie A. Serious games for knee replacement surgery procedure education and training. In: Procedia - Social and Behavioral Sciences. ; 2010. doi:10.1016/j.sbspro.2010.03.539
73. Dankbaar MEW, Alsma J, Jansen EEH, van Merrienboer JJG, van Saase JLCM, Schuit SCE. An Experimental Study on the Effects of a Simulation Game on Students' Clinical Cognitive Skills and Motivation. Adv Heal Sci Educ. 2016;21(3):505-521. http://search.ebscohost.com.proxy-ub.rug.nl/login.

aspx?direct=true&db=eric&AN=EJ1105118&site=ehost-live&scope=site

74. Leach MEH, Pasha N, McKinnon K, Etheridge L. Quality improvement project to reduce paediatric prescribing errors in a teaching hospital. Arch Dis Child Educ Pract Ed. 2016;101(6):311-315. doi:10.1136/archdischild-2015-309299
75. Richey Smith CE, Ryder P, Bilodeau A, Schultz M. Use of an Online Game to Evaluate Health Professions Students' Attitudes toward People in Poverty. Am J Pharm Educ. 2016;80(8):139. doi:10.5688/ajpe808139
76. Mishori R, Kureshi S, Ferdowsian H. War games: using an online game to teach medical students about survival during conflict "When my survival instincts kick in, what am I truly capable of in times of conflict?" Med Confl Surviv. 2017;33(4):250-262. doi:10.1080/13623699.2017.1406439
77. Patton KK, Branzetti JB, Robins L. Assessment and the Competencies: A Faculty Development Game. J Grad Med Educ. 2016;8(3):442-443. http://10.0.16.204/JGME-D-15-00596.1
78. Lim EC-H, Seet RCS. Using an online neurological localisation game. Med Educ. 2008;42(11):1117. doi:10.1111/j.1365-2923.2008.03188.x
79. Campbell C. The examination game. That's the game I'm in. J Med Educ. 1967;42(10):974-975.
80. Inangil D. Theoretically Based Game for Student Success: Clinical Education. Int J Caring Sci. 2017;10(1):464-470. http://search.ebscohost.com.proxy-ub.rug.nl/login.aspx?direct=true&db=cin20&AN=123010477&site=ehost-live&scope=site
81. Courtier J, Webb EM, Phelps AS, Naeger DM. Assessing the learning potential of an interactive digital game versus an interactive-style didactic lecture: the continued importance of didactic teaching in medical student education. Pediatr Radiol. 2016;46(13):1787-1796. doi:10.1007/s00247-016-3692-x
82. Creutzfel dt J, Hedman L, Heinrichs LR, Youngblood P, Felländer-Tsai L. Cardiopulmonary resuscitation training in high school using avatars in virtual worlds: An international feasibility study. J Med Internet Res. Published online 2013. doi:10.2196/jmir.1715
83. Dankbaar MEW, Richters O, Kalkman CJ, et al. Comparative effectiveness of a serious game and an e-module to support patient safety knowledge and awareness. BMC Med Educ. 2017;17(1):30. doi:10.1186/s12909-016-0836-5
84. Bigdeli S, Kaufman D. Digital games in medical education: Key terms, concepts, and definitions. Med J Islam Repub Iran. 2017;31:52. doi:10.14196/mjiri.31.52
85. Hudon A, Perreault K, Laliberté M, et al. Ethics teaching in rehabilitation: results of a pan-Canadian workshop with occupational and physical therapy educators. Disabil Rehabil. Published online 2016. doi :10.3109/09638288.2015.1123308
86. Kaylor SK. Fishing for Pharmacology Success: Gaming as an Active Learning Strategy. J Nurs Educ. 2016;55(2):119. doi:10.3928/01484834-20160114-12
87. Boysen PG 2nd, Daste L, Northern T. Multigenerational Challenges and the Future of Graduate Medical Education. Ochsner J. 2016;16(1):101-107.
88. Montrezor LH. Performance in Physiology Evaluation: Possible Improvement by Active Learning Strategies. Adv Physiol Educ. 2016;40(4):454-457. http://search.ebscohost.com.proxy-ub.rug.nl/login.aspx?direct=true&db=eric&AN=EJ1115811&site=ehost-live&scope=site
89. Mullen K. Innovative Learning Activity: Toy Closet: A Growth and Development Game for Nursing Students. J Nurs Educ. 2018;57(1):63. doi:10.3928/01484834-20180102-13

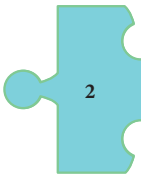
90. Lin DT, Park J, Liebert CA, Lau JN. Validity evidence for Surgical Improvement of Clinical Knowledge Ops: a novel gaming platform to assess surgical decision making. Am J Surg. 2015;209(1):79-85. http://10.0.3.248/j.amjsurg.2014.08.033
91. Forni MF, Garcia-Neto W, Kowaltowski AJ, Marson GA. An active-learning methodology for teaching oxidative phosphorylation. Med Educ. 2017;51(11):1169-1170. doi:10.1111/medu.13418
92. El-Beheiry M, McCreery G, Schlachta CM. A serious game skills competition increases voluntary usage and proficiency of a virtual reality laparoscopic simulator during first-year surgical residents' simulation curriculum. Surg Endosc Other Interv Tech. 2017;31(4):1643-1650. doi:10.1007/s00464-016-5152-y
93. Kerfoot BP, Turchin A, Breydo E, Gagnon D, Conlin PR. An online spaced-education game among clinicians improves their patients' time to blood pressure control: a randomized controlled trial. Circ Cardiovasc Qual Outcomes. 2014;7(3):468-474. doi:10.1161/CIRCOUTCOMES.113.000814
94. Adami F, Cecchini M. Crosswords and word games improve retention of cardiopulmonary resuscitation principles. Resuscitation. 2014;85(11):e189. doi:10.1016/j.resuscitation.2014.08.021
95. Van Nuland SE, Roach VA, Wilson TD, Belliveau DJ. Head to head: The role of academic competition in undergraduate anatomical education. Anat Sci Educ. 2015;8(5):404-412. doi:10.1002/ase.1498
96. Butt AL, Kardong-Edgren S, Ellertson A. Using Game-Based Virtual Reality with Haptics for Skill Acquisition. Clin Simul Nurs. 2018;16:25-32. doi:10.1016/j.ecns.2017.09.010
97. Verkuyl M, Romaniuk D, Atack L, Mastrilli P. Virtual Gaming Simulation for Nursing Education: An Experiment. Clin Simul Nurs. 2017;13(5):238-244. doi:10.1016/j.ecns.2017.02.004
98. El Tantawi M, Sadaf S, AlHumaid J. Using gamification to develop academic writing skills in dental undergraduate students. Eur J Dent Educ. 2018;22(1):15-22. doi:10.1111/eje.12238
99. Koivisto J-M, Multisilta J, Niemi H, Katajisto J, Eriksson E. Learning by playing: A cross-sectional descriptive study of nursing students' experiences of learning clinical reasoning. Nurse Educ Today. 2016;45:22-28. doi:10.1016/j.nedt.2016.06.009
100. Chen P-H, Roth H, Galperin-Aizenberg M, Ruutiainen AT, Gefter W, Cook TS. Improving Abnormality Detection on Chest Radiography Using Game-Like Reinforcement Mechanics. Acad Radiol. 2017;24(11):1428-1435. doi:10.1016/j.acra.2017.05.005
101. Kolb DA, Boyatzis RE. Experiential Learning Theory: Previous Research and New Directions. In: Perspectives on Cognitive, Learning, and Thinking Styles. ; 2001.
102. Kolb DA, Boyatzis RE, Mainemelis C. Experiential Learning Theory: Previous Research and New Directions.; 2000. doi:10.5465/AMLE.2005.17268566
103. Knowles MS. THE MODERN PRACTICE OF ADULT EDUCATION : From Pedagogy to Andragogy.; 1980. doi:10.4324/9780203802670
104. Ericsson KA, Krampe RT, Tesch-Römer C. The role of deliberate practice in the acquisition of expert performance. Psychol Rev. Published online 1993. doi:10.1037/0033-295X.100.3.363
105. Corcoran K, Crusius J, Mussweiler T. Social Comparison : Motives , Standards , and Mechanisms. Handb Theor Soc Psychol Vol One. Published online 2011.
106. Festinger L. A Theory of Social Comparison Processes. Hum Relations. 1954;7(2):117-140. doi:10.1177/001872675400700202
107. Börgers T, Sarin R. Learning through reinforcement and replicator dynamics. J Econ Theory. Published

online 1997. doi:10.1006/jeth.1997.2319

108. Scales CD, Moin T, Fink A, et al. A randomized, controlled trial of team-based competition to increase learner participation in quality-improvement education. Int J Qual Heal care J Int Soc Qual Heal Care. 2016;28(2):227-232. doi:10.1093/intqhc/mzw008
109. Worm BS, Buch SV. Does competition work as a motivating factor in e-learning? a randomized controlled trial. PLoS One. 2014;9(1). doi:10.1371/journal.pone.0085434
110. Kerr S, Tolliver J, Petree D. Manuscript Characteristics Which Influence Acceptance for Management and Social Science Journals. Acad Manag J. Published online 1977. doi:10.2307/255467
111. Møllerand AP, Jennions MD. Testing and adjusting for publication bias. Trends Ecol Evol. Published online 2001. doi:10.1016/S0169-5347(01)02235-2
112. Andrade FRH, Mizoguchi R, Isotani S. The bright and dark sides of gamification. In: Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). ; 2016. doi:10.1007/978-3-319-39583-8_17
113. Reeve J, Deci EL. Elements of the competitive situation that affect intrinsic motivation. Personal Soc Psychol Bull. Published online 1996. doi:10.1177/0146167296221003
114. Kerfoot BP, Kearney MC, Connelly D, Ritchey ML. Interactive spaced education to assess and improve knowledge of clinical practice guidelines: A randomized controlled trial. Ann Surg. Published online 2009. doi:10.1097/SLA.0b013e31819f6db8
115. Hintzman DL. Repetition and Memory. Psychol Learn Motiv - Adv Res Theory. Published online 1976. doi:10.1016/S0079-7421(08)60464-8
116. Slamecka NJ, McElree B. Normal forgetting of verbal lists as a function of their degree of learning. J Exp Psychol Learn Mem Cogn. Published online 1983. doi:10.1037/0278-7393.9.3.384
117. Murre JMJ, Dros J. Replication and analysis of Ebbinghaus' forgetting curve. PLoS One. Published online 2015. doi:10.1371/journal.pone.0120644
118. Deci EL, Koestner R, Ryan RM. Extrinsic Rewards and Intrinsic Motivation in Education: Reconsidered Once Again. Rev Educ Res. 2001;71(1):1-27. doi:10.3102/00346543071001001
119. Deci EL, Koestner R, Ryan RM. A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. Psychol Bull. 1999;125(6):627-668. doi:10.1037/0033-2909.125.6.627
120. Hanus MD, Fox J. Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. Comput Educ. 2015;80:152-161. doi:10.1016/j.compedu.2014.08.019
121. Lepper MR, Greene D, Nisbett RE. Undermining children's intrinsic interest with extrinsic reward: A test of the "overjustification" hypothesis. J Pers Soc Psychol. 1973;28(1):129-137. doi:10.1037/h0035519
122. Bermudez MA, Schultz W. Timing in reward and decision processes. Philos Trans R Soc B Biol Sci. Published online 2014. doi:10.1098/rstb.2012.0468
123. Butler AC, Karpicke JD, Roediger HL. The Effect of Type and Timing of Feedback on Learning From Multiple-Choice Tests. J Exp Psychol Appl. Published online 2007. doi:10.1037/1076-898X.13.4.273
124. Ashby GF, O'Brien JB. The effects of positive versus negative feedback on information-integration category learning. Percept Psychophys. Published online 2007. doi:10.3758/bf03193923
125. Gruder CL. Determinants of social comparison choices. J Exp Soc Psychol. Published online 1971.

doi:10.1016/0022-1031(71)90010-2

126. Wills TA. Downward comparison principles in social psychology. Psychol Bull. Published online 1981. doi:10.1037/0033-2909.90.2.245
127. Tilley N, Pawson R. Realistic Evaluation: An Overview. Br J Sociol. Published online 2000. doi:10.2307/591330
128. Marczewski A. 52 Gamification Mechanics and Elements. Gamified UK.
129. Egger M, Zellweger-Zähner T, Schneider M, Junker C, Lengeler C, Antes G. Language bias in randomised controlled trials published in English and German. Lancet. Published online 1997. doi:10.1016/S0140-6736(97)02419-7


2

"One plays only if and when one whishes to"
~ Roger Callois (Man, play and Games)

3

The Second Act

Medical Students' Perceptions of Play and Learning: Qualitative Study With Focus Groups and Thematic Analysis

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Abstract

Background

In times where distance learning is becoming the norm, game-based learning (GBL) is increasingly applied to health professions education. Yet, decisions for if, when, how and for whom GBL should be designed cannot be made on a solid empirical basis. Though the act of play seems to be intertwined with GBL, it is generally ignored in current scientific literature.

Objective

The objective of our study was to explore students' perceptions of play in leisure time, and of GBL, as part of a mechanistic, bottom-up approach towards evidence-informed design and implementation of GBL in health professions education.

Method

We conducted six focus group discussion in medical and dentistry students, which were analysed using thematic analysis.

Results

A total of 58 students participated. We identified four major themes based on the students' perception of play in leisure time and on the combination of play and learning. Our results indicate that while play preferences were highly various in our health profession student cohort, pleasure was the common ground reported for playing. Crucially, play and the serious act of learning seemed paradoxical, indicating that the value and meaning of play is strongly context-dependent for students.

Conclusion

Four key points can be constructed from our study: (1) Students play for pleasure. Perceptions of pleasure vary considerably among students; (2) Students consider play as inefficient. Inefficiency will only be justified when it increases learning; (3) Play should be balanced with the serious and only be used for difficult or tedious courses; (4) Game-based learning activities should not be made compulsory for students. We provide practical implication and directions for future research.

Introduction

In times where distance learning is becoming the norm, game-based learning (GBL) is increasingly applied to health professions education [1,2]. Yet, recent reviews in this field indicate that GBL research is still in its infancy and that robust study designs based on sound theoretical foundations or supporting scientific evidence are scarce [3–5]. Although certain trends in GBL-use can be observed, there seems to be little theoretical support to clarify the effects of GBL on academic learning [3]. Most studies report on the use of GBL applications that are tailored to specific local settings [3]. Therefore, decisions about implementing game-like interventions – if, when, how and for whom – cannot be made on a solid empirical basis. This increases the likelihood of suboptimal and even counterproductive educational design. In this study, we took a user-driven approach in an attempt to unravel key processes that could explain why and how GBL does or does not work in health professions education and, therewith, advancing the science and practice in this field.

GBL has been applied based on the idea that play and learning are closely intertwined [6,7]. Intriguingly, studies investigating GBL in academic settings do not seem to explicitly scrutinize, measure or mention play [3–5,8,9]. GBL studies mainly focus on outcome measures such as, learning outcome, motivation and likability of GBL [3] but seem to dismiss play itself. This situation seems to persist despite significant scientific interest in the fundamentals of play-learning interaction [10–13]. Generally, empirical evidence supports claims that play positively influences the learning of problem solving [14–16], creativity [17,18], and self-regulatory skills [19]. Most knowledge on this play-learning interaction stems from early experimental animal research [20,21] [20,21] or research on developmental psychology in children (e.g. [14,22]. By comparison, play in the realm of adult learning has received very little attention, especially with regard to GBL.

The studies that came closest to research on play-learning interactions in educational contexts for adult learning were quantitative in nature and primarily used questionnaires aimed to examine experiences with already existing games or to inform the design of a specific game [23–27]. However, these studies did not investigate how play can be elicited in students or, more specifically, which type of play can benefit or support student learning, in which situations or under which conditions. Furthermore, because of the specific study set-up or study intent, participants in such studies may have directed their answers to a specific game or game design, which does not allow for generalization of the results to other contexts or game designs. Next to quantitative studies, qualitative approaches have been employed in order to describe adult playfulness [28], or inform game design [29–33]. Findings of these studies gave insight into self-perceived reasons for adult engagement in play such as stress relief, challenge and friendship. However,

whether these needs for play in adults can also be met in combination with learning was not explored in these studies. The links between play, academic learning and GBL, thus, remain a blind spot in the literature.

Provided that there are meaningful play-learning interaction in GBL, even when the nature of that interaction is unknown, we need to understand how to elicit play in students. But what exactly is play, how do we define play and how do we relate play to GBL? There is no univocal answer to any of these questions, since there is considerable disagreement in the scientific literature as to what constitutes play and games [13,34]. Interestingly, and perhaps as a logical consequence of this disagreement, there *is* strong consensus that playfulness is an individual predisposition [35] and that the liking of play is dependent on personal opinions, characteristics [36–38] and context [34]. Some propositions have been made by play-scholars to classify different expressions of play and distinguish play from other behaviours such as exploration [13,39]. Probably most interesting in this regard is the distinction between *paidia* (free, spontaneous, expressive, creative forms of play) and *ludus* (rule-bound play) [40]. These heuristics can be very valuable for the theoretical conceptualization of GBL, because GBL-design seems to relate much more to rule-bound "ludic" play [3,26,40] than to free, creative "paidic" play. Furthermore, the strong individual character of play that has been established in the literature seems to require qualitative research approaches to understand students' perceptions of play and academic learning, especially in relation to GBL.

In the present study, we took inspiration from play research as a first step towards a mechanistic analysis of GBL effects. We employed the qualitative method of open focus group discussions to help us gain deeper insight into medical and dentistry students' perceptions of play and learning by exploring their ideas, interpretations, feelings and actions [41] as well as favorable circumstances or limitations for engaging in GBL activities. Although, at this point, we do not have scientific reasons to assume that the range of opinions on play would vary significantly across students as a function of the academic level or discipline they are enrolled in, we chose to focus on medical and dental students for main reasons. First, our main teaching experience as well as our research interest in GBL lies within the context of health professions education. Second, if play preferences are indeed highly individual and contextual, this would also apply to students enrolled in a particular programme or discipline. In sum, in this focus group study we explored health professions students' perceptions of what constitutes play, play-learning interaction, and if, how and when GBL material should be designed and implemented in health professions education to foster their learning.

Methods

Context

We conducted this study at the University of Groningen, University Medical Center Groningen, the Netherlands, between March and April 2019. The 6-year undergraduate medical curriculum of the University of Groningen comprises a 3-year Bachelor's and a 3-year Master's phase. The Bachelor's programme includes 2 Dutch-taught and 2 English-taught tracks, called learning communities. The programme is problem-based and patient and student-centred, with a focus on tutor groups, practicals and e-learning rather than lectures. From the students is expected that they are pro-active and they are encouraged to develop self-regulated and self-directed learning skills to pursue lifelong learning. The 3-year Master's programme includes 2.5 years of clinical rotations (1 year junior clerkships 1 year senior clerkships, half year elective clerkship), and 0.5 year master thesis. The 6-year undergraduate dentistry curriculum of the University of Groningen, likewise, comprises a 3-year Bachelor's and 3-year Master's phase and has a patient-centred approach. Compared to medicine, the dentistry Bachelor's phase has a stronger focus on lectures and practicals and is taught in Dutch only. The Master's phase consists of 1 year of mainly skills lab and practicals the final two years mainly consist of clinical rotations and a master thesis. Both medicine and dentistry students use e-learning, teachers sometimes apply GBL, but there is no considerable or structural implementation of GBL in either curriculum.

Participants and ethical considerations

We used convenience sampling and invited all medical and dental students to participate in our study via an online announcement on the virtual learning environment of the University of Groningen, which is also used as a communication platform and is visible to all students (N = 1600). We explained that the purpose of the focus group study was to gain more insight into students' perceptions of play due to increasing interest in game-based learning. It was communicated that students not interested in games would also be able to participate in this study. We did not set specific exclusion criteria.

Ethical approval was obtained via the Netherlands Association for Medical Education (NVMO, 2019.1.11). Prior to the start of each focus group session, the participants signed an informed consent form and completed a brief demographic questionnaire. They were informed that participation was on a voluntary basis and that they had the right to withdraw at any time if they were not comfortable with the study. After each session, participants received a gift certificate of 10 Euros for their time and effort.

Focus group sessions

The focus group sessions followed the guidelines as described by Krueger et al. [42] [42]

as well as the AMEE guideline on using focus groups [41]. Initially, six focus groups sessions (four Dutch and two English spoken sessions, with a maximum capacity of 13 students per session) were planned, each lasting 1.5–2 hours.

With the consent of the students, all meetings were audiotaped for later transcription and analysis. It was explained that there were no correct or incorrect answers and that we were interested in all ideas and perceptions. The discussions were structured around a short break. Before the break, discussions aimed at exploring playful behaviour in leisure time. After the break, discussions continued and focused on participants' ideas and perceptions of the play-learning interaction and how GBL could be implemented in the curricula to foster their learning. We used a topic list with open-ended questions (Table 1) and encouraged further discussion. The first four sessions were moderated by one of the authors (AJ). An observer (Ob1) was seated outside the group and took detailed field notes of group dynamics, atmosphere and non-verbal communications. The last two sessions were moderated by the observer of the first four sessions and, consequently, a different observer (Ob2) was used. To create an open and social atmosphere, pizza and soft drinks were served.

After four sessions, our sample provided sufficient information power to address the aims of this study [43]. The information we had gathered from these focus groups was used to fine-tune and add some questions to the topic list for the final two focus group sessions (Table 2). Since no new information was obtained in these two sessions, we decided not to schedule any further sessions [42].

Table 1. General question route for focus group discussions.

Opening question.	*What is your favorite game?*
Discussion on games and gameplay.	*Why do you like your favorite game?*
	Which type of games do you dislike? And why?
	How does your favorite game night look like?
	What do you think about when thinking of playing games?
	Do you play less now than when you were young? Why so? Do you wish it were different?
Break	
Discussion on game-based learning and implementation.	*Try to think about how you would like to use a game or game elements within the current education. What would that look like? Try to invent something in groups of 2 / 3 that you would actually like to use yourself.*
	Let's talk about your ideas. Why did you chose this course and these game elements?
	Is your intrinsic motivation (not) enough obvious? Is using game-elements really necessary?
	Suppose you are the director of your education, how would you organize your education with GBL?
Summary	*"summary of discussion" Did I summarize it correctly? Anyone want to add something?*

Table 2. Additional questions.

What does a game make 'addictive'?
Does anyone not like to play games?
When do you prefer to play?
Do you ever play drinking games? Why do you think that is attractive?
Which type of play-elements do you believe would work in education?

Data analysis

All audio tapes were transcribed verbatim and anonymized before analysis. Atlas.ti (version: 8.4) was used as software to help us manage and analyse the data [44]. The method of thematic analysis was used to evaluate the data [42]. We used the most widely adopted approach for thematic analysis [45] outlined by Braun and Clark [46] consisting out of six steps: (1) familiarization with the data; (2) generating initial codes; (3) searching for themes; (4) reviewing themes; (5) defining and naming themes; (6) producing the manuscript. Notably, this method of analysis is recursive, meaning that each subsequent step in the analysis might have prompted us to circle back to earlier steps in light of newly emerged themes or data [45]. The detailed observers' field notes facilitated additional exploration of themes when needed throughout the entire process. First, coders (AvG and Ob1) familiarized themselves with the data by examining and re-examining the transcripts and audiotapes. Second, initial codes were generated (Avg and Ob1) to organize the data on potential items of interest [45]. One focus group discussion was coded (AvG and Ob1), thereafter the coders discussed and defined a coding framework for the remaining data set while denoting possible patterns or discrepancies between the codes (Table 3). [46]. All disagreements between coders were resolved via discussion between the coders. Open coding was used to ensure flexibility to incorporate themes outside our questioning route or initial coding table (table 3) [47]. Third, the identified codes from all focus groups were discussed with the entire team in order to construct themes. We inductively [41] and iteratively constructed themes by comparing, analysing, combining and mapping codes [45]. Fourth, the team (iteratively) reviewed the identified themes to examine whether they were sufficiently common and coherent, but also whether they were sufficiently distinct from each other to justify separation [45,46,48]. Fifth, we ensured that the denominators of our themes were adequately clear and descriptive. Finally, we wrote the manuscript, which proved to be a continuation of the iterative interpretation and analytic process of thematic analysis [49].

Table 3. Initial coding framework.

Preliminary codes	*Examples*
Meaning	Luck and unpredictability, ownership, meaning
Escapism	Fantasy, immersion, escapism, relaxation
Social	Being together, helping eachother
Strategy	Strategy
Mechanics	Duration, variation
Achievement	Challenge, wining, losing, competition, revenge, provocation
Devotion	Dark play, eagerness
Exploration	Story-telling, learning new things, curiosity
Applicability for learning	Difficulty subject, boring, paradox with leisure

Reflections

Our research team consisted of researchers with various backgrounds, supporting a critical examination and interpretation of the data, from multiple perspectives. During the team discussions we deliberately addressed all these perspectives, while allowing each team member to make an equal contribution.

AvG has a medical degree, is appointed as a lecturer (i.e. anatomist), and has a research interest in the motivational pull of play and games and develops GBL strategies. JG is an associate professor of anatomy with a research interest in affective neuroscience and motivational forces in education. AJ is a full professor of Health Professions Education and Research with ample experience in qualitative research. Ob1 is a master students in Dentistry, assists multiple (clinical) educators in developing e-learning and helped perform this study as part of her graduation assignment.

AvG and JG did not join the focus group sessions, because they might know the participating students; AJ did not know any of them. Ob1 knew some participants in 2 out of 4 focus group sessions she observed, however, these participants did not consider this to be a problem and they felt free to speak their minds. When Ob1 acted as a moderator, she did not know any of the participants.

Results

A total number of 58 participants volunteered to participate (41 females and 17 males; mean age 22.8 years, range 18 -31). This sample comprised 30 Bachelor students in Medicine, 8 Master students in Medicine, 2 Bachelor students in Dentistry, and 18 Master students in Dentistry. Fifty-one participants reported to have the Dutch nationality and 7 a nationality other than Dutch (Brazilian, French, Israeli, Italian, Saudi Arabian, Romanian, South African). The number of participants joining each focus group ranged

between 7-13 students. One focus group session only included dentistry students (n=13), one focus group session was predominantly attended by dentistry students (6 out of 7 were dentistry students), one session was predominantly attended by medicine students (11/12 student were medical) and three sessions (including the two English sessions) were only attended by medicine students. We found no distinct differences between the opinion on play or GBL between dentistry and medical students. The detailed fieldnotes yielded no additional results for analysis.

We chose to present our findings based on the structure of the focus group discussions: first, students' perceptions of play in leisure time; then their perceptions of GBL; and, finally, the interaction between play and learning. Below, quotations are used to illustrate the findings. Identified themes are in ***bold and italic***, identified sub-themes are underlined.

Perceptions of play in leisure time

At the start of each focus group session, students discussed their favourite games in leisure time. A great diversity of favourite game genres were mentioned by the students, for example, puzzle/jigsaw games, shooting games, strategy games, sport games and adventure games. As one student stated

> *"I think there's no game that everyone likes to play…"*

All students liked to play, but the amount of play in leisure time ranged considerably from only once a year to daily. ***Pleasure*** seemed to be the common ground as to why students engaged in games, in all their diversity.

Pleasure

Whether it were solitary (e.g. patience, jigsaw or shooter games) or multi-player/ collaborative games (e.g. Monopoly®, settlers of Catan® or FIFA ®), students felt that games should be fun. However, ways to achieve a pleasurable experience from play varied considerably across students.

For instance, fun could come from the joy of winning

> *"I really like winning."*

Or from the feeling of supremacy and achieving something

> *"You are special. You have something that others don't have."*

Or from the delight of getting a good story out of a game

> "*I've always seen video games as "my book kind of thing". I don't read a lot of books, so I get my stories from games.*"

A striking aspect that was highlighted in the discussions, was that not only the pleasure experience itself (e.g. the experience of a victory), but also the sense of pleasurable anticipation motivated students to continue playing

> *"I continue playing until I win the final match."*

Students indicated that pleasure should not be easily obtainable

> *"it has to be a challenge to win*"

Reward uncertainty seemed to modulate the impact of the pleasure experience, such that uncertain wins were associated with greater pleasure than certain wins. Analysing the students' statements, it became clear that they experienced greater joy after a difficult win, compared to easy wins.

> *"… father always wins [at Scrabble], that's not the worst. … it also gives more satisfaction if you beat him."*
> *"What I like, is when you really make a brilliant move, so someone else just doesn't win, but you do."*

However, the degree of reward uncertainty seemed to have an optimum. Students said that if the reward seemed out of reach and their chances of winning were little to none, or even close to a certain loss, all anticipatory tension was gone. When students no longer had fun or prospect of pleasure, they felt less motivated to continue playing.

> *"When you keep losing, you're done with it [the game]."*
> *"It [Monopoly] takes too long. You're like 'let's just stop, do we really have to finish [the game]?'. "*

The final major part of the pleasure experienced in play that was brought up in the discussions, was social pleasure. Students tended to play games in groups of close friends or family, or with new people (met in pubs, societies or in a digital world), which helped them gain or strengthen the sense of collectiveness and sociability.

> *"It* [playing a game with each other] *makes you feel like you are in your own*

world."
"You can talk about the game and about everyday life, which offers opportunities for discussion."
"… then you just want it [the game] to last a long time, because you have such a good time with each other."

Students mentioned that play more easily creates a bond, a sense of social togetherness, which in turn can also be enriched through play.

"… it makes you feel connected."

However, the sociability of play could also backfire when players with competitive spirits who couldn't win (sore losers) ruined the game.

"I'm very fanatic. If I lose, I'll also be grumpy for an hour. A lot of people also don't like to play a game with me."

Or, when players who disliked strong competition were disappointed because play was merely reduced to competitiveness and the desire to win.

"If they are all very fanatic, it (the game) doesn't matter that much to me anymore."

Perceptions of Game-Based Learning
In order to keep the balance between play and the serious act of learning, participants brought up and discussed their ***perceived requirements*** and the ***relevance*** for implementing GBL.

Perceived requirements
Despite a possible unpleasant confrontation with the serious world (see '*paradox*' later), competition was believed to enhance learning.

"The more you compete, the more you will learn by yourself, because you want to improve."

However, in order to keep competition playful and in balance with the more serious part of learning, students felt that players' identities should remain confidential in GBL using competition (for example by choosing a nickname) or that players should be grouped into (collaborative) teams.

"They [the other students] *are allowed to see the [game] results, but then*

anonymously"
"When you're losing [a teamplay game], *you're not losing alone. So that's also nice."*

Students' perceptions of meaningful GBL design generally stayed close to their learning task at hand; i.e. the learning task itself could be easily recognized. Students particularly referred to disciplines they found difficult or tedious, such as: anatomy, physiology, cell biology, immunology or statistics.

"… if courses are really tedious and dry, it [GBL] *shows you that it's [the course content is] useful, and if you play it right, the [new] knowledge sticks"*
"if you can find a game to make people understand physiology, you're a genius!"

Furthermore, students often mentioned game-versions of their future workplace (based on The Sims® game), which gave them opportunities to learn playfully by building their own practice.

"*I used to play The Sims a lot and really liked to build. … Wouldn't it be great to build your own dentistry practice in a Sims kind of way!? Designing your practice, doing treatment, making money to go to courses in which you can learn new treatments, through which you can make even more money so you can improve your practice, can get more staff etc. …"*

Relevance
Students' opinions on the need for game-based learning were divided.

"I don't necessarily want to play a game every time I go to class."
"… yes I think we need it [GBL]."

Although there was some debate about how frequently GBL should be used, the consensus seemed to be that GBL could support learning. At times, the medical education continuum was experience as long-lasting, hectic and stressful.

"it [dentistry] is really a study for the long haul"
"we are all really stressed, and everyone's stressing each other out, like: 'Have you passed the exam/the test?' or 'Did you hear? He hasn't passed it [the exam/the test]!'"

Subsequently, students mentioned that adding playful fun to learning might help relieve

stress in stressful times.

> *"Why not make it a little more light-hearted? Just to relieve the tension every now and then."*

Nevertheless, students felt that there has to be a balance between the playful and the serious, which has to be respected.

> *"if we turn aspects of the six-year learning process into play, it feels as if the/ all seriousness has been lost"*

The extent to which the serious and the playful should be balanced, depended very much on personal preferences. Therefore, an approach tailored to students' needs would be the best fit according to the students.

> *"Make it an extra activity, because playing a game just doesn't work for some people…"*
> *"I think it's also important to keep in mind that everybody is different ..."*

Perceptions of the interaction between play and learning

The combination of play and the serious act of learning seemed **paradoxical** to students (figure 1).

Paradox.

Students overwhelmingly indicated that game-based learning should not be made compulsory. Compulsory play sounded for them like a 'contradictio in terminis': play would become serious, which cannot be play.

> *"if you are forced to play games, it would be like school."*
> *"If it* [a game-based learning activity] *becomes compulsory, then I don't like it anymore"*

Students considered play to be a leisure-time activity to temporary escape the serious demands of daily life.

> *"It's really relaxation, just something completely different [play], which has nothing to do with anything else."*

Integrating play and the serious act of learning into education, therefore, seemed to be a paradox.

> *"I think it's strange that you can be enjoying gameplay in your private life for fun and relaxation, but apparently, if you frame it as "education", it suddenly becomes too much."*

Indeed, although students were apt to think of play as pleasure during leisure time, it was difficult for them to link play and pleasure to academic learning.

> *"I find it difficult to see it* [learning/GBL] *as a game, because it's all so serious. Something is depending on it. And when I think of playing games, I think 'Ah, cozy, fun!' ..."*
> *"If I have to get together with everyone for a joint activity* [GBL]*, then I think 'No, I just have my own way of studying. And if I deviate from that, then I get really upset'."*

Students believed that adding play [to education] would reduce their learning efficiency.

> *"You probably have to "camouflage" the learning [part], which will probably require more study time."*
> *"I think (educational) games just have to be short and efficient…"*
> *"if something* [GBL] *really takes a lot of time, then people are inclined to think, as always: 'I just quickly read this [book] instead of wasting my time on a game."*

In addition to reduced learning efficiency, the paradox of play and learning was attributed to a mismatch in identity in play as compared to reality.

> *"That's the funny thing with games, you can pretend to be different than you normally are."*

Losing a game in the imaginary play environment was never seen as fun but considered trivial nonetheless; from a gameplay point of view the game was over and the ending was (most of time) appreciated.

> *"It's just a game."*

However, student felt that their playful imaginary identity would be lost in learning. Losing a game in a learning activity/environment was named to possibly lead to unpleasant and stressful confrontations with the real world.

> *"… because it's a game, just a one-time thing. And here, even if it's just a*

> *Kahoot, and in general, sometimes you just have a group of questions you really don't know anything about. But you can take it personally, even though you don't have to. And think 'I'm not a good student, but I want to become a good doctor' and 'they're all going to be better doctors than me' and 'my resume is not good enough'."*

In such cases, students particularly mentioned that competition had influenced this unfavorable confrontation with the serious.

> *"I think you don't want to show [your peers] that you're not able to do something [well], and if you do it* [GBL] *in the form of a competition, that there's always someone better than you. You have the feeling that you're less good at it."*

Or students were concerned that competitive behaviour in games would become prominent in their education as well.

> *" I'm already chasing all the credits* [in the curriculum] *and I feel like it* [competitive GBL] *would make me too competitive, too reward focused."*

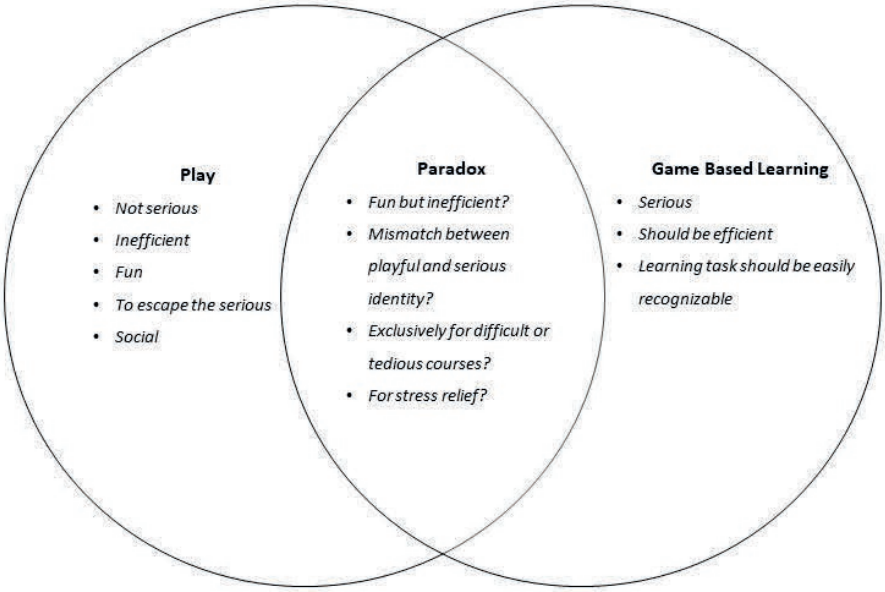

Figure 1. A paradoxical interaction between play and game base learning based on identified subthemes.

Discussion

In our study, we took inspiration from play research as a first step towards a mechanistic analysis of GBL effects. On the basis of open focus group discussions, we explored how medical and dental students perceived play in leisure time as well as in the context of academic learning, GBL in particular. The student samples were representative of the student population in terms of age, intellectual level (university students) and academic interest (medicine and dentistry). All students reported that they liked to play in leisure time. However, analysis of the transcripts showed that they had very different ideas about how pleasure could be achieved through play. Although we intentionally did not refer to a specific definition or conceptualization of play during the focus group discussions, students naturally discussed play in the context of digital, card and board games. At the evaluative level, we observed a strong tendency towards rule-bound 'ludic' play, and only a weak tendency towards free, creative 'paidic' forms of play [34,40,50–52]. An important observation from our analysis pertains to the context-dependency of the reported playfulness. Students openly and enthusiastically discussed play in leisure time, but when they were asked to discuss play in the context of GBL and academic learning, they began to carefully formulate their perceptions of play. They became cautious, began to change their perceptions of play and many even became sceptical or disapproving. It seems that the outcomes of our focus group study did not only allow us to confirm some of the key principles of adult play (e.g. challenge and sociability) [34,50,52,53], they also enabled us to generalize these to the context of health professions education. Moreover, we were able to identify key elements to consider in deciding if, how and when to adopt GBL in health professions education to, possibly, foster learning.

Pleasure was a central theme in the open focus group discussions. This is not surprising because play, in its most fundamental expression, is seen as one of the primary positive emotions common to all mammals. Interestingly, students' perceptions of what made play pleasurable varied considerably, and involved not only positive affect (e.g. fun, sociability) but also affective states that can be taken in a more negative way (e.g. the urge to win). This variation persisted across participants and focus group sessions, even though the focus group composition was similar regarding demographic characteristics. This finding is consistent with previous literature stating that play preference, inclination to play, and the meaning of play is associated with many variables such as culture [54–56], personality [57–59], gender [60–62] and play frequency [63,64]. Attesting to the variable nature of play liking is that even negative affect, such as feelings of guilt or anti-social behaviours like sadism and violence [65–67], can be pursued in play and games and might be considered pleasurable in certain contexts [68–71]. It thus seems clear that in humans any analysis of the interaction between pleasure and play must also exceed the level of primary emotion.

In our analysis of the transcripts, we adopted a multilevel conceptualization of pleasure [72], where we consider pleasure as more than just the joy of playing, which resonates findings from other fields such as developmental psychology, psychoanalysis and neuroscience [18,72–74]. Pleasure research showed that various positive and negative behaviours and incentives can activate the same pleasure system in the brain, and that pleasure is contextual and mainly dependent on individual experiences [75,76]. Pleasure can also refer to mood states (e.g. happiness [77], a feeling of content), which can be maintained by perseverance [78,79] , even at the cost of momentary negative affect [80, 81].Human play has also been associated with interest [82–84], surprise [85–87], and arousal [88–90]. In our focus group discussions, some students mentioned that the anticipatory joy of possibly winning as a main reason why playing was fun for them. Students also discussed the pleasure of uncertainty in this respect. On one hand, they perceived the pleasure of uncertainty (imagining winning the game) as more motivating than the pure pleasure of certainly winning ("difficult wins over easy wins"). On the other hand, they perceived a high probability of not being able to achieve the desired outcome (certain loss) as demotivating, and in fact, as a reason to end the game, which is in line with the literature [91]. Indeed, is it well established that reward probability has a powerful effect on the anticipatory state of pleasure; the greater the reward uncertainty, the greater the motivating effect will be, but only if there is (at least) some probability in receiving that reward [91,92].

Another frequently discussed element of play pleasure was sociality. Many students believed that playing together was way more fun than playing alone. This is in line with findings of research in animals other than humans, in which social play is characterized as a high level reward [93,94], more pleasurable than other forms of social interaction [95–97] and, intriguingly, at times even more pleasurable than food [98,99]. Also in human studies, it has empirically been shown that a prominent characteristic of social play is its high reward value [98,100]. However, some students appeared to be hesitant of social play, they perceived that pleasure gained from social play was sensitive to any dominance hierarchy within the player group.

A main observation from the focus group sessions was that students' enthusiasm about play dampened when the context of the discussion shifted from leisure time to academic learning and GBL. Students mentioned many instances where play could be beneficial for their learning, or even for their personal wellbeing. However, students also mentioned that GBL felt, at times, like a paradox and that play cannot be implemented in every course. Perhaps, this might be attributed to a shift from intrinsically motivation (free play in leisure time) and extrinsically motivation (when play becomes tasked based and therefore, possibly, less fun). Another important aspect of this particular discussion was that students perceived the implementation of play as the opposite of efficient learning.

This criticism had to do with the underlying belief that academic learning is serious, and that the opposite of seriousness is play. Students indicated that the act of academic learning should be efficient, but saw play as inefficient. Nevertheless, they seemed to justify the *inefficiency* of play when it could increase the *efficiency* of learning. They saw the greatest benefits for the somewhat tedious, difficult subject matter. As a corollary, this may also imply that if students judge a particular learning activity as too playful, they will critisize it as inefficient and rather prefer to avoid participating. This is in line with the moderate enjoyment hypothesis theorizing that the general relationship between entertainment and learning is inverse u-shaped [101]. According to this hypothesis, entertainment (and the resulting pleasure) only facilitates learning up to a certain point, the peak of the inverted u-shape. After that point, learning will decreases, possibly due to distraction (leading to inefficiency) of entertainment [88]. Interestingly, but paradoxically enough, pleasure associated with playing may be perceived as hindering the achievement of higher (academic) goals which, in turn, is also part of the pursuit of happiness and wellbeing by providing long-term pleasures [75].

Considering play as inefficient corresponds with the literature on this subject. For instance, Suits et al. (1978) stated that all play involves sacrifice of efficiency; there are always easier ways to obtain goals than through play. In golf, for example, there are far more efficient ways to get a small round object into the ground than with the swing of a golf club, but the voluntary acceptance of game rules permits the player to do so [52]. He and many others argued that without the voluntary acceptance of these rules (with an inherent loss of efficiency), play will be lost [34,50–52]. Voluntarily accepting rules in favor of less efficient means also resonates with our finding. Students stated that play implemented as a learning tool (i.e. GBL) should not become a compulsory activity for students. This is in line with work from developmental psychologists [102,103], research on motivational theories applied to play [104] and views from play scholars [34,50,52].
Students' opinions about competition in play varied considerably, depending on the context. When students considered competition in the context of leisure time play, their focus was on the (prospective) joy of winning and they could also interpret winning and losing as trivial outcomes of play. However, students saw it as a serious matter in the context of academic learning. They felt that competitive elements in a learning environment could possibly lead to unwanted and stressful confrontations with the serious world, or make them too much reward focused. Nevertheless, competition was believed to enhance learning but especially when played in teams or when played anonymously.

Finally, our findings can be explained by various theories on motivation and game design. For instance, the findings that students play for sociability and challenge, but need to feel free in doing so, closely ties in with the self-determination theory [105]. This theory

has been linked to videogames [104] serious games [106]and gamification [107,108] in prior studies, and states that individuals are intrinsically motivated when the basic psychological needs of feelings of competence (challenges), relatedness (sociability) and autonomy are met. Many of our findings reflect these psychological needs, yet, students did not seem to prefer all the three psychological needs simultaneously. For instance, some students implicitly mentioned that competence was an important indicator to continue play; the possibility to improve one-self. Others, however, did not play for competence, but rather for the sake of sociability (pertaining to the 'relatedness' need). Also differing from the relatedness need were the students that were interested in a single player game that draws them in the story-line. Autonomy on the other hand was very much agreed upon; play should not be compulsory. Building on the self-determination theory, Nicholson's RECIPE for meaningful gamification is a design theory that describes six elements (Reflection, Engagement, Information, Choice, Exposition and Play) in order to attain intrinsically motivated usage [107]. This theory is in line with many of our findings. For instance, GBL/play should be free (Play element) and should be a choice (Choice element), should not deviate too much from the real world setting (otherwise it might be deemed inefficient; Information and Exposition element), should be challenging and socially engaging (Engagement element) and have a narrative (Exposition element).

Practical and research implications

In research on GBL, design choices have rarely been made explicit and most studies use the same type of design [3]. However, perceptions of play are highly individual, contextual and variable so one-design-fits-all approaches do not seem to work well for GBL research, according to our results. A thorough understanding of specific students' perceptions within a culture or university might therefore play a pivotal role in utilizing the full potential of GBL. In the future, researchers and educators should map students' play preferences before implementing GBL. Such information is essential for both the design of effective GBL activities and transfer of existing research into educational practice. As a first step in designing GBL and engaging in evidence-based decision making, teachers need to compare the play preferences of research participants in the study design with the play preferences of their own target group. This information also helps researchers understand and clarify what type of design works, for whom, in what situation/circumstances. Thanks to the manageable and flexible possibilities of digital media, such an approach will bring tailor-made education a step closer.

Educators who want to implement GBL should aim at balancing the interaction between play and learning, harmonizing the right amount of play with the serious to increase efficiency of learning. What educators first should determine when they engage in teaching difficult subjects, is whether there is a real need for play by identifying problems in students' learning attitudes or learning behaviours (van Gaalen et al., 2020 online

ahead of print). Currently, determining the *right* amount of play and *how* learning efficiency can be improved seems to depend on intuition and personal perceptions rather than evidence-based decision and is therefore an area for future research.

One of our main findings was that participants strongly expected, or found, pleasure in play. The pleasure in games is strongly related to playing time [90]. Longer periods of time spent at GBL might indicate increased repetition of the learning material which, in turn, will lead to improved learning outcomes and retention[3,109–112]. Educators who want to design GBL could, therefore, adopt different positive motivational forces of pleasure as method to guide their design. Using pleasure as motivational force also opens exciting new ways for research. Negative motivational forces (e.g. violence) were also often observed in games [65,66], but their roles have rarely been investigated in the context of GBL [3,5,9,113].

We identified sociability as major incentive for medical and dental students to play. Consequently, social play might be an interesting design option for GBL material. Strikingly, social play is underrepresented in GBL research, since most studies adopt a single player approach [3,9,26,113,114]. Although students felt that competition could enhance their learning, educators should be careful with implementing competitive elements in GBL, because these may also cause undesired effects such as increased stress. Playing in teams or in anonymity may be more appropriate options for such scenarios.

Strength and Limitations

A strength of our focus group study may be that it generated a rich understanding of students' perceptions, experiences and beliefs with respect to play and the interaction between play and learning. An experienced moderator guided the focus group session and stimulated in-depth discussions, we thoroughly explored students' perceptions, two independent researchers identified codes and the whole team, including the moderator, discussed and reflected on themes.

As in any focus group study, the identified themes unavoidably bear some relation to the original impetus for asking the questions and designing the interview guide. We tried to counteract this by actively encouraging input from all students during the sessions, even if it deviated from the original topic list.

In focus group studies, researchers sometimes meet with their participants to verify the generated themes. Although we did end every focus group discussion with a summary, to check whether our summary was appropriate to how the participants experienced it - we did not opt to meet with our participants - which potentially could have altered our outcome.

The gender ratio in our sample was imbalanced in favour of female students (70% was female). Although this ratio represents the Dutch medical student population [115], some countries might have gender ratios more balanced towards males (e.g. medical schools in the USA have around 50% male students[116]). Literature argues that the liking of play differs between gender [117,118]. Therefore, there is a possibility that our findings are more pertinent to female students. Yet, our aim was not to provide generalization, or find a consensus, during the focus group. Even in our coding we aimed to include varied opinions on play and GBL. However, although we tried to counteract an imbalance towards female students, results might be localized to the students of Dutch medical schools.

The meaning of play is associated with many variables such as culture [54–56]. Since we used convenience sampling, the participants in this study predominantly had a similar ethnic background (European/Caucasian), and possible also a similar socioeconomic background [119]. Therefore, cultural and regional differences might have affected the results of our study. In a different setting the same methodology might yield different results.

Finally, our findings on the play-learning interaction reflect students' perceptions. Perceptions, however, do not always reflect actual behaviour, meaning that students not always do what they say they do. For example, in a study on using leader boards to increase the use of laparoscopic simulators, the majority of the surgical residents mentioned not to be motivated by leader boards. However, the results showed that the time students in the competition group had spent on the simulation was increased as compared to the control group [120]. Additionally, because students in our sample have little experience with GBL they might not fully understand all the possibilities of GBL and, therefore, might have provided limited answers. Nonetheless, we believe that our findings offer important insights for future research to examine which design and GBL situation holds the highest promise for learning.

Conclusion

With this focus group study we aimed to explore students' perceptions of play and the play-learning interaction. We explored what they considered to be play and how they believed it could interact with their learning. Four key points emerge from our study: (1) Students play for pleasure. Perceptions of pleasure vary considerably among students; (2) Students consider play as inefficient. Inefficiency will only be justified when it increases learning; (3) Play should be balanced with the serious and only be used for difficult or tedious courses. (4) GBL activities should not be made compulsory for students, since there is a discrepancy between the serious of compulsory activities and the free nature of play.

References

1. Suppan M, Gartner B, Golay E, et al. Teaching Adequate Prehospital Use of Personal Protective Equipment During the COVID-19 Pandemic: Development of a Gamified e-Learning Module. JMIR Serious Games. Published online 2020. doi:10.2196/20173
2. Iancu AM, Kemp MT, Alam HB. Unmuting Medical Students' Education: Utilizing Telemedicine During the COVID-19 Pandemic and Beyond. J Med Internet Res. Published online 2020. doi:10.2196/19667
3. van Gaalen AEJ, Brouwer J, Schönrock-Adema J, Bouwkamp-Timmer T, Jaarsma ADC, Georgiadis JR. Gamification of health professions education: a systematic review. Adv Heal Sci Educ. Published online 2020. doi:10.1007/s10459-020-10000-3
4. Gentry SV, Gauthier A, Ehrstrom BLE, et al. Serious gaming and gamification education in health professions: systematic review. J Med Internet Res. Published online 2019. doi:10.2196/12994
5. Gorbanev I, Agudelo-Londono S, Gonzalez RA, et al. A systematic review of serious games in medical education: quality of evidence and pedagogical strategy. Med Educ Online. 2018;23(1):1438718. doi:10.1080/10872981.2018.1438718
6. Hosseini H, Hartt M, Mostafapour M. Learning IS child's play: Game-based learning in computer science education. ACM Trans Comput Educ. Published online 2019. doi:10.1145/3282844
7. Barzilai S, Blau I. Scaffolding game-based learning: Impact on learning achievements, perceived learning, and game experiences. Comput Educ. Published online 2014. doi:10.1016/j.compedu.2013.08.003
8. Dicheva D, Dichev C, Agre G, Angelova G. Gamification in education: A systematic mapping study. Educ Technol Soc. Published online 2015.
9. Dichev C, Dicheva D. Gamifying education: what is known, what is believed and what remains uncertain: a critical review. Int J Educ Technol High Educ. Published online 2017. doi:10.1186/s41239-017-0042-5
10. D'Angour A. Plato and Play: Taking Education Seriously in Ancient Greece. Am J Play. Published online 2013.
11. Thorndike EL. The mental life of the monkeys. Psychol Rev Monogr Suppl. Published online 1901. doi:10.1037/h0092994
12. Hobhouse LT. Mind in Evolution. Philos Rev. Published online 1903. doi:10.2307/2176983
13. Vandenberg B. Play, problem-solving, and creativity. New Dir Child Adolesc Dev. Published online 1980. doi:10.1002/cd.23219800906
14. Smith PK, Dutton S. Play and Training in Direct and Innovative Problem Solving. Child Dev. Published online 1979. doi:10.2307/1128950
15. Bruner JS, Jolly A, Sylva K. Play-Its Role in Development and Evolution (Book). J Pers Assess. Published online 1978. doi:10.1207/s15327752jpa4205_20
16. Pellegrini AD, Gustafson K. Boys' and Girls' Uses of Objects for Exploration, Play, and Tools in Early Childhood. In: The Nature of Play: Great Apes and Humans. ; 2004.
17. Dansky JL. Make-Believe: A Mediator of the Relationship between Play and Associative Fluency. Child Dev. Published online 1980. doi:10.2307/1129296
18. Lieberman JN. PLayfulness. Its Relationship to Imagination Akd Creativity.; 1977. doi:10.1037/h0071291
19. Whitebread D, Coltman P, Jameson H, Lander R. Play, cognition and self-regulation: What exactly are

children learning when they learn through play? Educ Child Psychol. Published online 2009.

20. Köhler W. Problem Solving by Chimpanzees. In: Readings in General Psychology. ; 1925. doi:10.1037/11352-044
21. Vandenberg B. Play and development from an ethological perspective. Am Psychol. Published online 1978. doi:10.1037/0003-066X.33.8.724
22. Cheyne JA, Rubin KH. Playful precursors of problem solving in preschoolers. Dev Psychol. Published online 1983. doi:10.1037/0012-1649.19.4.577
23. De Croon R, Wildemeersch D, Wille J, Verbert K, Abeele V Vanden. Anthropomorphism-based focus group protocol to select gamification mechanics. In: CEUR Workshop Proceedings. ; 2017.
24. Hsu SH, Chang JW, Lee CC. Designing attractive gamification features for collaborative storytelling websites. Cyberpsychology, Behav Soc Netw. Published online 2013. doi:10.1089/cyber.2012.0492
25. Oksanen K. Subjective Experience and Sociability in a Collaborative Serious Game. Simul Gaming. Published online 2013. doi:10.1177/1046878113513079
26. Wang R, DeMaria SJ, Goldberg A, Katz D. A Systematic Review of Serious Games in Training Health Care Professionals. Simul Healthc. 2016;11(1):41-51. doi:10.1097/SIH.0000000000000118
27. Wu SC, Rao N. Chinese and German teachers' conceptions of play and learning and children's play behaviour. Eur Early Child Educ Res J. Published online 2011. doi:10.1080/1350293X.2011.623511
28. Barnett LA. The nature of playfulness in young adults. Pers Individ Dif. Published online 2007. doi:10.1016/j.paid.2007.02.018
29. Yee N, Ducheneaut N, Nelson L. Online gaming motivations scale. In: ; 2012. doi:10.1145/2207676.2208681
30. Chin A Paw MJM, Jacobs WM, Vaessen EPG, Titze S, van Mechelen W. The motivation of children to play an active video game. J Sci Med Sport. Published online 2008. doi:10.1016/j.jsams.2007.06.001
31. Colwell J. Needs met through computer game play among adolescents. Pers Individ Dif. Published online 2007. doi:10.1016/j.paid.2007.06.021
32. Johnson D, Wyeth P, Sweetser P, Gardner J. Personality, genre and videogame play experience. In: ACM International Conference Proceeding Series. ; 2012. doi:10.1145/2367616.2367633
33. Poels K, De Kort Y, IJsselsteijn W. "It is always a lot of fun!" Exploring dimensions of digital game experience using focus group methodology. In: Proceedings of the 2007 Conference on Future Play, Future Play '07. ; 2007. doi:10.1145/1328202.1328218
34. Eberle SG. The Elements of Play Toward a Philosophy and a Definition of Play. Am J Play. Published online 2014.
35. Glynn MA, Webster J. The Adult Playfulness Scale: An Initial Assessment. Psychol Rep. Published online 1992. doi:10.2466/pr0.1992.71.1.83
36. Yee N. Facets: 5 motivation factors for why people play MMORPGs. Http://WwwNickyeeCom/Facets/HomeHtml. Published online 2002.
37. Quaiser-Pohl C, Geiser C, Lehmann W. The relationship between computer-game preference, gender, and mental-rotation ability. Pers Individ Dif. Published online 2006. doi:10.1016/j.paid.2005.07.015
38. Hamari J, Tuunanen J. Player Types: A Meta-synthesis. Trans Digit Games Res Assoc. Published online 2014. doi:10.26503/todigra.v1i2.13
39. Hutt C, Bhavnani R. Predictions from play. Nature. Published online 1972. doi:10.1038/237171b0

40. Caillois R, Berger BM, Barash M. Man, Play, and Games. Am Sociol Rev. Published online 1963. doi:10.2307/2090095
41. Stalmeijer RE, McNaughton N, Van Mook WNKA. Using focus groups in medical education research: AMEE Guide No. 91. Med Teach. Published online 2014. doi:10.3109/0142159X.2014.917165
42. Krueger AR, Casey AM. Richard A. Krueger & Mary Anne Casey (2000). Focus Groups. A Practical Guide for Applied Research (3rd Edition).; 2000.
43. Malterud K, Siersma VD, Guassora AD. Sample Size in Qualitative Interview Studies. Qual Health Res. Published online 2016. doi:10.1177/1049732315617444
44. Frey BB. ATLAS.ti. In: The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation. ; 2018. doi:10.4135/9781506326139.n57
45. Kiger ME, Varpio L. Thematic analysis of qualitative data: AMEE Guide No. 131. Med Teach. Published online 2020. doi:10.1080/0142159X.2020.1755030
46. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. Published online 2006. doi:10.1191/1478088706qp063oa
47. Barbour R. Doing Focus Groups.; 2011. doi:10.4135/9781849208956
48. Attride-Stirling J. Thematic networks: An analytic tool for qualitative research. Qual Res. Published online 2001. doi:10.1177/146879410100100307
49. King N, Cassell C, Symon G. Using templates in the thematic analysis of texts. Essent Guid to Qual methods Organ Res. Published online 2004.
50. Huizinga J. Homo Ludens: A Study of the Play-Element in Culture.; 1938. doi:10.4324/9781315824161
51. Sutton-Smith B. Play and Ambiguity. Game Des Read A Rules Play Anthol. Published online 2005.
52. Suits B. The Grasshopper: Games, Life and Utopia, Bernard Suits.; 1978. doi:10.1073/pnas.0703993104
53. Wein E, Sutton-Smith B. The Ambiguity of Play. J Am Folk. Published online 2000. doi:10.2307/541295
54. Fajans J. They make themselves: work and play among the Baining of Papua New Guinea. Choice Rev Online. Published online 1997. doi:10.5860/choice.35-2189
55. Vandenberg B. Play: Dormant Issues and New Perspectives. Hum Dev. Published online 1981. doi:10.1159/000272730
56. Farver JAM, Kim YK, Lee Y. Cultural Differences in Korean- and Anglo-American Preschoolers' Social Interaction and Play Behaviors. Child Dev. Published online 1995. doi:10.1111/j.1467-8624.1995.tb00924.x
57. Teng CI. Personality differences between online game players and nonplayers in a student sample. Cyberpsychology Behav. Published online 2008. doi:10.1089/cpb.2007.0064
58. Chory RM, Goodboy AK. Is basic personality related to violent and non-violent video game play and preferences? Cyberpsychology, Behav Soc Netw. Published online 2011. doi:10.1089/cyber.2010.0076
59. Demaree HA, DeDonno MA, Burns KJ, Erik Everhart D. You bet: How personality differences affect risk-taking preferences. Pers Individ Dif. Published online 2008. doi:10.1016/j.paid.2008.01.005
60. Jansz J, Avis C, Vosmeer M. Playing the sims2: An exploration of gender differences in players' motivations and patterns of play. New Media Soc. Published online 2010. doi:10.1177/1461444809342267
61. Hoeft F, Watson CL, Kesler SR, Bettinger KE, Reiss AL. Gender differences in the mesocorticolimbic system during computer game-play. J Psychiatr Res. Published online 2008. doi:10.1016/j.jpsychires.2007.11.010

62. Ostrov JM, Keating CF. Gender differences in preschool aggression during free play and structured interactions: An observational study. Soc Dev. Published online 2004. doi:10.1111/j.1467-9507.2004.000266.x
63. Denden M, Tlili A, Essalmi F, Jemni M. Does personality affect students' perceived preferences for game elements in gamified learning environments? In: Proceedings - IEEE 18th International Conference on Advanced Learning Technologies, ICALT 2018. ; 2018. doi:10.1109/ICALT.2018.00033
64. Cheong C, Filippou J, Cheong F. Towards the gamification of learning: Investigating student perceptions of game elements. J Inf Syst Educ. Published online 2014.
65. Hartmann T, Toz E, Brandon M. Just a game? unjustified virtual violence produces guilt in empathetic players. Media Psychol. Published online 2010. doi:10.1080/15213269.2010.524912
66. Jansz J. The emotional appeal of violent video games for adolescent males. Commun Theory. Published online 2005. doi:10.1093/ct/15.3.219
67. Kircaburun K, Jonason PK, Griffiths MD. The Dark Tetrad traits and problematic online gaming: The mediating role of online gaming motives and moderating role of game types. Pers Individ Dif. Published online 2018. doi:10.1016/j.paid.2018.07.038
68. Goldsmith K, Cho EK, Dhar R. When guilt begets pleasure: The positive effect of a negative emotion. J Mark Res. Published online 2012. doi:10.1509/jmr.09.0421
69. Hanich J. Dis/liking disgust: the revulsion experience at the movies. New Rev Film Telev Stud. 2009;7:3:293-309. doi:10.1080/17400300903047052
70. Strenziok M, Krueger F, Deshpande G, Lenroot RK, Van der meer E, Grafman J. Fronto-parietal regulation of media violence exposure in adolescents: A multi-method study. Soc Cogn Affect Neurosci. Published online 2011. doi:10.1093/scan/nsq079
71. Buckels EE, Trapnell PD, Paulhus DL. Trolls just want to have fun. Pers Individ Dif. Published online 2014. doi:10.1016/j.paid.2014.01.016
72. Moccia L, Mazza M, Nicola M Di, Janiri L. The experience of pleasure: A perspective between neuroscience and psychoanalysis. Front Hum Neurosci. Published online 2018. doi:10.3389/fnhum.2018.00359
73. Ferguson CJ, Olson CK. Friends, fun, frustration and fantasy: Child motivations for video game play. Motiv Emot. Published online 2013. doi:10.1007/s11031-012-9284-7
74. Proyer RT. A new structural model for the study of adult playfulness: Assessment and exploration of an understudied individual differences variable. Pers Individ Dif. Published online 2017. doi:10.1016/j.paid.2016.12.011
75. Berridge KC, Kringelbach ML. Pleasure Systems in the Brain. Neuron. Published online 2015. doi:10.1016/j.neuron.2015.02.018
76. Georgiadis JR, Kringelbach ML. The human sexual response cycle: Brain imaging evidence linking sex to other pleasures. Prog Neurobiol. Published online 2012. doi:10.1016/j.pneurobio.2012.05.004
77. Seligman. Flourish: a visionary new understanding of happiness and well-being. Choice Rev Online. Published online 2011. doi:10.5860/choice.48-7217
78. Vella-Brodrick DA, Park N, Peterson C. Three ways to be happy: Pleasure, engagement, and meaning - Findings from Australian and US samples. Soc Indic Res. Published online 2009. doi:10.1007/s11205-008-9251-6

79. Peterson C, Ruch W, Beermann U, Park N, Seligman MEP. Strengths of character, orientations to happiness, and life satisfaction. J Posit Psychol. Published online 2007. doi:10.1080/17439760701228938
80. Singh K, Jha SD. Positive and negative affect, and grit as predictors of happiness and life satisfaction. J fo Indian Acad Appl Psychol. Published online 2008.
81. Panksepp J. Affective Neuroscience: The Foundations of Human and Animal Emotions (Series in Affective Science).; 2004.
82. Ellsworth PC, Smith CA. Shades of joy: Appraisals differentiating among positive emotions. Cogn Emot. Published online 1988. doi:10.1080/02699938808412702
83. Smith CA, Ellsworth PC. Patterns of Cognitive Appraisal in Emotion. J Pers Soc Psychol. Published online 1985. doi:10.1037/0022-3514.48.4.813
84. Boulanger JS, Kienzle J, Verbrugge C. Comparing interest management algorithms for massively multiplayer games. In: Proceedings of 5th ACM SIGCOMM Workshop on Network and System Support for Games, NetGames '06. ; 2006. doi:10.1145/1230040.1230069
85. Mellers BA, Schwartz A, Ho K, Ritov I. Decision Affect Theory: Emotional Reactions to the Outcomes of Risky Options. Psychol Sci. Published online 1997. doi:10.1111/j.1467-9280.1997.tb00455.x
86. Mellers B, Fincher K, Drummond C, Bigony M. Surprise. A belief or an emotion? In: Progress in Brain Research. ; 2013. doi:10.1016/B978-0-444-62604-2.00001-0
87. De Alfaro L, Faella M, Henzinger TA, Majumdar R, Stoelinga M. The element of surprise in timed games. Lect Notes Comput Sci (including Subser Lect Notes Artif Intell Lect Notes Bioinformatics). Published online 2003. doi:10.1007/978-3-540-45187-7_9
88. Conati C. Probabilistic assessment of user's emotions in educational games. Appl Artif Intell. Published online 2002. doi:10.1080/08839510290030390
89. Reuderink B, Mühl C, Poel M. Valence, arousal and dominance in the EEG during game play. Int J Auton Adapt Commun Syst. Published online 2013. doi:10.1504/IJAACS.2013.050691
90. Poels K, Hoogen W Van Den, Ijsselsteijn W, De Kort Y. Pleasure to play, arousal to stay: The effect of player emotions on digital game preferences and playing time. Cyberpsychology, Behav Soc Netw. Published online 2012. doi:10.1089/cyber.2010.0040
91. Knutson B, Taylor J, Kaufman M, Peterson R, Glover G. Distributed neural representation of expected value. J Neurosci. Published online 2005. doi:10.1523/JNEUROSCI.0642-05.2005
92. Tobler PN, Fiorillo CD, Schultz W. Adaptive coding of reward value by dopamine neurons. Science (80-). Published online 2005. doi:10.1126/science.1105370
93. Vanderschuren LJMJ, Niesink RJM, Van Ree JM. The neurobiology of social play behavior in rats. Neurosci Biobehav Rev. Published online 1997. doi:10.1016/S0149-7634(96)00020-6
94. Panksepp J, Siviy S, Normansell L. The psychobiology of play: Theoretical and methodological perspectives. Neurosci Biobehav Rev. Published online 1984. doi:10.1016/0149-7634(84)90005-8
95. Calcagnetti DJ, Schechter MD. Place conditioning reveals the rewarding aspect of social interaction in juvenile rats. Physiol Behav. Published online 1992. doi:10.1016/0031-9384(92)90101-7
96. Trezza V, Damsteegt R, Vanderschuren LJMJ. Conditioned place preference induced by social play behavior: Parametrics, extinction, reinstatement and disruption by methylphenidate. Eur Neuropsychopharmacol. Published online 2009. doi:10.1016/j.euroneuro.2009.03.006

97. Humphreys AP, Einon DF. Play as a reinforcer for maze-learning in juvenile rats. Anim Behav. Published online 1981. doi:10.1016/S0003-3472(81)80173-X
98. Trezza V, Baarendse PJJ, Vanderschuren LJMJ. The pleasures of play: Pharmacological insights into social reward mechanisms. Trends Pharmacol Sci. Published online 2010. doi:10.1016/j.tips.2010.06.008
99. Mason WA, Saxon S V., Sharpe LG. Preferential responses of young chimpanzees to food and social rewards. Psychol Rec. Published online 1963. doi:10.1007/bf03393535
100. Sanfey AG. Social decision-making: Insights from game theory and neuroscience. Science (80-). Published online 2007. doi:10.1126/science.1142996
101. Ritterfeld U, Weber R. Video games for entertainment and education. In: Playing Video Games: Motives, Responses, and Consequences. ; 2006. doi:10.4324/9780203873700
102. L.S Vygotsky. Mind in Society The Role of Play in Development. Univ Texas Press Slav Ser. Published online 1978:92-104. doi:10.2307/3726822
103. Karpov Y V. The Neo-Vygotskian Approach to Child Development.; 2014. doi:10.1017/CBO9781316036532
104. Ryan RM, Rigby CS, Przybylski A. The motivational pull of video games: A self-determination theory approach. Motiv Emot. 2006;30(4):347-363. doi:10.1007/s11031-006-9051-8
105. Ryan R, Deci E. Self-determination theory and the facilitation of intrinsic motivation. Am Psychol. 2000;55(1):68-78. doi:10.1037/0003-066X.55.1.68
106. Tyack A, Mekler ED. Self-Determination Theory in HCI Games Research: Current Uses and Open Questions. In: ; 2020. doi:10.1145/3313831.3376723
107. Nicholson S. A recipe for meaningful gamification. In: Gamification in Education and Business. ; 2015. doi:10.1007/978-3-319-10208-5_1
108. Landers RN, Bauer KN, Callan RC, Armstrong MB. Psychological theory and the gamification of learning. In: Gamification in Education and Business. ; 2015:165-186. doi:10.1007/978-3-319-10208-5_9
109. Kerfoot BP, Kearney MC, Connelly D, Ritchey ML. Interactive spaced education to assess and improve knowledge of clinical practice guidelines: A randomized controlled trial. Ann Surg. Published online 2009. doi:10.1097/SLA.0b013e31819f6db8
110. Hintzman DL. Repetition and Memory. Psychol Learn Motiv - Adv Res Theory. Published online 1976. doi:10.1016/S0079-7421(08)60464-8
111. Slamecka NJ, McElree B. Normal forgetting of verbal lists as a function of their degree of learning. J Exp Psychol Learn Mem Cogn. Published online 1983. doi:10.1037/0278-7393.9.3.384
112. Murre JMJ, Dros J. Replication and analysis of Ebbinghaus' forgetting curve. PLoS One. Published online 2015. doi:10.1371/journal.pone.0120644
113. M. G, J.M. S, M.P. S. Systematic review of serious games for medical education and surgical skills training. Br J Surg. 2012;99(10):1322-1330. doi:10.1002/bjs.8819
114. Akl EA, Pretorius RW, Sackett K, et al. The effect of educational games on medical students' learning outcomes: A systematic review: BEME Guide No 14. Med Teach. 2010;32(1):16-27. doi:10.3109/01421590903473969
115. Een op vijf leerlingen gezondheid of welzijn is man.
116. More women than men are enrolled in medical school | AAMC.
117. Williams D, Consalvo M, Caplan S, Yee N. Looking for gender: Gender roles and behaviors among online

gamers. J Commun. Published online 2009. doi:10.1111/j.1460-2466.2009.01453.x

118. Codish D, Ravid G. Detecting playfulness in educational gamification through behavior patterns. IBM J Res Dev. Published online 2015. doi:10.1147/JRD.2015.2459651
119. Wu Suen LJ, Huang HM, Lee HH. A comparison of convenience sampling and purposive sampling. J Nurs. Published online 2014. doi:10.6224/JN.61.3.105
120. El-Beheiry M, McCreery G, Schlachta CM. A serious game skills competition increases voluntary usage and proficiency of a virtual reality laparoscopic simulator during first-year surgical residents' simulation curriculum. Surg Endosc Other Interv Tech. 2017;31(4):1643-1650. doi:10.1007/s00464-016-5152-y

"everyone gets the experience some get the lesson"
~T.s. Eliot

4

The Headliner

Identifying Player Types to Tailor Game-Based Learning Design to Learners: Cross-sectional Survey using Q Methodology

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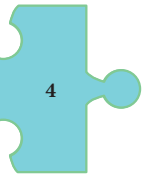
Introduction

In health professional education, there has been a growing interest in game-based learning because of its engaging properties and positive effects on students' motivation and learning [1]. Yet, the understanding of how and when to implement game-based learning in educating health professionals remains in its infancy [1] as well as in other educational domains [2]. Although there are myriad ways to design game-based learning strategies [2-4], there is little good-quality evidence to guide the choice of the most effective game-based learning design in a given educational context [1]. This, in turn, may increase the likelihood of choosing suboptimal or even counterproductive game-based learning strategies [5]. Hence, there is a need for empirical research to inform future game-based learning design [1].



Some scholars have stated that educational games are designed by academics who do not understand the culture, art, and science of games [6-8]. This may result in educational learning tools that can either be a success or a failure with respect to playability and engagement. On the other hand, games developed by game designers with little or no understanding of the theory and practice of game-based learning can be fun to play but are also hit-or-miss with respect to educational goals and outcomes. Indeed, designing an educationally sound game-based learning tool is a challenging task and depends highly on the synergy between pedagogy and engagement [5-8].

Practical applications of game-based learning have not been substantiated by a significant body of scientific research [1,3,9], which could be interpreted as corroboration for the abovementioned assertions. Researchers in health professional education generally take an educational approach to game-based learning without considering the body of knowledge available in the field of game research. For example, most game-based learning research in health professional education focused on one specific game attribute (ie, the effects of scoring and rewards) [1,2,10], although many other game attributes have also been investigated [3,11]. Moreover, game elements that motivate some learners may actually demotivate others [12-14] indicating that personal preference is a crucial element for motivation to play [15-18]. Game [19] and game-based learning [5,20] research consistently demonstrated that people vary greatly in what they like in play and games. Outside the domain of education for health professionals, individual differences in age, gender, culture, and personality play a role in a person's preferences for specific types of play, games, and responses to different game-based learning designs [20]. Linking personality traits with game-based learning design solutions that best fit each particular trait has been shown to improve learner experience (eg, perceived playfulness) [12,21-27], motivation [28-31], and performance [28,30]. Hence, preferences should be considered in designing game-based learning strategies to engage and motivate an entire cohort of students (not only a subgroup).

In the field of game research, the concept of player types is used to characterize users who share preference for a specific type of play, which enables game designers to create an optimal user experience [32]. In an earlier and probably best-known player typology [18], users of a multiplayer role-playing game were classified on the basis of two in-game behaviors—(1) acting versus interacting and (2) world versus player—which resulted in 4 different player types: socializers (users who like to interact with other players, eg, the game is a tool to meet other people), explorers (users who like to interact with the world, eg, discover new areas, and immerse themselves in the game world), achievers (users who like to act on the world, eg, prefer gaining rewards, points, and equipment from the game world), and killers (users who like to act upon other players, eg, thrive on beating other people) (Figure 1). Since then, various player types have been proposed [17,19,33-35]. However, there are major concerns with these player typologies. Many are not supported by empirical evidence [35]. Instead, they are based on researchers' prior experience in developing games [18,33], on nonscientific literature [36,37], or on combinations of some of the aforementioned player types [38]. Player typologies based on empirical data [17,19,39] tend to be based on research into a specific game genre, which means the typologies may be biased and incomplete. In addition, surveys that were used (eg, Likert-scale surveys [17,19,39]) may have unnecessarily limited respondents' answers and, thereby, researchers' interpretations. Hence, important information may have been overlooked [40].

In this study, we aimed to identify player types among a representative group of education for health professional students, independent of game context. As the first study of its kind, we aimed to explore the widest possible range of preferences for game and play in this group. We formulated the following research question: What patterns in students' perceptions of play and games (ie, player types) can be identified and what are their most important characteristics?

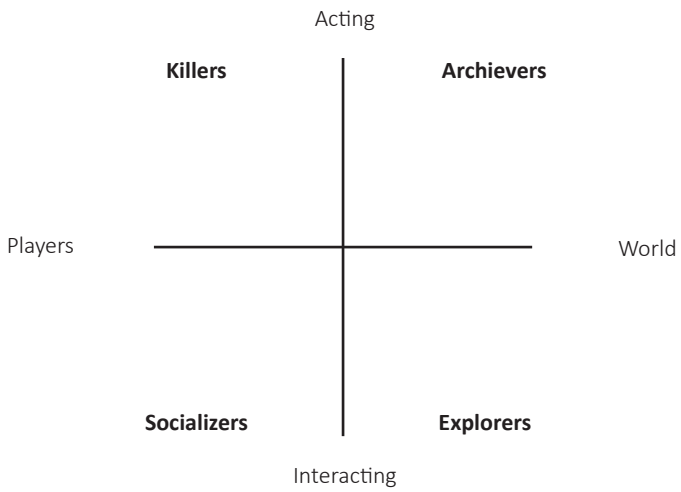
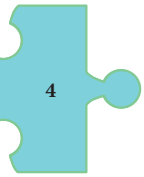


Figure 1. Typology [18] with 4 player types based on 2 themes: player vs world and acting vs interacting.

Methods

Design

To investigate students' perceptions of play, we applied Q-methodology [41], which is a mixed methods research technique that aims to account for all key subjective viewpoints on a certain matter [42]. The qualitative component of Q-methodology allows the expression of subjective opinions to be considered, and the quantitative component uses statistical analysis in order to group participants with shared opinions. Q-methodology is used to cluster individuals based on shared opinions rather than based on latent variables, which is the case in regular factor analysis (or R-methodology). The Q-methodology technique has been used before in medical education, although for different purposes (eg, for identifying different patterns of self-regulating learning behavior [43-45]). Q-methodology is characterized by two main stages: (1) designing a set of statements and let participants sort that set of statements, and (2) by-person correlation and factor analysis of a sample of the included participants.



Ethics

We obtained ethical approval for this study from the Netherlands Association for Medical Education (NVMO 2019.1.11).

Setting and Participants

This study was conducted in May 2019 at the Faculty of Medical Sciences of the University of Groningen, the Netherlands. The 6-year undergraduate medical and the 6-year undergraduate dental curriculum both consist of a 3-year Bachelor and a 3-year Master's phase. In both curricula, teachers used face-to-face and web-based teaching methods and sometimes apply game-based learning, but not on a regular or structural basis.

We invited all medical and dental students (3000 eligible undergraduate students) to participate in our study by posting an announcement on the web-based learning environment (called Nestor) of the university. Participants were informed about the purpose and procedures of the study. Their participation was anonymous, voluntary, and confidential. Participants had the right to withdraw from the study at any time. All participants provided informed consent. In appreciation for their time and effort, each participant received a 5€ (approximately US $5.66) gift certificate.

Although there is no decisive minimum or maximum number of participants for performing Q-methodology research [43], generally, the number of statements should exceed the number of participants [46], and 40 to 60 participants is considered adequate [47,48]. To achieve a highly diverse sample—which is recommended for Q-sort analysis [46,48]—we purposively selected participants. Therefore, we asked participants to

complete a sociodemographic questionnaire (eg, age, gender, and whether or not they considered themselves a gamer) prior to the sorting process that also included a question about the participant's favorite game. For our purposive sample, we included only participants who had specified a favorite game. We identified the game genre to ensure each game genre was represented evenly in the final sample. In addition, only participants who had performed the sorting task in 12 minutes or more were included. We conducted pilot testing and found that the average sorting time was 25 minutes (range 2-3 minutes) and that reading the statements and swiftly sorting the statements took at least 12 minutes; thus, for less than 12 minutes, the sort was regarded as ill-considered. If there were participants with identical favorite games, only one participant was included. Participants' preferences for modality (digital or analog) had to be distributed as evenly as possible across game genres; the male-to-female ratio had to be evenly distributed across game genres; and medical and dental student had to be evenly distributed across game genres. If a decision about inclusion or exclusion of a participant could not be made based the preceding criteria, the decision was made by rolling dice.

Statement Set

There is no single correct way to compile a set of statements in Q-methodology [41]. In general, the Q sample size is 40 to 80 statements [41,48], and the number of statements should exceed the number of participants [46]. A set containing too many statements can make the sorting process an exhausting and burdensome task, whereas a set containing too few statements may result in inadequate coverage of the topic of game preferences [41]. By sorting and prioritizing each statement from the statement set, individual participants provided us with a model of their view on their own game preferences. Statements should be carefully selected since their nature limits what can be expressed by a participant [49].

We aimed to develop a set of statements in which each statement was unique and made its own original contribution, and all statements together covered the full range of game preferences. Statements were based on the findings of an earlier focus group study [5] among medical and dental students (n=58) with no experience in game-based learning but widely varying experiences in play and games that had been conducted to obtain perspectives on leisure time and academic education. To make sure that the statement set covered as many aspects of game preferences as possible, we also examined player type studies [17-19,50] that possibly addressed different game preferences. This resulted in an initial set of 136 statements. We grouped the statements into 28 themes, duplicates were removed, and statements were translated into English and reworded to start with the phrase "I like games that…." in order to improve clarity and make sorting more intuitive for participants [41]. The final set (Table 1) consisted of 49 statements and was piloted by 3 medical students. Based on their feedback, we considered the final statement set to meet our abovementioned aims.

Table 1. Statement set.

Item no. Statement	Factors				
	1	2	3	4	5
1 I like games in which people help each other.	1	0	-2	3	-1
2 I like to see how others learn a new game.	-2	0	-1	-3	-3
3 I like games with easy wins.	-3	-3	-1	2	-2
4 I like games which create an atmosphere of sociability.	3	0	-3	1	1
5 I like games that let me build relationships.	2	0	-3	1	0
6 I like games that let me play in teams.	2	-1	0	2	0
7 I like to play games to maintain relationships.	1	-3	-2	2	0
8 I like games that let me play on my own.	-3	3	3	0	-1
9 I like games in which I can create something.	1	1	0	2	2
10 I like games that allow different ways of winning.	2	3	1	2	-2
11 I like games that use luck to enhance my odds of winning.	-1	-3	-1	-1	-4
12 I like games with a good storyline.	1	4	1	3	1
13 I like games in which I can influence the storyline.	0	4	0	0	-1
14 I like games in which I need to actively participate.	3	1	0	4	1
15 I like games in which I know the other players.	2	0	-2	0	3
16 I like games in which I can solve a difficult part / puzzle.	1	2	3	4	3
17 I like to improve my gameplay by searching for new techniques.	0	2	0	-2	-3
18 I like games in which I learn new things (e.g. knowledge/skills)	3	2	3	1	0
19 I like games in which I can act differently than I usually do in real life.	-2	1	-2	0	0
20 I like games which make you feel immersed in your own world.	-2	3	-1	-1	4
21 I like games that let me apply a strategy.	4	2	2	0	1
22 I like games in which I can bluff.	-1	-1	-2	0	3
23 I like games that have trading elements.	0	-2	-1	1	2
24 I like games in which I can negotiate.	1	1	-1	0	0
25 I like games that can be played differently than they are intended.	-1	1	-3	-2	2
26 I like games in which I can cheat.	-4	-2	-3	-4	3
27 I like games in which other players cheat.	-4	-4	-4	-4	-3
28 I like games in which I can be fanatic.	3	-2	1	-1	1
29 I like games in which I can play strictly by the rules.	0	-3	1	2	-2
30 I like games to which I can bring modifications.	-2	1	0	-2	0
31 I like games in which I can obtain as many points as possible.	-1	0	2	0	1
32 I prefer losing with lots of rewards over winning with very few.	-3	-1	-1	-1	-2
33 I like games which show me my progression.	2	2	2	1	0
34 I like games which let me have items that others don't manage to collect.	-2	-2	0	-1	0
35 I like games which have a reward at stake.	0	1	0	-1	-1
36 I like games in which I can get my revenge after losing.	0	-2	1	-1	1
37 I like games that show everyone that I've won.	-1	-2	1	-3	-3
38 I like games in which I can prove to the other players that I am the best.	-1	-1	2	-2	-2
39 I like games that use competition as a way to improve myself.	2	0	3	-1	-2
40 I like games in which I can annoy other players.	-1	-4	-2	-3	2
41 I like games that use competition to defeat other players.	1	0	1	-3	1
42 I like to be the best in a game.	1	-1	4	-2	2
43 I'm a good loser.	0	-1	-4	0	-4
44 Winning is important to me.	-1	-1	4	-2	2
45 I like games in which I can play alone against a game or computer	-3	3	2	1	-1
46 I like games which let me stay anonymous.	-2	1	1	1	-1
47 I like to get better in a game.	4	2	2	3	3
48 I like games that use a lot of different materials (e.g. dices, cards, fake money)	0	0	0	1	-1
49 I like games in which losing is okay.	0	-1	-1	3	-1

Sorting Procedure

Participants performed the sorting procedure using a web app (Q-sorTouch), in which the 49 statements were randomly presented. Participants were asked to drag and drop each statement into 3 piles: agree, neutral, disagree. After sorting all the statements, they had to refine their 3 piles by ranking the statements into a Q-sort grid ranging from −4, extremely disagree, to +4, extremely agree. In Q-methodology, the number of statements that can be assigned to each scale point are fixed and represent a quasi-normal distribution (Table 2) [41]; thus, participants placed the 2 statements with which they disagreed most under −4 and the 2 with which they agreed most under +4.

Table 2. Quasi-normal distribution.

Position	-4	-3	-2	-1	0	+1	+2	+3	+4
Number of items	2	4	6	8	9	8	6	4	2

The sorting procedure ended when all statements were placed in the fixed distribution and the participants felt that the final sort represented their viewpoint. In the final stage of the data collection, participants provided answers to open-ended questions to elaborate on the rationale behind their sort (eg, why statements were assigned to the extreme ends).

Statistical Analysis

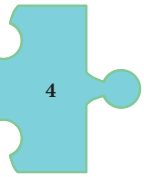
To identify groups of participants with shared, but distinct, viewpoints (ie, who subjectively ranked the 49 statements in a similar way), we conducted by-person factor analysis using dedicated software (PQMethod, version 2.35; developer: J Atkinson), which we later verified with formulas [48] in MATLAB (version R2020a; The MathWorks).

Because each sort was correlated with every other sort, the correlation matrix of the participants' sorted statement sets (ie, sorts) was used to identify factors (ie, groups of respondents whose Q-sorts were statistically similar) by subjecting the correlation matrix to varimax rotation [41]. Varimax rotation generates a factor solution according to the best mathematical solution (while maintaining an orthogonal basis) [48]. Only factors with eigenvalues >1 and on which at least 2 participants are loaded significantly ($P<.01$) were accepted [41,48,49], which corresponded to a factor loading >0.37, calculated using $2.58 \times (1 / \sqrt{}$ (number of items in the Q set) [41,48]. Since our aim was to extract patterns that were unique, participants loading on more than one factor were not used for the construction of a factor. This is in line with the procedures applied in other Q-methodology studies [41,43,44,48].

A range of factor solutions were generated. To describe patterns of the participants' game preferences, each factor solution was interpreted in conjunction with qualitative data from participants' responses in the final stage of the sort. To facilitate factor interpretation, ideal Q-sorts were computed for each factor. These so-called factor arrays are weighted averages of sorts loading on that factor [41,49]. A group of 9 independent researchers individually interpreted all factor solutions and were asked to identify the solution with the highest number of viewpoints while providing distinct and clearly interpretable factors.

Results

Overview



A total of 102 students volunteered to participate in our study and completed the sorting procedure. On the basis of their statements about their favorite games, we identified 7 game genres: action games (n=7), adventure games (n=6), party games (n=13), simulations or sports games (n=15), strategy games (n=35), puzzle games (n=14), and role-playing games (n=10). Consequently, we excluded 60 participants: 2 participants did not provide their favorite game; 10 participants performed the sort in less than 12 minutes; 36 participants had duplicate favorite games (eg, 11 participants stated the game Settlers of Catan); 9 participants (4 favorite digital games, 2 females and 3 male students) to ensure a more even distribution of these variables; and 3 participants, by the roll of the dice. The sample consisted of 42 participants (dental students: n=13; medical students: n=29) having 41 different favorite games, of whom 31 were female and 11 were male, with a mean age of 23.3 years (SD 4.0; range 18-42). Of the 42 participants, 15 participants considered themselves to be gamers. Nine sorts were confounded, and 3 sorts did not load significantly on any of the factors (factor loading <0.37; Table 3).

Factor Interpretation

Overview Solutions with up to 5 factors were obtained. The 5-factor solution was retained after analysis by 9 independent researchers because it represented 5 clearly distinguishable patterns in students' perceptions of play and games and had the highest percentage agreement between researchers (88.9%).

Of the 42 included sorts, 30 loaded significantly (factor loading >0.37; Table 3) on 1 of the 5 factors. These patterns are presented below, with sociodemographic information about the participants and a relevant statement to illustrate each pattern. For example, in pattern 1, statement 21 is in the extremely agree position (21: +4) in that factor array (Table 1). To give a concise (but oversimplified) overview of the patterns, we chose a descriptor for each that reflected its interpretation in a broad sense.

Table 3. Factor Matrix

Q sort	*Factor*				
	1	**2**	**3**	**4**	**5**
1	0.383	0.675[a]	0.211	0.182	0.170
2	0.559[a]	0.096	0.089	0.282	0.166
3	−0.041	0.670[a]	0.109	0.284	−0.019
4[b]	0.521	0.522	0.294	0.132	0.312
5	0.578[a]	0.183	0.147	0.031	0.025
6	0.226	0.753[a]	−0.057	0.188	0.048
7	−0.176	0.124	0.584[a]	0.171	0.109
8[c]	0.168	0.364	0.087	0.336	−0.094
9[c]	0.303	−0.296	0.316	0.361	−0.255
10	0.423[a]	0.288	−0.089	0.354	−0.065
11[b]	0.208	0.100	0.521	0.414	−0.334
12	0.501[a]	0.104	0.143	0.160	0.176
13[b]	0.531	0.253	0.535	0.241	−0.045
14	0.344	0.054	0.014	0.526[a]	0.060
15	0.368	0.562[a]	−0.065	0.387	0.110
16[b]	0.402	0.645	0.178	−0.003	0.106
17	−0.113	0.358	0.135	0.639[a]	−0.131
18	0.357	0.166	−0.137	−0.035	0.569[a]
19	0.191	0.703[a]	0.134	0.134	−0.392
20[b]	0.607	0.214	0.073	0.621	0.094
21	0.047	0.686[a]	0.188	−0.011	0.292
22	0.550[a]	0.097	0.038	0.328	−0.293
23	−0.011	0.695[a]	0.308	−0.158	0.055
24	0.708[a]	−0.067	0.237	0.159	0.009
25	0.341	0.175	−0.323	0.556[a]	−0.092
26	0.068	0.380	0.721[a]	0.222	0.131
27[b]	0.658	0.162	−0.202	0.448	−0.175
28	−0.041	0.089	0.246	−0.025	0.598[a]
29	0.320	0.019	0.052	0.479[a]	0.257
30	0.391	0.046	0.276	0.572[a]	−0.045
31[b]	−0.324	0.504	0.439	0.133	0.057
32	0.709[a]	−0.288	0.065	0.265	0.099
33	0.357	0.118	0.658[a]	−0.274	−0.137
34	0.551[a]	0.058	−0.100	0.042	−0.137
35	0.512[a]	0.226	0.223	0.195	−0.064
36	0.508[a]	0.128	−0.086	0.129	0.210
37	0.138	0.064	0.625[a]	−0.030	0.071
38[c]	0.173	0.096	0.190	0.294	−0.299
39[b]	0.199	0.435	0.043	0.073	0.452
40	0.474[a]	0.108	0.055	0.026	0.041
41[b]	0.467	0.327	0.580	−0.106	−0.030
42	0.596[a]	0.272	0.272	0.233	−0.070

a=A defining sort for a specific factor. b= A confounded Qsort (multiple loadings). c=A Q-sort with a factor loading <0.37.

Social Achiever

Pattern 1 comprised 12 participants with significant factor loadings (female: 9, male: 3; age: mean 23.7 years, range 18-42 years), of whom 7 were medical students, and 5 were

dental students. Of the 12 participants, 5 self-identified as gamers. Favorite game genres were strategy (n=5), action (n=3), party (n=2), and simulation or sport games (n=2). Preferred modality was distributed evenly; 6 participants favored analog games, and 6 participants favored digital games.

Participants in Pattern 1 shared the opinion that playing is a social act (4: +3; 5: +3), playing alone or in an individual competition with the self was, therefore, generally disliked (8: −3; 45: −3).

> *What I really like in games is to collaboratively achieve something meaningful.*- Student 3

The act of social togetherness was not enough for these participants, as they also expressed the need to obtain something meaningful through play (18: +3). Participants loading on this pattern tended to work hard and fanatically toward that goal (28: +3; 3: −3).

Notably, strategy was liked to a great extent (21: +4), which seemed attributable to the fun of being able to play socially and achieving something together (18: +3). Student 67 mentioned,

> *In my opinion, games are way more fun when you play them with friends …. besides, they will give us way longer fun when it is possible to apply a strategy…. This keeps the game interesting and fun for a longer time.*

Explorer

Pattern 2 comprised 7 participants with significant factor loadings (female: 5, male: 2; age: mean 23.1 years, range 20-31 years), of whom 6 were medical students, and 1 was a dental student. Of the 7 participants, 5 participants self-identified as gamers. Favorite games genres were adventure (n=3), role-playing (n=2), action (n=1), and puzzle games (n=1). The majority (n=5) favored a digital modality over an analog modality.

Pattern 2 was characterized by a need for immersion (20: +3), which was especially satisfied through story-driven games (12: +4, 13: +4). Student 21 stated,

> *A good game must drag me into the story and not let go until I am finished.*

These participants generally liked games that granted them substantial autonomy (10: +3; 29: −3) to explore and alter the game (25: +1; 30: +1). They seemed to be drawn to exploring the potential of the game rather than searching for sociability in play (8: +3; 45: +3; 7: −3). Participant 12 stated,

For me, gaming is something that I can do primarily on my own.

These participants played for their own sake or individual pleasure. (6: −1; 7: −3).

Competitor

Pattern 3 comprised 4 participants with significant factor loadings (female: 2, male: 1; age: mean 22.2 years, range 21-23 years). Two participants were medical, and 2 participants were dental students. Two participants self-identified as gamers. Favorite game genres in this group were puzzle (n=2) and simulation or sports games (n=2). Of the 4 participants, 3 students favored a digital modality over an analog modality.

Hunger for competition was the defining aspect of pattern 3 (39: +3)—not only winning or being the best (42: +4; 44: +4), but also parading their supremacy was considered important compared to the other patterns (37: +1; 38: +2). As stated by Student 93,

I am very competitive, I want to win every game and I want to show that to everyone.

Losing was therefore greatly disliked (43: −4). These participants shared the opinion with those described by pattern 2 that other game players were not important to them and they would rather play alone (8: +3); however, whereas participants described by pattern 2 had neither a strong preference nor a dislike for social togetherness as a characteristic of play (4: 0; 5: 0), participants described by pattern 3 found sociability in play unnecessary (4: −3; 5: −3; 7: −2; 15: −2). As Student 23 stated,

I play for myself, not for others.

Thus, competitors like competition that does not involve collaboration with others but is directed against other players (since they want to prove they are the best (37: +1; 38: +2)) or a nonplayable character. Student 23 stated,

I like to play independently of other players but with an opponent; so, against a computerized opponent.

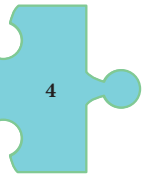
Socializer

Pattern 4 comprised 5 participants with significant factor loadings (female: 4, male: 1; mean age 26.2 years; range 2-9 years), of whom 4 were medical students, and 1 was a dental student. Of the 5 participants, 2 participants identified themselves as gamers. Favorite game genres in this group were party (n=2), role-playing (n=2), and action games (n=1). The majority favored an analog modality (n=4) over a digital modality (n=1).

Participants described by Pattern 4 and Pattern 1 had similar characteristics. They valued collaborative play (5: +1; 6: +2); however, whereas being fanatic was important in Pattern 1, in pattern 4, participants did not have the urge to focus on winning (44: −2) or being fanatic (28: −1). They generally disliked competition (41: −3; 42: −2; 44: −2).

> *Winning is not important to me, I just enjoy working together with others and having a good time together.* - Student 68

This concept of "having a good time" seemed to be a recurrent characteristic for Pattern 4. Games were seen as a means for social togetherness (7: +2; 1: +3) that should depend on nothing but sociability. Losing should be okay (49: +3) and winning should be easy (3: +2); however, participants felt that active participation would be needed to have a good time (14: +4).



Troll

Pattern 5 comprised 2 participants with significant factor loadings (female: 2; age: mean 23.5 years, range 2-5 years), and both were both medical students. One student self-identified as a gamer. One student favored action games, the other student favored simulation or sports games. Both students favored a digital modality (n=2).

Having the ability to exploit game mechanics to cheat (26: +3), annoy other players (40: +3), and bluff (22: +3) was important for these 2 participants compared with participants described by the other patterns. Such behavior seemed to be the result of boredom or laziness and not really being interested in the game itself. Notably, these participants were not inclined to invest time to learn new techniques (17: −3) but, paradoxically, wanted to get better in a game (47: +3), did not like to see others learn the game (2: −3), and were inclined to play games differently than intended when the game would take too much time (25: +2; 29: −2).

> *I like it when a game requires little prior knowledge. It is much simpler and easier to play.* - Student 51

Figure 2 presents a theoretical framework illustrating different player types in relation to sociability and achievement themes.

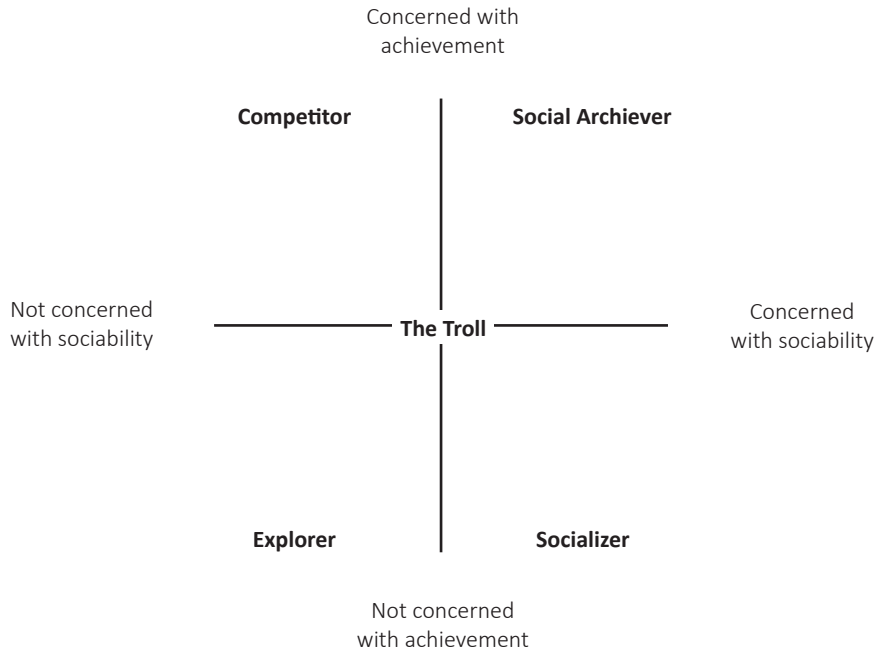


Figure 2. Theoretical framework illustrating player types in relation to the sociability and achievement themes.

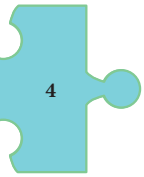
Discussion

Principal Findings

We aimed to improve the understanding of game-based learning design, in general, and of game-based learning in health professional education, in particular. We contended that player typology, a concept that has been used to inform game design and game play, may be relevant to game-based learning design. To the best of our knowledge, this study is the first to investigate player types in a student cohort, outside of a game design context, using a methodology deliberately aimed to accommodate the largest variety in game preferences. We found that, in a cohort of medical and dental students with likely similar academic interests and intellectual ability, there was considerable variability in play preferences. We identified 5 distinct and clearly interpretable patterns in game preferences, which can be considered player types: the social achiever, the explorer, the socializer, the competitor, and the troll. Given that only a few game elements are applied in education for health professionals research—predominantly points and rewards [1]—our findings indicate that there is room for improvement within game-based learning design; the current variety of game-based learning designs in education for health professionals seems too limited to be able to tailor game-based learning to students' game preferences to improve learning through motivation and engagement.

Each player type has distinct characteristics. Social achievers like to play collaboratively to achieve something meaningful. They like competition and difficult games, preferably in teams. In contrast, explorers are drawn to the game's story and immersive elements of play rather than winning and team play. Competitors on the other hand, thrive by winning and competition and would rather not depend on others. Socializers (much like social achievers) play for sociability, and interaction with other players is important to them. Yet, whereas competition is important to social achievers, socializers would rather play to find a sense of sociability and togetherness. They look for easy wins just to have a good time. Trolls like games in which they can annoy other players, bluff, and cheat.

Two themes (Figure 2) are salient in the player types that we identified, and likewise in scientific and grey literature on play and player typologies [17,19,35,39,51-56]: sociability and achievement. Competitors and social achievers like the achievement aspect of play, however, explorers and socializers instead preferred playing for the storyline or to enjoy playing together, respectively. Social achievers and socializers are driven by sociability, collaboration, and interaction; explorers and competitors, however, seem less prone to these traits or only need others to prove their supremacy. The troll is more ambivalent about sociability and achievement aspects of games than other player types and is, therefore, situated at the intersection of achievement and sociability.



Interestingly, the main themes identified in our theoretical framework bear similarity to the very first and often-cited player typology [18], which was based on a sample with homogeneity in terms of the preferred game, instead of homogeneity in terms of academic interest and which lacked any empirical basis. The fact that our study (which followed a more rigorous scientific approach) resulted in a similar typology may suggest that the existence of player types in a cohort is stable. Our scientific approach led to the identification of the explorer and the socializer, player types that have also previously been described [18]. We identified the social achiever, a player type that seems comparable with that of "achiever [18]." We additionally identified 2 other player type—the competitor and the troll—whereas in [18] only one other player type, namely the "killer [18]," which, upon close inspection, includes troll-like aspects (eg, annoying other players) as a social component (acting on other players). In our study, these characteristics appeared in other player types. We identified the troll and the competitor as separate player types. The achiever [18], with its social component was therefore interpreted as social achiever. The reason for these differences between both typologies may be that we also included games involving teamplay as a play genre in our framework, since we aimed to avoid selection bias from using only one or a few specific game genres to identify player types. The earlier typology [18] did not include teamplay, probably because it was based on a multiuser dungeon game that included role playing, player versus player, and chat functions but rarely team effort. We also found differences in relation to the dimensions on which the player types varied.

Whereas the dimensions world versus player and action versus interaction have been previously described [18] our empirical evidence supported achievement and sociability as player type dimensions. As a result, competitors and socializers were opposites in our framework (instead of "killers" and "explorers" [18]).

The troll as a player type has not been identified in previous studies [20]. Remarkably, however, the troll phenomenon is well known in the field of problematic gaming and internet use [57,58]. Trolling is defined as deliberately trying to create distress or conflict via provocation, for instance, for the purpose of deception or disruption [58]. More than one-third of American millennials said they engaged in the act of trolling [59] and an immensely popular digital game, called Among Us, is based on the concept of trolling (ie, sabotaging and causing chaos [60]). This suggests that the game-related behavior of trolling is not rare or marginal. Although the relevance of this player type to game-based learning design is unclear, this player type might also be pertinent outside the field of education for health professionals.

Strength and Limitations

The player types in this study represent a broad spectrum of views on games and play. One of the strengths of this study is that the comprehensive set of statements was derived from prior research among medical and dental students [5] and supplemented with statements taken from existing player type studies. Furthermore, a solid scientific method was used to account for all key subjective viewpoints on game preferences, and we included of a variety of participants (independent from game context) to prevent selection bias on game genre. In addition, we discussed multiple factor solutions, sought advice from expert authors [41], and verified Q-methodology software results. In doing so, we added a new perspective to literature on player types and game-based learning by identifying 5 patterns that were distinct, characteristic, and could be considered player types.

This study had some limitations: (1) In the interpretation of our patterns, we cannot (and do not) claim to be exhaustive with respect to all viewpoints on game preferences in the entire population. While Q-methodology is a method that aims to capture variety and heterogeneity, our participant group was relatively homogenous (medical and dental students). Therefore, we cannot claim that replication of our study in a different educational context would yield the same outcomes. However, by adding statements from prior (nonmedical) studies on player types in the statement set, and by using stratification to provide profuse and varied participants' opinions, we feel that the quantitative aspect of the Q-methodology (ie, analyzing participants' rankings using multivariate data reduction techniques) helped us detect meaningful patterns and connections in game preferences. This, in turn, may provide future researchers with a starting point to investigate the generalizability of our results. (2) In a recent study [5],

we showed that game elements are possibly context dependent (ie, aspects that motivate play may not necessarily play a motivating role in game-based learning). For instance, although competition was liked and named trivial in play in leisure time, students considered it stressful and unwanted in play focused on learning. Since we did not ask participants to keep a specific learning environment in mind when they answered the question about their game preferences, their answers may not reflect their game-based learning preferences. (3) We aimed to reduce selection bias by selecting participants independent of game context, however, we do not know whether they had a specific game or context in mind when they performed the sorting procedure. (4) We chose to adopt the 5-factor solution after rigorous discussions and with the help of 3 independent researchers. Although this allowed us to detect a new player type (the troll), few students had significant factor loadings on this player type. Nevertheless, this player type adhered to the widely accepted rules for including a factor in Q-methodology and helped explain the largest variety in play preferences [58].

By using Q-methodology, we aimed to explain as much variety in existing game preferences as possible; thus, our player types are extreme ends of a spectrum on game preferences. The factor arrays that construct these player types are the combined average of all sort loadings on that player type. Therefore, there is very little chance that a participant's sort will load 100% on a specific player type and fully match its definition [41]. Indeed, all sorts demonstrated characteristics of all player types, and no sort loaded 100% on one player type. Yet, most sorts loaded clearly on one player type.

Practical Implications and Future Research

Systematic reviews indicate that, often, game-based learning strategies are selected based on researchers' personal opinions rather than theory or a conceptual framework [1,2,61]. Additionally, there is a tendency in game-based learning strategies to use scoring and reward, especially in gamification [1,61]. Our taxonomy provides a novel theoretical framework that may help to tailor game-based learning strategies to student preferences. Future research is needed to investigate whether such tailoring would result in increased effectiveness of applying game-based learning in education.

Based on our findings, all player types except explorers might need the presence or participation of other players to be optimally motivated to continue playing. To develop game-based learning strategies that optimally engage and motivate the majority of students, multiplayer options appear to be critical. However, this feature is currently overlooked in game-based learning strategies in current practice [1,11,61].

Our theoretical framework and corresponding factor arrays indicate that preferences for multiplayer modalities can be diverse and are not limited to sociability [62], social media

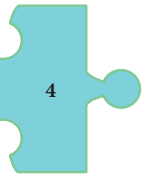
[63], a chat function [34], and message boards [64]. Competitors, for instance, need other players or computerized opponents to triumph over and show their supremacy, social achievers need other players to work with, trolls need other players to annoy, and socializers need other players to have a good time together. By including each player type in a game-based learning-strategy, the complex and dynamic interaction between player types can turn game-based learning into a meaningful strategy for every student. For example, although trolls might only make a small contribution to the overall player population, their actions can have major impact on social play and interaction [65-68], much more than, for example, the actions of social achievers. The inclusion of trolls in game-based learning design can unite socially oriented players by giving them a common foe. Future research should explore how each player type can contribute to multiplayer game-based learning strategies to enhance collaborative learning.

Future research can focus on investigating whether the range of opinions on play vary significantly across students as a function of the academic level or discipline they are enrolled in, for instance, a medical or a nonmedical group, or medical specialization. Such findings would provide an understanding for future student-specific game-based learning designs. Game preferences might be dependent on context [5] or the players' current needs [31]. For instance, in the playground game called Tag, one player is it and chases the other players in an attempt to tag them by touching them. Then the tagged player becomes it and starts chasing the others to tag someone else. This means that, when being it, a player must adopt the competitor player type (ie, competing and winning from the others), while the others (who are getting chased) can adopt the social achiever or even troll player type to act as a group against the one that is it. Likewise, other digital games (eg, Among Us) perhaps also use changing player types, where one is sometimes a troll and, at other times, needs to take on the role of the social achiever [60]. This raises the question whether player types are in search of a specific game design or does the game design elicit different types of behavioral responses (ie, player types). This might also suggest that game designers should adhere to the entire diversity of player types to ensure inclusion of all participants of the game-based learning strategy.

As a first step in this direction, we aimed to investigate the prevalence of player types among medical and dental students. This may not only provide more evidence for the existence of the currently identified typology in education for health professional students, it may also shed light on the true diversity of player types within medical and dental education. Furthermore, it may improve our understanding of whether the current educational strategy focusing on the achievement-oriented player type is effective and can be justified or whether it might be better to tailor game-based learning strategies to individual player types.

Conclusion

We identified 5 clear and distinct patterns of game preferences. These patterns represent player types that differ in terms of the player type dimensions achievement and sociability. Our taxonomy and accompanying factor arrays can be used to tailor game-based learning design to students' game preferences to optimize game-based learning effectiveness.



References

1. van Gaalen AEJ, Brouwer J, Schönrock-Adema J, Bouwkamp-Timmer T, Jaarsma ADC, Georgiadis JR. Gamification of health professions education: a systematic review. Adv Heal Sci Educ. 2021:683–711. doi: 10.1007/s10459-020-10000-3. doi: 10.1007/s10459-020-10000-3. [PMCID: PMC8041684] [PubMed: 33128662] [CrossRef: 10.1007/s10459-020-10000-3] [CrossRef: 10.1007/s10459-020-10000-3]
2. Dichev C, Dicheva D. Gamifying education: what is known, what is believed and what remains uncertain: a critical review. Int J Educ Technol High Educ. 2017 Feb 20;14(1) doi: 10.1186/s41239-017-0042-5. [CrossRef: 10.1186/s41239-017-0042-5]
3. Bedwell WL, Pavlas D, Heyne K, Lazzara EH, Salas E. Toward a taxonomy linking game attributes to learning: an empirical study. Simul Gaming. 2012 May 14;43(6):729–760. doi: 10.1177/1046878112439444. [CrossRef: 10.1177/1046878112439444]
4. Marczewski A. 52 gamification mechanics and elements. Gamified UK. 2017. [2022-02-25]. https://www.gamified.uk/user-types/gamification-mechanics-elements/
5. Van Gaalen AEJ, Jaarsma ADC, Georgiadis JR. Medical students' perceptions of play and learning: qualitative study with focus groups and thematic analysis. JMIR Serious Games. 2021 Jul 28;9(3):e25637. doi: 10.2196/25637. https://games.jmir.org/2021/3/e25637/ v9i3e25637 [PMCID: PMC8367104] [PubMed: 34319237] [CrossRef: 10.2196/25637]
6. Papert S. Does easy do it? children, games, and learning. Game Developer. 1998;88:1. https://dailypapert.com/does-easy-do-it-children-games-and-learning/
7. DiSalvo B. Pink boxes and chocolate-dipped broccoli: bad game design providing justifications for reluctant learners. 11th Games + Learning + Society Conference; July 7-10; Chicago, Illinois, USA. 2015. p. 11.
8. Van ECK R. Digital Game-Based Learning: It's Not Just the Digital Natives Who Are Restless. EDUCAUSE Review. 2006 Apr;:1–16. https://er.educause.edu/articles/2006/1/digital-gamebased-learning-its-not-just-the-digital-natives-who-are-restless .
9. Landers RN, Bauer KN, Callan RC, Armstrong MB. Gamification in Education and Business. New York: Springer; 2015. Psychological theory and the gamification of learning; p. 86.
10. Böckle M, Novak J, Bick M. Towards adaptive gamification: a synthesis of current developments. 25th European Conference on Information Systems; June 5-10; Guimarães, Portugal. 2017.
11. Dicheva D, Dichev C, Agre G, Angelova G. Gamification in education: A systematic mapping study. Educ Technol Soc. 2015:1–14. https://www.jstor.org/stable/jeductechsoci.18.3.75 .
12. Monterrat B, Lavoué É, George S. Adaptation of gaming features for motivating learners. Simul Gaming. 2017 Jun 30;48(5):625–656. doi: 10.1177/1046878117712632. [CrossRef: 10.1177/1046878117712632]
13. Harviainen J. Critical challenges to gamifying education: A review of central concept. Game On! Conference; 03-17-2014; Moscow. 2014.
14. Burgers C, Eden A, van Engelenburg MD, Buningh S. How feedback boosts motivation and play in a brain-training game. Comput Human Behav. 2015 Jul;48:94–103. doi: 10.1016/j.chb.2015.01.038. [CrossRef: 10.1016/j.chb.2015.01.038]
15. Chen C, Chang S. An exploration of the tendency to online game addiction due to users liking of design

features. Asian J Heal Inf Sci. 2008:38–51. https://www.researchgate.net/publication/255590068_An_Exploration_of_the_Tendency_to_Online_Game_Addiction_Due_to_User%27s_Liking_of_Design_Features .

16. Robinson M, Fischer A, Ahuja A, Lesser E, Maniates H. Roles of "wanting" and "liking" in motivating behavior: gambling, food, and drug addictions. Curr Top Behav Neurosci. 2016;27:105–36. doi: 10.1007/7854_2015_387. [PubMed: 26407959] [CrossRef: 10.1007/7854_2015_387]
17. Yee N. Motivations for play in online games. Cyberpsychol Behav. 2006 Dec;9(6):772–5. doi: 10.1089/cpb.2006.9.772. [PubMed: 17201605] [CrossRef: 10.1089/cpb.2006.9.772]
18. Bartle R. Hearts, clubs, diamonds, spades: players who suit MUDs. Research Gate. 1996. [2022-02-25]. https://www.researchgate.net/publication/247190693_Hearts_clubs_diamonds_spades_Players_who_suit_MUDs .
19. Yee N, Ducheneaut N, Nelson L. Online gaming motivations scale: Development and validation. SIGCHI Conference on Human Factors in Computing Systems; 05/12/2012 - 05/10/2012; Texas. 2012. [CrossRef: 10.1145/2207676.2208681]
20. Klock ACT, Gasparini I, Pimenta MS, Hamari J. Tailored gamification: a review of literature. Int J Hum Comput Stud. 2020 Dec;144:102495. doi: 10.1016/j.ijhcs.2020.102495. [PMCID: PMC7293851] [PubMed: 32565668] [CrossRef: 10.1016/j.ijhcs.2020.102495]
21. Codish D, Ravid G. Detecting playfulness in educational gamification through behavior patterns. IBM J Res Dev. 2015 Nov;59(6):1–14. doi: 10.1147/jrd.2015.2459651. [CrossRef: 10.1147/jrd.2015.2459651]
22. Codish D, Rabin E, Ravid G. User behavior pattern detection in unstructured processes – a learning management system case study. Interact Learn Env. 2019 May 19;27(5-6):699–725. doi: 10.1080/10494820.2019.1610456. [CrossRef: 10.1080/10494820.2019.1610456]
23. Codish D, Ravid G. Personality Based Gamification. Educational Gamification for Extroverts and Introverts. 9th Chais Conference for the Study of Innovation and Learning Technologies: Learning in the Technological Era; 02/11/2014 - 02/12/2014; Israel. 2014.
24. Codish D, Ravid G. Personality based gamification: How different personalities percive gamification. 22nd European Conference on Information Systems; 06/09/2014 - 06/11/2014; Israel. 2014.
25. Codish D, Ravid G. Gender Moderation in Gamification: Does One Size Fit All?. 50th Hawaii International Conference on System Sciences; 01/04/2017 - 01/07/2014; Hawaii. 2017. [CrossRef: 10.24251/hicss.2017.244]
26. Denden M, Tlili A, Essalmi F, Jemni M. An investigation of the factors affecting the perception of gamification and game elements. International Conference on Information and Communication Technology and Accessbility, ICTA; Dec 19-21; Muscat. 2017. [CrossRef: 10.1109/icta.2017.8336019]
27. Tlili A, Essalmi F, Ayed LB, Jemni M. A smart educational game to model personality using learning analytics. IEEE 17th International Conference on Advanced Learning Technologies; July 3-7; Romania. 2017. [CrossRef: 10.1109/icalt.2017.65]
28. Buckley P, Doyle E. Individualising gamification: an investigation of the impact of learning styles and personality traits on the efficacy of gamification using a prediction market. Comput Educ. 2017 Mar;106:43–55. doi: 10.1016/j.compedu.2016.11.009. [CrossRef: 10.1016/j.compedu.2016.11.009]
29. Davis K, Sridharan H, Koepke L, Singh S, Boiko R. Learning and engagement in a gamified course:

investigating the effects of student characteristics. J Comput Assist Learn. 2018 Apr 19;34(5):492–503. doi: 10.1111/jcal.12254. [CrossRef: 10.1111/jcal.12254]

30. Pedro L, Lopes A, Prates B, Vassileva J, Isotani S. Does gamification work for boys and girls? An exploratory study with a virtual learning environment. ACM Symposium on Applied Computing; April 13-17; Spain. 2015. [CrossRef: 10.1145/2695664.2695752]
31. Tu C, Yen C, Sujo-Montes L, Roberts GA. Gaming personality and game dynamics in online discussion instructions. Educ Media Int. 2015 Sep 11;52(3):155–172. doi: 10.1080/09523987.2015.1075099. [CrossRef: 10.1080/09523987.2015.1075099]
32. Charles D, Kerr A, McNeill M. Player-centred game design: Player modelling and adaptive digital games. Digital Games Research Conference; 16/06/2005 - 20/06/2005; Vancouver, British Columbia, Canada. 2005.
33. Barata G, Gama S, Jorge J, Goncalves D. Early prediction of student profiles based on performance and gaming preferences. IEEE Trans Learning Technol. 2016 Jul 1;9(3):272–284. doi: 10.1109/tlt.2016.2541664. [CrossRef: 10.1109/tlt.2016.2541664]
34. Klock A, da Cunha LF, de Carvalho MF, Rosa B, Anton A, Gasparini I. Gamification in e-learning systems: a conceptual model to engage students and its application in an adaptive e-learning system. In: Zaphiris P P, Ioannou A, editors. Learning and Collaboration Technologies. Cham: Springer; 2015. p. 9192.
35. Nacke LE, Bateman C, Mandryk RL. BrainHex: a neurobiological gamer typology survey. Entertain Comput. 2014 Jan;5(1):55–62. doi: 10.1016/j.entcom.2013.06.002. [CrossRef: 10.1016/j.entcom.2013.06.002]
36. Borges S, Mizoguchi R, Durelli V, Bittencourt I, Isotani S. A link between worlds: towards a conceptual framework for bridging player and learner roles in gamified collaborative learning contexts. In: Koch F, Koster A, Primo T, Guttmann C, editors. Advances in Social Computing and Digital Education. Cham: Springer; 2016.
37. Marczewski A. Gamified UK. San Fransisco: BLURB Incorporated; 2015. Even Ninja Monkeys Like to Play: Gamification, Game ThinkingMotivational Desig.
38. Ferro L, Walz S, Greuter S. Towards personalised, gamified systems: An investigation into game design, personality and player typologies. ACM International Conference Proceeding Series; 10/6/2013 - 10/9/2013; United Kingdom. 2013. [CrossRef: 10.1145/2513002.2513024]
39. Yee N. The demographics, motivations, and derived experiences of users of massively multiuser online graphical environment. Presence (Camb) 2006 Jun 01;15(3):309–329. doi: 10.1162/pres.15.3.309. [CrossRef: 10.1162/pres.15.3.309]
40. Danielson S. Q method and surveys: three ways to combine Q and R. Field Methods. 2009 Apr 06;21(3):219–237. doi: 10.1177/1525822x09332082. [CrossRef: 10.1177/1525822x09332082]
41. Watts S, Stenner P. Doing Q methodology: theory, method and interpretation. Qual Res Psychol. 2005 doi: 10.1191/1478088705qp022oa. [CrossRef: 10.1191/1478088705qp022oa]
42. Brown SR, Danielson S, van Exel J. Overly ambitious critics and the Medici effect: a reply to Kampen and Tamás. Qual Quant. 2014 Feb 28;49(2):523–537. doi: 10.1007/s11135-014-0007-x. [CrossRef: 10.1007/s11135-014-0007-x]
43. Berkhout JJ, Teunissen PW, Helmich E, van Exel J, van der Vleuten CPM, Jaarsma DADC. Patterns in

clinical students' self-regulated learning behavior: a Q-methodology study. Adv Health Sci Educ Theory Pract. 2017 Mar 27;22(1):105–121. doi: 10.1007/s10459-016-9687-4. http://europepmc.org/abstract/MED/27235123 .10.1007/s10459-016-9687-4 [PMCID: PMC5306423] [PubMed: 27235123] [CrossRef: 10.1007/s10459-016-9687-4]

44. Fokkema J, Teunissen P, Westerman M, van der Lee Nadine, van der Vleuten Cees P M, Scherpbier Albert J J A, Dörr P Joep, Scheele Fedde. Exploration of perceived effects of innovations in postgraduate medical education. Med Educ. 2013 Mar;47(3):271–81. doi: 10.1111/medu.12081. [PubMed: 23398013] [CrossRef: 10.1111/medu.12081]
45. Meade L, Caverzagie K, Swing S, Jones R, O'Malley Cheryl W, Yamazaki Kenji, Zaas Aimee K. Playing with curricular milestones in the educational sandbox: Q-sort results from an internal medicine educational collaborative. Acad Med. 2013 Aug;88(8):1142–8. doi: 10.1097/ACM.0b013e31829a3967. [PubMed: 23807106] [CrossRef: 10.1097/ACM.0b013e31829a3967]
46. Watts S, Stenner P. Doing Q Methodological Research: Theory, Method and Interpretation. Los Angeles: SAGE Publications; 2012. Factor interpretation; pp. 147–169.
47. Solomon H, Stephenson W. The study of behavior: Q-technique and its methodology. J Am Stat Assoc. 1955 Dec;50(272):1415. doi: 10.2307/2281274. [CrossRef: 10.2307/2281274]
48. Brown SR. Political subjectivity: applications of Q methodology in political science. J Politics. 1981 Aug;43(3):912–914. doi: 10.2307/2130649. [CrossRef: 10.2307/2130649]
49. Stenner PH, Cooper D, Skevington SM. Putting the Q into quality of life; the identification of subjective constructions of health-related quality of life using Q methodology. Soc Sci Med. 2003 Dec;57(11):2161–2172. doi: 10.1016/s0277-9536(03)00070-4. [PubMed: 14512246] [CrossRef: 10.1016/s0277-9536(03)00070-4]
50. Sherry J, Greenberg B, Lucas K, Lachlan K. Playing Video Games: Motives, Responses, and Consequences. New York: Routledge; 2006. Video game uses and gratifications as predictors of use and game preference; pp. 213–224.
51. Hamari J, Tuunanen J. Player types: a meta-synthesis. Trans Digit Games Res Assoc. 2014 Mar 24;1(2) doi: 10.26503/todigra.v1i2.13. [CrossRef: 10.26503/todigra.v1i2.13]
52. Tseng F. Segmenting online gamers by motivation. Expert Syst Appl. 2011 Jun;38(6):7693–7697. doi: 10.1016/j.eswa.2010.12.142. [CrossRef: 10.1016/j.eswa.2010.12.142]
53. Whang L, Chang G. Lifestyles of virtual world residents, living in the on-line game "Lineage". Cyberpsychol Behav. 2004:592–600. doi: 10.1109/cyber.2003.1253430. [PubMed: 15667054] [CrossRef: 10.1109/cyber.2003.1253430]
54. Fullerton T. Game Design Workshop. New York: CRC Press; 2008. A playcentric approach to creating innovative games.
55. Berger BM, Caillois R, Barash M. Man, Play, and Games. Am Sociol Rev. 1963 Aug;28(4):651. doi: 10.2307/2090095. [CrossRef: 10.2307/2090095]
56. Huizing J. Homo Ludens: A Study of the Play-Element in Culture. New York: Angelico Press; 1951. Apr,
57. Jones D, Paulhus D. Handbook of Interpersonal Psychology: Theory, Research, Assessment, and Therapeutic Interventions. New Jersey: John Wiley & Sons; 2012. Differentiating the dark triad within the interpersonal circumplex.

58. Buckels E, Trapnell P, Paulhus D. Trolls just want to have fun. Personality and Individual Differences. 2014 Sep;67:97–102. doi: 10.1016/j.paid.2014.01.016. [CrossRef: 10.1016/j.paid.2014.01.016]
59. Over a quarter of Americans have made malicious online comments. YouGov. [2022-02-25]. https://today.yougov.com/topics/politics/articles-reports/2014/10/20/over-quarter-americans-admit-malicious-online-comm .
60. Among us. Wikipedia. [2022-02-25]. https://en.wikipedia.org/wiki/Among_Us .
61. Gentry SV, Gauthier A, L'Estrade Ehrstrom Beatrice, Wortley D, Lilienthal A, Tudor Car L, Dauwels-Okutsu S, Nikolaou CK, Zary N, Campbell J, Car J. Serious gaming and gamification education in health professions: systematic review. J Med Internet Res. 2019 Mar 28;21(3):e12994. doi: 10.2196/12994. https://www.jmir.org/2019/3/e12994/ v21i3e12994 [PMCID: PMC6458534] [PubMed: 30920375] [CrossRef: 10.2196/12994]
62. Christou G, Lai-Chong Law E, Zaphiris P, Ang CS. Challenges of designing for sociability to enhance player experience in massively multi-player online role-playing Games. Behav Inf Technol. 2013 Jul;32(7):724–734. doi: 10.1080/0144929x.2012.754497. [CrossRef: 10.1080/0144929x.2012.754497]
63. Petrucci AM, Kaneva P, Lebedeva E, Feldman LS, Fried GM, Vassiliou MC. You have a message! social networking as a motivator for FLS training. J Surg Educ. 2015 May;72(3):542–8. doi: 10.1016/j.jsurg.2014.10.007.S1931-7204(14)00289-X [PubMed: 25496795] [CrossRef: 10.1016/j.jsurg.2014.10.007]
64. Wongso O, Rosmansyah Y, Bandung Y. Gamification framework model, based on social engagement in e-learning. 2nd International Conference on Technology, Informatics, Management, Engineering and Environment; December 19-21; Indonesia. 2014. [CrossRef: 10.1109/time-e.2014.7011583]
65. Bishop J. Gamification for Human Factors Integration: Social, Education, and Psychological Issues. Pennsylvania: IGI Global; 2015. The psychology of trolling and lurking: the role of defriending and gamification for increasing participation in online communities using seductive narratives; pp. 160–176.
66. Ruiz C, Domingo D, Micó JL, Díaz-Noci J, Meso K, Masip P. Public sphere 2.0? the democratic qualities of citizen debates in online newspapers. Int J Press Polit. 2011 Sep 22;16(4):463–487. doi: 10.1177/1940161211415849. [CrossRef: 10.1177/1940161211415849]
67. Shachaf P, Hara N. Beyond vandalism: Wikipedia trolls. J Inf Sci. 2010 Apr 13;36(3):357–370. doi: 10.1177/0165551510365390. [CrossRef: 10.1177/0165551510365390]
68. Thacker S, Griffiths M. An exploratory study of trolling in online video gaming. Int J Cyber Behav Psychol Learn. 2012:17–33. doi: 10.4018/ijcbpl.2012100102. [CrossRef: 10.4018/ijcbpl.2012100102]

"You can deny seriousness but you cannot deny play"
- Huizinga (Homo ludens)

5

The Last Act

The occurrence of gaming personalities in medical education: a nation-wide study

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Introduction

In the last two decades, there has been a surge of research interest in games and how to utilize them for other benefits than leisure [1]. Game-based learning (GBL) refers to the use of game elements to improve students' engagement, motivation and, ultimately, to augment their learning. There are two types of GBL: gamification (defined as the use of game design elements in non-game contexts [2]) and serious games (defined as games in which education is the primary goal rather than entertainment [3]) [1]. In health professions education (HPE), GBL has been increasingly and enthusiastically implemented under the presumption that it improves the efficiency and effectiveness of teaching and learning [1]. However, choosing the type of game or game elements that best suit the teaching objectives and individual students' game preferences is challenging [4]. In previous work we not only showed that empirical evidence for the presumed effectiveness of gamification interventions is lacking in HPE, but also that much of the existing empirical work on GBL seems to be carried out without a clear concept of the mechanisms by which GBL would improve learning. Furthermore, we found that most GBL interventions in HPE are strongly biased towards challenge (e.g. competition) and assessment (e.g. scoring) attributes of games [5]. This focus is not justified by game design research that instead underscores the variability of play preference [6]. We recently confirmed this variability in subjects relevant to the HPE context [4]. A relatively homogenous group of local medical and dental students expressed vastly different opinions about what makes games attractive and fun to play, while their opinions also suggested that attitudes towards games are profoundly context-dependent. This raises serious doubts about the way GBL is currently designed and implemented in HPE.

To enable a more informed approach to select GBL designs, we recently adopted a concept that originated in the field of game psychology: player typology [1]. It is based on the idea that games are designed to appeal to a specific user type and that, likewise, GBL ought to be designed to appeal to a specific target group. Literature showed that understanding users' game preferences can explain motivation to play games [7,8], which, in turn, can help researchers and educators develop effective, targeted GBL designs to, for example, improve students' learning outcomes [9].

In a previous mixed- method study, we identified patterns in students' preferences of play and games [1]. Based on the extent to which students (dis)agreed with statements about their liking of games, we statistically calculated and identified five patterns of game preferences that were distinct and characteristic. These patterns could be considered player types and we named them: social achievers, explorers, socializers, competitors and trolls (Table 1). In general terms, social achievers like to collaborate in teams in a competitive and challenging way; explorers are individualistic and drawn to narrative

elements; competitors thrive by competition and winning, but do not like to depend on others; socializers purely play for a sense of togetherness; and trolls like games in which they can annoy others and exploit game dynamics but seem not to be interested to invest in the game itself. To our knowledge, this was the first time that research conducted outside the narrow context of a specific game and even outside the scope of the gaming industry provided empirical evidence for the possible relevance of player types. The results strongly suggested that current GBL design in HPE (that primarily focuses on challenge and assessment game attributes) only sparks interest, and possibly only optimally motivates, a part of the students.

The strength of this study was that it explored students' subjective viewpoints while statistical analysis grouped shared opinions. To ensure the widest possible variety of game preferences, a meticulous procedure of targeted subject inclusion was applied [10,11]. There were also a few limitations, for instance regarding the generalizability and the extended characterisation of the identified player types. The study grouped individuals to generate the five groups of unique game preferences, but people might be a combination of player types or may switch player types depending on the context. In fact, twelve out of the 42 participants turned out to be a combination of player types or did not have a player type. Only player types – or combinations of player types - that can be generalized to a larger population can form a solid basis for user-driven GBL design. Likewise, understanding students' characteristics within a player type can provide valuable insights to improve GBL strategies. For instance, it has been suggested that men tend to be more competitive-oriented than women [9]. If this can be empirically confirmed, these findings could provide scientific support for player typology and could guide GBL design in educational contexts with a strong gender bias. Besides gender [9], culture [12], age [12,13], and gaming behaviour (e.g. frequency of play [14]) have been proposed to influence game preferences. Hence, exploring these variables in a large homogeneous group of students and relating them to the player types provides a step forward in the development of effective player-based GBL design.

The purpose of this current study is to (1) validate the generalisability of the player typology we identified in our previous study [1] in a larger, national HPE student population and (2) identify (additional) characteristics that are associated with game preferences. In particular, we explored the frequency and configurations of individual game preferences and we explored whether demographic and academic variables (age, institute, study year) and self-reported gaming behaviour variables (playing frequency, preference for digital or analogue games) covaried with player types.

Table 1. Playertypes with corresponding play preference

Item no. Statement	Player types					
	SA	Ex	Ki	So	Tr	
1 I like games in which people help each other.	1	0	-2	3	-1	
2 I like to see how others learn a new game.	-2	0	-1	-3	-3	
3 I like games with easy wins.	-3	-3	-1	2	-2	
4 I like games which create an atmosphere of sociability.	3	0	-3	1	1	
5 I like games that let me build relationships.	2	0	-3	1	0	
6 I like games that let me play in teams.	2	-1	0	2	0	
7 I like to play games to maintain relationships.	1	-3	-2	2	0	
8 I like games that let me play on my own.	-3	3	3	0	-1	
9 I like games in which I can create something.	1	1	0	2	2	
10 I like games that allow different ways of winning.	2	3	1	2	-2	
11 I like games that use luck to enhance my odds of winning.	-1	-3	-1	-1	-4	
12 I like games with a good storyline.	1	4	1	3	1	
13 I like games in which I can influence the storyline.	0	4	0	0	-1	
14 I like games in which I need to actively participate.	3	1	0	4	1	
15 I like games in which I know the other players.	2	0	-2	0	3	
16 I like games in which I can solve a difficult part / puzzle.	1	2	3	4	3	
17 I like to improve my gameplay by searching for new techniques.	0	2	0	-2	-3	
18 I like games in which I learn new things (e.g. knowledge/skills)	3	2	3	1	0	
19 I like games in which I can act differently than I usually do in real life.	-2	1	-2	0	0	
20 I like games which make you feel immersed in your own world.	-2	3	-1	-1	4	
21 I like games that let me apply a strategy.	4	2	2	0	1	
22 I like games in which I can bluff.	-1	-1	-2	0	3	
23 I like games that have trading elements.	0	-2	-1	1	2	
24 I like games in which I can negotiate.	1	1	-1	0	0	
25 I like games that can be played differently than they are intended.	-1	1	-3	-2	2	
26 I like games in which I can cheat.	-4	-2	-3	-4	3	
27 I like games in which other players cheat.	-4	-4	-4	-4	-3	
28 I like games in which I can be fanatic.	3	-2	1	-1	1	
29 I like games in which I can play strictly by the rules.	0	-3	1	2	-2	
30 I like games to which I can bring modifications.	-2	1	0	-2	0	
31 I like games in which I can obtain as many points as possible.	-1	0	2	0	1	
32 I prefer losing with lots of rewards over winning with very few.	-3	-1	-1	-1	-2	
33 I like games which show me my progression.	2	2	2	1	0	
34 I like games which let me have items that others don't manage to collect.	-2	-2	0	-1	0	
35 I like games which have a reward at stake.	0	1	0	-1	-1	
36 I like games in which I can get my revenge after losing.	0	-2	1	-1	1	
37 I like games that show everyone that I've won.	-1	-2	1	-3	-3	
38 I like games in which I can prove to the other players that I am the best.	-1	-1	2	-2	-2	
39 I like games that use competition as a way to improve myself.	2	0	3	-1	-2	
40 I like games in which I can annoy other players.	-1	-4	-2	-3	2	
41 I like games that use competition to defeat other players.	1	0	1	-3	1	
42 I like to be the best in a game.	1	-1	4	-2	2	
43 I'm a good loser.	0	-1	-4	0	-4	
44 Winning is important to me.	-1	-1	4	-2	2	
45 I like games in which I can play alone against a game or computer	-3	3	2	1	-1	
46 I like games which let me stay anonymous.	-2	1	1	1	-1	
47 I like to get better in a game.	4	2	2	3	3	
48 I like games that use a lot of different materials (e.g. dices, cards, fake money)	0	0	0	1	-1	
49 I like games in which losing is okay.	0	-1	-1	3	-1	

First column showing statement on game preference. Numbers indicating (dis)agreement with that statement, ranging from totally disagree -4 to totally agree 4. SA=social achiever, Ex =explorer, Ki= killer, So=socializer, Tr=Troll

Methods

To validate our player typology, we applied the data collection procedure as from our earlier Q-methodology study [1] to a much larger, national HPE student population. We used the same statement set on game preferences (Table 1), and collected additional information on relevant demographic, academic, and gaming variables (gender, age, institute, study year, self-reported gaming playing frequency, preference for digital or analogue games).

The Netherlands Association for Medical Education granted ethical approval for this study (NVMO, 2020.6.5).

Participants and context

All first to sixth year medical students who were enrolled in one of the eight medical schools in the Netherlands (AMC [Amsterdam], Erasmus MC [Rotterdam], LUMC [Leiden], Maastricht UMC+ [Maastricht], Radboudumc [Nijmegen], UMCG [Groningen], UMCU [Utrecht], and VUmc [Amsterdam]), were eligible for study inclusion. Each Dutch medical school enrols an average of 400 students annually. Generally, the 6-year undergraduate medical curriculum in Dutch Universities comprises a 3-year Bachelor's and a 3-year Master's phase. The 3-year Master's programme includes 2.5 years of clinical rotations (of which 0.5 year is an elective clerkship), and 0.5 year master thesis. In none of these universities, GBL is employed on a structural basis.

Students from the UMCG who had participated in our prior study (identifying five player types) were excluded [1]. There were no other exclusion criteria. We calculated the required sample size of our experiment with an expected medium effect size and eight medical schools, leading to a required minimum of 405 participants.

Participants were invited to participate in the study via different digital announcements depending on the universities' preferred mode of communication (e.g. newsletters, online lectures or digital learning environments) as decided by a contact within each university (e.g. communication office, dean, or professor in education). Participants were briefed about the procedure and purpose of the study and were informed that their participation was anonymous and voluntary. At any time, participants had the right to withdraw from the study. Each participant received a 5-euro gift-certificate certificate in appreciation for their time and effort. From all participants an informed consent was obtained.

Data collection

From each participant, two types of data were collected: an individual sort of statements on game preference and a questionnaire on basic demographic information and self-

reported gaming behaviour. All data were collected online at the participants' convenience. After agreement of participation, participants were sent a link to the data collection procedure, which was run in the online program Qsortouch (via www.qsortouch.com) dedicated to perform Q methodology studies. The data were collected as follows. First, the participant was presented a brief questionnaire on sociodemographic characteristics and game behaviour addressing gender (male/female/other), age, university, study year, phase of study (preclinical or clinical), whether they considered themselves a gamer and whether they would rather play digital or analogue games.

After they had filled out the questionnaire participants proceeded to the sorting procedure. Here, the participant sorted statements on play preference (n=49, Table 1) in the dedicated online Q-methodology application (for details see also, [1]). Stated briefly, all statements displayed in Table 1 were randomly presented by the Qsortouch web application and participants were asked to sort statements by 'drag and dropping' them into three piles: 'disagree', 'neutral' and 'agree'. After sorting every statement on a preferred pile participants were asked to refine their sorts/piles using a grid that ranged from -4 extremely disagree to +4, extremely agree. This way statements were sorted and prioritized in a fixed (quasi-normal distributed) fashion (see Table 2). Participants were told to submit the sort only when all the statements were placed on the grid and when they felt that the sort reflected their viewpoints.

Table 2. Quasi-normal distribution.

Position	-4	-3	-2	-1	0	+1	+2	+3	+4
Maximum number of statements	2	4	6	8	9	8	6	4	2

Analysis

Our aim was to study the prevalence of our previously identified groups (player types) in a wider population, not to identify new player types. This required correlation of each new sort with the five player types previously identified [1]. To this end we built an analysis in MATLAB (MATLAB ver. R2020a)) using the standard formulas in Q-methodology to correlate every sort from each participant in the present study (i.e. each participants' play preference), with the earlier found player types from our prior study [1].

We used the appropriate formulas for Q-methodology, as originally presented by Brown [10]: $r=1-(\sum d^2/2Ns^2)$, where r=correlation coefficient, $\sum d^2=$ is the sum of squared differences (d^2) for an item in a sort and the item in a player type, N and s^2 are the number of statements and the variance of the forced distribution respectively and are a constant for all Q-sorts. A correlation between individual sorts and player type sort configurations was considered significant when $r>0.37$. This correlation coefficient,

with standard significance level of $p<0.01$) was calculated using the typical equation in Q-methodology: $r=2.58\times(1/\sqrt{\text{no. of items in Q set}})$, where 2.58 is a constant [10,11]. We validated this method with our previous data, showing that individual sorts that previously constructed a player type indeed correlated again with the right player type using this customized analysis.

Q-methodology typically aims to identify new and unique factors (in our prior study: player types) and therefore excludes participants who load on more than one factor or do not load on any factor to achieve the highest variety in unique opinions [11]. Presently, our aim was not to investigate whether different player types are present in a larger population than we previously investigated; rather, we aimed to investigate the prevalence of the five player types previously identified. In addition, we aimed to get a more precise picture of individuals correlating to each player type and whether one participant could have multiple player types. This meant that in our analysis we did *not* exclude participants who correlated to multiple player types, or who did *not* load on any player type, since this could lead to the false conclusion that individuals only have one player type or to false conclusion that our model explains the entire population, respectively. Hence, the prevalence of each player type included the number of participants correlating uniquely on that player type as well as the number of participants correlating on different player types was calculated.

To assess a possible statistical significant relationship between player types we conducted a correlation analysis (using spearman correlation coefficient).

Lastly, student characteristics possibly associated with game preferences were correlated. Categorical variables (self-identifying as a gamer, gender, favourite game-type, and study phase) without a normal distribution (tested using Shapiro-Wilk test) were correlated with each player type using Mann-Whitney U test. Kruskal-Wallis H was used to calculate correlations between player types and the different Dutch universities or year of study. Relations are used for further interpretation if they survived the threshold of $p<0.05$.

Results

A total of 314 students (*mean age 21.6, range 17-32, SD=2.92*) performed the sorting procedure. Students in this sample represented first- (*n=39, 12.4%,*), second-(*n=108, 34.4%,*), third-(*n=54, 17.2%,*), fourth-(*n=53, 16.9%*), fifth-(*n=31, 9.9%,*), and sixth-(*n=29, 9.2%,*) year medical students. Most of the students were in their bachelor's phase (first three years of study, *78,0%, n=245*). The participants sample originated from six

different Dutch universities; AMC [Amsterdam] *(9.5%, n=30*), Erasmus MC [Rotterdam] (*20.1%, n=63*), LUMC [Leiden] (*8.9%, n=28*), Maastricht UMC+ [Maastricht] (*15.6%, n=49*), Radboudumc [Nijmegen] (*16.6%, n=52*) and UMCG [Groningen] (*29.3%, n=92*), one university was unable to provide participants, one university did want not participate. There were more female (78.0%, *n*=245) than male respondents (*22.0%, n=69*). Slightly more than half of the participants sample considered themselves a gamer (*56.4%, n=177).* Most of the participants preferred analogue games (*62.7%, n=197*) over digital games (*37.3%, n=117*).

Almost all students loaded significantly on at least one player type (*87.6%, n=275,* r>0.37, *p<.01; figure 1).* Ninety-two students loaded on only one player type (*29.3%*), 118 students loaded on two player types (*37.6%*), 53 students loaded on three player types (*16.8%*), 11 students loaded on four player types (*3.5%*) and one student loaded on five player types. Most students loaded on *social achievers* (*65,3%, n=205*), with socialisers (*37%, n=117*), *explorers* (*34.7%, n=109*), *competitors* (*25%, n=79*), trolls (*8.3%, n=26*) following in descending order; note that each student can load on multiple player types, hence the total exceeds 100% (figure 1). The prevalence of students uniquely loading on a player type were *social achiever* (*n=61*), *explorer* (*n=13*), *competitor* (*n=10*), *socializer* (*n=3*) and troll (*n=5*). The combination *social achiever* and *socializer* (*n=43*), *social achiever* and competitor *(n=26), socializer* and *explorer (n=23)* were the three most prevalent two player type combinations. '*Social Achiever*, *Competitor*, *Socializer*', '*Social achiever*, *Explorer* and *Socializer*', '*Explorer*, Competitor, *Socializer*' were the most prevalent combinations of three player types (each combination *n=9*).

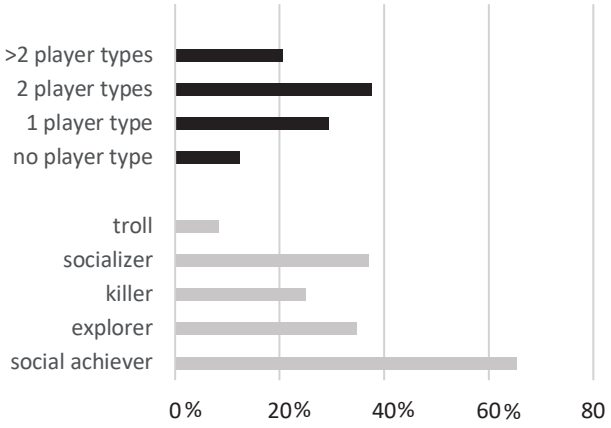


Figure 1. Percentage of subjects loading on player types.
Dark bars indicating total percentage of students loading on zero, one, or a combination of player type(s). Grey bars indicating percentage of students loading on a specific player type. Note that each student can load on multiple player types hence the total exceeds 100%.

Almost all player types correlated significantly with some other player type (*p<.01; Table 3*). There was a significant *positive correlation* between *social achievers* and socialisers, *social achievers* and trolls, *explorers* and *competitors*, *explorers* and *socialisers*. There was a *negative correlation* between *social achievers* and *explorers*, between *competitors* and socialisers, and between socialisers and trolls.

Table 3. Correlation matrix player types

	Social achiever	Explorer	Competitor	Socializer
Social achiever				
Explorer	-0,155**			
Competitor	-0,068	0,236**		
Socializer	0,316**	0,462**	-0,209**	
Troll	0,205**	-0,003	0,08	-0,182**

None of the player types was more likely to occur in a particular medical school (*Kruskall-Wallis H6, p>.05*), likewise, none of the player types showed an association with study phase (*Kruskall-Wallis H5, P>.05)*. Age did not significantly predict player type (*F(5, 307)=1.75, p=.131, R=0.16*) (Table 4). Students in their clerkships were more likely to have troll player type (*Mann-Whithney U=6874.5, r=0.13,* n_{clerk}*=6, p=.018)*. Students that considered themselves gamers were more often *explorers* (*U=10342.5, r=0.13,* n_{gamer}*=72, p=0,026)* and trolls (*U=10358.0, r=0.13,* n_{gamer}*=16, p=.027)*.

Gender and play modality (digital/analogue) showed the largest effect on play preference (Table 4). *Social achievers* preferred analogue games over digital games (*U=5298.5, r=0.45,* $n_{analogue}$*=72, p<.001*). In contrast, *explorers* (*U=5979.0, r=0.40,* $n_{digital}$*=62, p<.001*) and *competitors* (*U=9556.0, r=0.14,* $n_{digital}$*=31, p=0,011*) were more likely to prefer digital games. Women had a higher tendency to be *social achievers* (*U = 11445.0, r=0.15,* n_{female}*=159, P=.006*) and socialisers (*U=5614.5, r=0.31,* n_{female}*=102, p=<0.001*). Men had a higher tendency to be *competitor* (*U=7854, r=0.13,* n_{male}*=25, p=0,019*) and troll (*U=8102.5, r=0.11,* n_{male}*=10, p=.046*). There was no significant correlation between gender and the *explorer* player type.

Table 4. Significant differences in student characteristics per player types

Variable	N	Value	Social Achiever	Explorer	Competitor	Socializer	Troll
Clerk	Pre-clerkship (n=245)	Mean Rank	153.3	156.85	154.14	157.87	151.06
	Clerkship (n=69)	Mean Rank	171.61	159.82	169.42	156.17	180.37
		U	37614	38427	37765	10776	6874
		r	0.08	-0.01	-0.07	-0.01	0.13
		Z-score	-1.461	-0.240	-1.235	-0.137	-2.37
		P-value	0.144	0.810	0.217	0.891	**0.018***
Gamer	Gamer (n=177)	Mean Rank	152.27	167.57	160.31	154.08	167.48
	Non-gamer (n=137)	Mean Rank	164.26	144.49	153.88	161.92	144.61
		U	11198	10342	11628	11519	10358
		r	0.07	0.13	0.04	0.04	0.13
		Z-score	-1.161	-2.234	-0.622	-0.758	-2.214
		P-value	0.245	**0.026***	0.534	0.448	**0.027***
Modality	Analogue (n=197)	Mean Rank	189.10	129.35	147.51	161.60	160.65
	Digital (n=117)	Mean Rank	104.29	204.90	174.32	150.60	152.20
		U	5298	5979	9556	10717	10904
		r	0.45	0.40	0.14	0.06	0.05
		Z-score	-8.005	-7.130	-2.531	-1.038	-0.798
		P-value	**<0.001****	**<0.001****	**0.011***	0.299	0.425
Gender	Male (n=82)	Mean Rank	133.93	166.29	177.72	109.97	174.69
	Female (n=232)	Mean Rank	165.83	154.39	150.35	174.30	151.42
		U	5298	5979	9556	10717	10904
		r	0.15	0.06	0.13	0.31	0.11
		Z-score	-2.736	-1.020	-2.346	-5.516	-1.995
		P-value	**0.006****	0.308	**0.019***	**<0.001****	**0.046***

r= effect size, U=U-statistic Mann-Whitney Test, Bold text=significant p-value, =Correlation is significant at the 0.05 level (2-tailed), **=Correlation is significant at the 0.01 level (2-tailed uncorrected).*

5

Discussion

This study aimed to find evidence for generalisability, as well as to explore student characteristics, of the five player types in a national cohort of Dutch medical students. Typically, GBL designs are biased towards scoring and competition elements. However, opinions on what makes (learning) games attractive and fun paints a much more diverse picture suggesting a need for better informed designs in (and outside) medical education. We showed that the five player type model can adequately describe a large student population and can be substantiated by characteristics known to affect outcomes of GBL strategies. To our knowledge, this is the first time that a Q-methodology study is followed by a subsequent study which correlates new sorts to earlier identified factors on a larger scale to study generalizability [15].

Almost 90% of students' play preference could be accounted for in our model. Although this can be considered very high [16], we cannot substantiate claims on whether this is better, or worse, than existing player types. Accuracy of player typologies remained

unmentioned in prior studies investigating play game preferences. The majority of the students in our sample loaded on multiple player types. This is in line with Bartle's player typology [6], the hexad typology by Marczewski [17] and the Brainhex typology [18] that assign composition of player types to a user, whereas one type is usually predominant. Hence, player types are not mutually exclusive.

The current bias in health professions GBL designs (towards competitive and scoring elements) does not (fully) correspond with the preferred type of games by students. Almost two-third of our student sample significantly loaded on the *social achievers* player type. The most prevalent combination of player-types was *social achiever* and *socializer.* Only 25% percent of our sample loaded on the *competitor* player type (which thrive by competition and winning, but do not like to depend on others). Hence, by focusing on competition and scoring elements at the individual level, as is often the case in current GBL designs, the *competitor* player type seems to be substantially over-represented in GBL design while sociability elements are (i.e. being *social achievers* or *socializers*) heavily underrepresented.

According to our findings nuance is needed in studies considering individual variables. Thus far, studies that considered individual variables, such as demographic characteristics (e.g. gender), explain game preferences from a unidimensional point of view. Competitive game-elements are often recommended for men [9,12,19–21], sociability elements are recommended for women, [13,22,23]. We have shown that a substantial group of women can prefer competition instead of sociability and that men can well prefer sociability over competition. Thus, even though student characteristics relate to many of the common presumptions on game-preferences, only considering such variables is a too limited approach and is likely to lead to misunderstanding and inaccuracy when designing GBL. A similar conclusion was drawn in a recent systematic review on tailored gamification [9]. Hence, the use of the player type model can be a meticulous tool to consider game preferences, superseding unidimensional student characteristics, and directly inform future GBL-design from a student-centred approach.

Lastly, we observed a considerable number of gamers in this study (*56.4%)*. This might have two explanations; (1) about half of the Dutch medical student population consider themselves gamer or (2) gamers are more prone to take part in research on game-based learning. Against the latter can be argued that most students in our sample were women, while women do not tend to self-identify as gamers (medium effect size). Additionally, the male-female ratio in our sample is very similar with the male-female ratio among Dutch medical schools [24]. Therefore, this finding indicates that at least half of the current medical student population have playful identities. This is in line with postulations that today's culture is becoming more playful [25–27] or, stated more

poetically, is undergoing a renaissance to a ludic culture [26,28]. Such a shift – attributed to the digital age with computers, mobile phones, games (and maybe even the inherent drive within the playful mind of humans [29]) [26] – may incite the usage of game-based learning material as well as encourage future research to endure the search for scientific foundation and clarification of the use of GBL strategies.

Strengths and limitation

A strength of this study is that it describes play preference in a national cohort of medical students for the first time. We used and validated a scientifically based player typology which paves the way to link player typologies as predictor for GBL effectiveness. Although the student sample was representative of the gender ratio in the Dutch medical student population, other countries have different gender ratios [30]. Therefore, using the same method in a different country or culture might yield different prevalences of player types. Our study was performed during COVID-19 restrictions, sociability player types might be overrepresented due to the need for more sociability [31]. Also, considering oneself a gamer might bring negative connotations [32]. Therefore, the incidence of actual gaming personas might be larger than could be reported. Furthermore, we cannot know for certain whether participants considered specific type of games (which possibly might elicit a player type [1] or whether they already thought of certain educational context which might also alter game preference [4]

Finally, but notably, it is currently unknown how to translate games or game-preference to (game-based) learning. Evidence is lacking whether adhering to play preference will lead to improved learning in medical students. Also, results from our prior study showed that the likability of play is study context dependent and that probably not every course should be game based [4]. Solely considering game-preference might therefore be a too limited approach. Variables such as study context and undesirable behaviours/attitudes towards a study context or course should be considered [4]. Since there might be negative consequences of applying GBL in medical education [4,5], scrutiny must remain at place when considering play and learning.

Future directions

Researchers and educators that intend to utilize GBL can resort to our player typology to guide their selection of GBL strategies. Future researchers/educators should focus on more than one aspect of GBL-design if they want to create an student inclusive GBL-strategy. From a time/cost-effectiveness point of view it might be compelling to consider one type of GBL design (e.g. scoring and competition). However, designers should be aware that certain students/player types might be favoured over others in using such an approach. In our study, the majority of students were *social achiever* and the *social achiever-socializer* player type was the most prevalent combination. We therefore urge

future researchers and instructional designers to ensure the use of social elements in GBL. We showed that students are particularly compositions of player types. Although uncertain from our data, having multiple player types might indicate users that are able to switch between different types of game-design. Future studies should investigate the impact of tailoring GBL-strategies towards the player types. Not only to understand whether adhering to player types actually increases motivation and learning outcome [1], but also to clarify the influence of having multiple player types, e.g. whether designs should be tailored to the most dominant type or to all player types [9].

Lastly, it would be interesting to investigate whether the ratio in player types is dependent on the type of study. For instance, are *social achievers* also more prevalent in a general population, or can this be attributed to students studying medicine? Or can it be attributed to the considerable amount of female students? Such an approach will evaluate our results in a wider audience outside a (medical) education context.

Conclusion

This article described the play preferences of a nationwide medical student cohort. We showed that the five player type model can adequately describe this student population. We anticipate that the use of the player type model will be a meticulous tool to inform future GBL-design from a user centred approach by considering their game preferences.

References

1. A E J Van Gaalen, J Schönrock-Adema, R J Renken, A D C Jaarsma JRG. Finding 'the killer' in medical and dental students: Q-methodology-based player typology to foster game-based learning (submitted). *JMIR serious games*. Published online 2021.
2. Deterding S, Khaled R, Nacke L, Dixon D. Gamification: toward a definition. *Chi 2011*. Published online 2011:12-15. doi:978-1-4503-0268-5/11/0
3. Susi T, Johannesson M, Backlund P. Serious Games – An Overview. *Tech Rep HS- IKI -TR-07-001, Sch Humanit Informatics, Univ Skövde, Sweden*. 2007;73(10):28. doi:10.1.1.105.7828
4. van Gaalen AEJ, Jaarsma ADC, Georgiadis JR. Medical Students' Perceptions of Play and Learning: Qualitative Study With Focus Groups and Thematic Analysis. *JMIR serious games*. Published online 2021.
5. van Gaalen AEJ, Brouwer J, Schönrock-Adema J, Bouwkamp-Timmer T, Jaarsma ADC, Georgiadis JR. Gamification of health professions education: a systematic review. *Adv Heal Sci Educ*. Published online 2020. doi:10.1007/s10459-020-10000-3
6. Bartle R. Hearts, clubs, diamonds, spades: Players who suit MUDs. *J MUD Res*. 1996;1:1-22.
7. Yee N. Motivations of Play in Online Games. *J CyberPsychology Behav*. 2007;9:772-775. doi:10.1089/cpb.2006.9.772
8. Yee N. Facets: 5 motivation factors for why people play MMORPGs. *Http://WwwNickyeeCom/Facets/HomeHtml*. Published online 2002.
9. Klock ACT, Gasparini I, Pimenta MS, Hamari J. Tailored gamification: A review of literature. *Int J Hum Comput Stud*. Published online 2020. doi:10.1016/j.ijhcs.2020.102495
10. Brown SR. Political Subjectivity: Applications of Q Methodology in Political Science. *J Poltics*. 1981;43(3):912-914. doi:10.2307/3151542
11. Watts S, Stenner P. Doing Q methodology: Theory, method and interpretation. *Qual Res Psychol*. Published online 2005. doi:10.1191/1478088705qp022oa
12. Authors:, Oyibo K, Orji R, Vassileva J. The influence of culture in the effect of age and gender on social influence in persuasive technology. In: *User Modelling, Adaptation and Personalization*. ; 2017. doi:10.1145/3099023.3099071
13. Tondello GF, Mora A, Nacke LE. Elements of gameful design emerging from user preferences. In: *CHI PLAY 2017 - Proceedings of the Annual Symposium on Computer-Human Interaction in Play*. ; 2017. doi:10.1145/3116595.3116627
14. Utomo AY, Santoso HB. Development of gamification-enriched pedagogical agent for e-learning system based on community of inquiry. In: *ACM International Conference Proceeding Series*. ; 2015. doi:10.1145/2742032.2742033
15. Danielson S. Q Method and Surveys: Three Ways to Combine Q and R. *SAGE Publ*. 2009;21(219):219-237. doi:10.1177/1525822X09332082
16. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate Data Analysis. *Vectors*. Published online 2010. doi:10.1016/j.ijpharm.2011.02.019
17. Marczewski A. Even Ninja Monkeys Like to Play: Gamification, Game Thinking and Motivational Desig. In: *Gamified UK*. ; 2015.

18. Nacke LE, Bateman C, Mandryk RL. BrainHex: A neurobiological gamer typology survey. *Entertain Comput*. Published online 2014. doi:10.1016/j.entcom.2013.06.002
19. Oyibo K, Orji R, Vassileva J. Investigation of the social predictors of competitive behavior and the moderating effect of culture. In: *UMAP 2017 - Adjunct Publication of the 25th Conference on User Modeling, Adaptation and Personalization*. ; 2017. doi:10.1145/3099023.3099113
20. Busch M, Mattheiss E, Orji R, Fröhlich P, Lankes M, Tscheligi M. Player type models - Towards empirical validation. In: *Conference on Human Factors in Computing Systems - Proceedings*. ; 2016. doi:10.1145/2851581.2892399
21. Orji R, Mandryk R, Vassileva J. Gender and Persuasive Technology: Examining the Persuasiveness of Persuasive Strategies by Gender Groups. *9th Int Conf Persuas Technol*. Published online 2014.
22. Orji R. Exploring the persuasiveness of behavior change support strategies and possible gender differences. In: *CEUR Workshop Proceedings*. ; 2014.
23. Busch M, Mattheiss E, Reisinger M, Orji R, Fröhlich P, Tscheligi M. More than sex: The role of femininity and masculinity in the design of personalized persuasive games. In: *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. ; 2016. doi:10.1007/978-3-319-31510-2_19
24. Een op vijf leerlingen gezondheid of welzijn is man.
25. Raessens J. The Ludification of Culture. In: *Rethinking Gamification*. ; 2014.
26. Raessens J. Playful identities, or the ludification of culture. *Games Cult*. Published online 2006. doi:10.1177/1555412005281779
27. Zimmerman E. Manifesto for a Ludic Century. In: *The Gameful World: Approaches, Issues, Applications* . ; 2015.
28. Douglas Rushkoff. Renaissance now!: The gamers' perspective. In: *Digital Material*. ; 2009:173-184.
29. Huizinga J. *Homo Ludens: A Study of the Play-Element in Culture*.; 1938. doi:10.4324/9781315824161
30. More women than men are enrolled in medical school | AAMC.
31. Liu S, Lithopoulos A, Zhang CQ, Garcia-Barrera MA, Rhodes RE. Personality and perceived stress during COVID-19 pandemic: Testing the mediating role of perceived threat and efficacy. *Pers Individ Dif*. Published online 2021. doi:10.1016/j.paid.2020.110351
32. Shaw A. Do you identify as a gamer? Gender, race, sexuality, and gamer identity. *New Media Soc*. Published online 2012. doi:10.1177/1461444811410394

"No epilogue, I pray you, for your play needs no excuse.
Never excuse."
- William Shakespeare, a midsummer night's dream

6

Final Scene

(Summary and General Discussion)

Can education science learn from game design? This question has a central role in this thesis. Game-based learning (GBL) gained an important role in the research of health professions education (HPE), especially with an increasing dependency on distance and digital learning due to the recent COVID pandemic. GBL is increasingly implemented and researched in medical education to increase motivation and change attitudes towards learning, but what is the best way to design and apply it? Most of the current studies seem to retrospectively focus on the describing implemented GBL-methods rather than illuminate paths for future developments by testing (or creating) a theoretical framework. The lack of creating and testing a theoretical framework is critical since such knowledge could explain why GBL should work, in which situation, how it should be implemented as well as provide future directions to further the field of GBL.

The aim of this thesis was to better understand the concept of game-based learning in health professions education. There are many ways to understand the concept of play and why it could be beneficial for learning. One vital concept that current studies do not seem to take in account is the liking of play. The liking of play is a personal attribute; a game that is fun and motivating for one can be abominable and demotivating for the other [1–4]. We used this personal feature to create and validate a conceptual framework tailored towards individual medical students (or groups of medical students) that could aid future research into medical education and that could help improve GBL-designs.

Summary

6

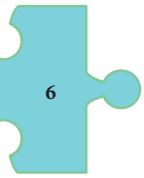
In **chapter 2** we performed a comprehensive systematic review on gamification in HPE. There is considerable confusion in the terminology used to describe GBL, which increases complexity for readers and complicates transferability to educational practice. Gamification and serious games are not the same. The most distinguishing feature is whether a learning method does (serious games) or does not provide (gamification) the impression of a game. Although gamification applies game-elements such as achievements, the isolated application of such elements is insufficient to constitute a game. Our systematic review showed that there are no reported, assessed, or observed negative effects associated with gamification interventions in HPE. However, we also revealed that the quality of the evidence is generally low, with effects on the level of satisfaction and use, and rarely on the level of learning. Furthermore, control groups were often lacking in intervention studies, making it difficult in many cases to attribute effects to gamification (instead of general effects of intervening). Interestingly, in the few studies that did include a control group, gamification could be linked to enhanced use of learning material and (when addressed) increased learning outcomes. With regard to the gamification attributes employed in GBL, we exposed a strong preference

on the part of researchers to engage assessment (e.g. scoring) as game-element. Most game attributes routinely used in game design, like (stimulating) social interaction, were almost never applied in GBL. Furthermore, there has been little interest in possible mechanisms underlying presumed GBL benefits, for instance by addressing or elaborating on theories or conceptual frameworks that aimed to clarify why and in what circumstances gamification could work. When theory did seem to underlie the intervention, most common assumptions were that gamification could positively alter learning behaviour (e.g. motivation) or help grow a positive attitude towards the learning subject. Unfortunately, in such events, the theory or concept did not connect to the specific game-elements that was chosen. Remarkably, in none of the studies included in the systematic review was there any mention of a reason to use or select a specific game-element for a certain learning situation.

To create a scientific rational to optimally select game-elements for a specific educational situation we conducted a focus group study in **chapter 3**. Focus group studies involve group interviews with demographically similar people to understand perceptions concerning a certain topic. Prior game design research indicated that what people like about play and games shows considerable variability across individuals. As game-design is part of GBL, it is important to understand students' opinions on games as well as their opinions on the play-learning interactions that GBL aspires to. We argued that by doing this in a bottom-up, student-driven fashion, we would collect information pertinent to student motivation. Favourite game-(elements), perceptions of play and learning interactions, and perceived favourable (or hindering) circumstances to implement game-elements were described. This way, we established many different play preferences among medical and dentistry students. Our findings mirrored suggestions from prior studies outside of the field of (medical) education research that the liking of play is individual and contextual [5–9]. Nevertheless, by using thematic analysis we were able to construct overarching themes. Medical and dentistry students mainly played with the goal to experience pleasure. How pleasure was reported to be attained in play differed considerably among students, and included both positive ways (e.g. social play) and emotionally more ambiguous ways (e.g. an almost irresistible urge to win). The enthusiasm about play and games was greatly forthcoming during the focus group sessions but damped when the discussion turned to the implementation of play into an academic context. The seriousness of academic learning and the frivolity of play seemed two entities not easily reconciled. According to this sample of HPE students, play may not be compatible with academic learning and should only be considered if such an approach would increase the efficiency of learning. For instance, courses that students considered difficult and tedious were considered most likely to benefit from GBL-designs. Importantly, according to students, the frivolity of play and seriousness of education should be balanced. When a particular learning situation is too playful, student might perceive it as inefficient and avoid participation entirely. One of the

most important incentives to play reported by students was sociability. This is in sharp contrast with the current state of GBL research where most studies apply a single player and assessment game-element approach (as reviewed in chapter 2). This is important since research outside of the field of HPE education showed that game-elements can motivate students but also can demotivate others at the same time [1–3].

In chapter 3, we learned about the existence of considerable differences among students as to their attitudes towards play and GBL. We then moved on to elaborate on the concept of individual play preference as possible indicator of student motivation. We argued that if game designers acknowledge individual play preferences and use these to design successful games (a concept coined player types), so should designers of GBL. In **chapter 4** we used the mixed method approach of Q methodology to identify possible patterns of play preference (so-called player types), as a scientific way to identify individual differences pertinent to GBL design. Student statements on play were used from the study conducted in chapter 3. We found five clearly distinguishable types of recurrent game preferences, namely *the social achiever*, *the explorer*, *the socializer*, *the competitor* and *the troll*. Each of these player-types revolved around two salient themes: achievement and sociability. We created a taxonomy based on these themes as depicted below in figure 1. Each player type has its own distinct characteristics. *Social Achievers* like to play in teams and achieve something in a game preferably in the form of competition. Likewise, *competitors* enjoy competition but would rather not depend on others. They seem to need sociability only to show-off their supremacy. *Explorers*, like *competitors*, are not very interested in sociability. *Explorers* are more drawn to the storyline of the game, to immersive elements and are interested in finding the boundaries of a game. S*ocializers* play, much like *social achievers,* for the sense of togetherness and sociability. Winning, however, is seen as means to an end and not as a necessity (in contrast to *the social achiever*). Finally, *trolls* are somewhat ambivalent about play. They seem to like play but seem to be more in the game to evoke chaos between players. Sociability and achievement (e.g. winning) seemed not very important to them. As shown in chapter 2, current studies on GBL in HPE mainly focus on achievement aspect of play (e.g. points and rewards). The player types we identified, as well as the resulting themes in this chapter, strongly suggest that currently GBL is not optimally catering to HPE students. Indeed, the current variety in GBL-designs in health professions education is possibly limited. By focusing on the achievement aspect of play, many students could be turned off, at least on the basis of their reported play-preference.



While Q methodology (chapter 4) is an excellent method to ensure the widest variety of game preferences, it cannot generalize findings to a larger group (e.g. what percentage of a group is socializer?) or provide characterization of the player types (e.g. are women more prone to be explorers?). This is important since understanding the occurrence

of player-types could give direction for further research and design. We validated and looked for the prevalence of the player types (or game-preferences) and identified further characteristics of each player type in **chapter 5**. To our knowledge, this was the first time that a study used patterns in opinions from a prior Q methodology study to gauge the prevalence of such patterns a larger population. In this national study (conducted on almost every medical school in the Netherlands), we showed that our taxonomy can adequately describe a medical student population. Almost 90% of the play-preferences was accounted for in our player type model. Distributions of player types were different between gender groups. Women had a higher tendency to be *social achievers* and *socializers*. Men had a higher tendency to be *competitors* and *trolls*. Most students loaded significantly on *the social achiever* (65%) and *the socializer* player types (37%; note that students can load on multiple player types). This orientation towards social play is of great relevance, and in sharp contrast with the current dominant approach in GBL research to study the impact of solitary elements (e.g. scoring and rewards). Importantly, we found that only 25% of students loaded on *the competitor* player type (people that thrive on competition and scoring, but preferable not together with others). This is in line with our earlier analysis of GBL in HPE (presented in Chapter 2) showing that social elements seem to be applied only very scarcely. Hence, game elements targeting *the competitor* player type might be substantially over-represented in GBL whereas game elements targeting social aspects of play might be greatly underrepresented.

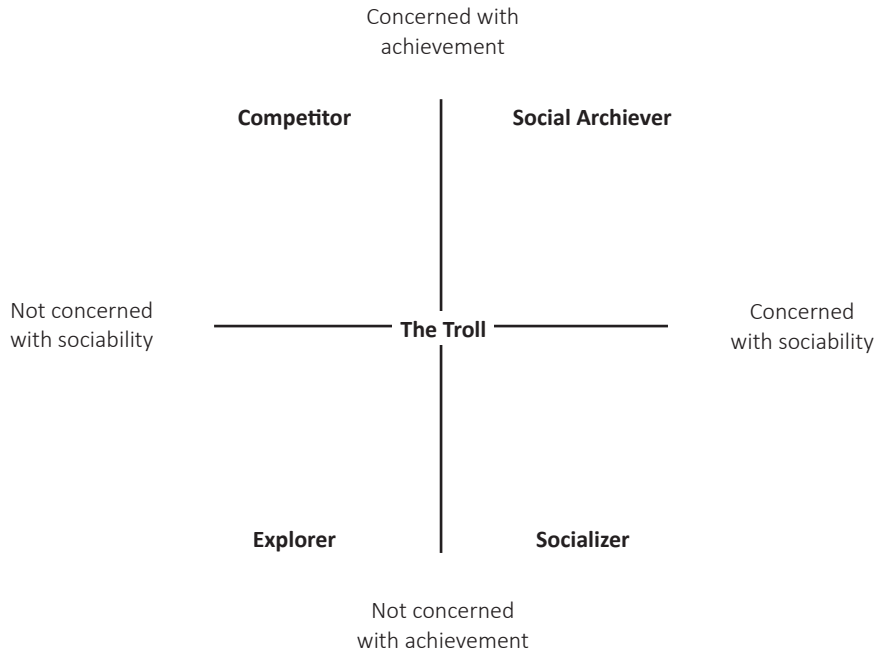


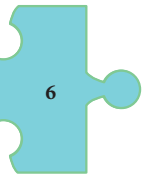
Figure 1. Theoretical framework illustrating player types in relation to the sociability and achievement themes.

General discussion

This thesis offers novel insights into the role of GBL in health profession education. While GBL is often studied with respect to the application of competition and rewards, the social aspect of play is often overlooked. Generally, a conceptual understanding as to why, how, and when game-elements need to be used seems to be lacking. We believe that the data presented in this thesis could provide a solid rationale for a new line of research and implementation of GBL.

Chocolate-coated broccoli

Covering everything in chocolate does not make it delicious. Making every course game-based does not make it fun. That is the gist of a quote by education professor Amy Bruckman, who states: *"Most attempts at making software both educational and fun end up being neither. Fun is often treated like a sugar coating to be added to an educational core. Which makes about as much sense as chocolate-dipped broccoli."* [10]. Indeed, taking a bad pedagogy and 'gamifying' it by adding points or creating a reward does not magically make it a good learning strategy. The power of GBL is to overcome behavioural or attitudinal problems in students, not to overcome bad instructional content created by teachers (Chapter 2). The very foundation for every learning strategy should be solid instructional content. GBL will not and cannot improve this.



Students who are reluctant to learn are not motivated to participate in educational experiences [11], and when learners are not engaged, academic performance is lower [12]. Student who do not actively participate benefit less [13], while investing little cognitive effort in studying results in decreased learning [14]. In such scenario's GBL might increase learning by changing attitudes and behaviour. Importantly, for GBL to be successful, the targeted behavioural or attitudinal change should in itself influence learning (Chapter 3)[15]. This is crucial for two reasons. First, let us hypothesize that I want to ensure that every page in this thesis is read. One way to accomplish that could be to award points for every page that is turned and provide a grant prize when all pages are turned. However, when readers are more interested in the points and prize than in reading the thesis this could result in readers turning every page without reading a single word. In this example, gamification does not result in learning but instead leads to unwanted behavioural effects (see also chapter 2 for other possible undesired effects of GBL). Second, the work presented in this thesis suggests that when GBL is too often applied, or when game-elements are used in abundance, students might consider learning as frivolous and inefficient (chapter 3). Students seem to accept play in academic learning when they believe it to act as motivational strategy to increase learning. However, it can be quickly viewed a threat to the efficiency of learning. In the line of chocolate-coated broccoli quote; some student might be repelled by the abundance of chocolate over their

broccoli and rather just get it over with.

Selecting the optimal GBL-strategy

Each study conducted in this thesis highlights the importance to take individuality into account when using play as a source for motivation. Chapter 1 showed that many studies investigating GBL focus on one group of game-elements (assessment) while most students may be more motivated by a different group of game-elements (human interaction) as we have shown in chapter 3, 4 and 5. So how should an (health profession) educator design a GBL-strategy? The very first thing is taking a step back and asking oneself whether there is a problem and, if so, what the problem is. As stated in the previous paragraph, GBL might be of value when there are deficiencies in attitude or behaviour but not when educational content itself lacks quality. A lack of quality could be related to factors ranging from bad instructional content deliverance (e.g. a weak structure or bad scaffolding of information) to a poorly designed user interface in e-learning (e.g. buttons that do not work properly). Such factors need to be minimized before GBL could be of added value. Of note, in the creation of a GBL-design an educator is often forced to already re-think the structure of the educational content.

When the problem is identified, an educator can start to think about what might be causing the problem and subsequently which GBL-strategy might be suited best (i.e. serious games or gamification). Do students generally regard the study subject as difficult, or is it viewed as boring and tedious? According to the result in chapter 3, these types of behaviour or attitudes might be best suited for a GBL-strategy like a serious game (or gamification with an abundance of game-elements). Do students rather like the subject but lack motivation to learn for retrieval? Then a gamification-strategy with less game-elements might be better suited. This line of reasoning follows from the conceptual difference between gamification and serious games, which is the presence of a game-context (chapter two). A game-context would make students more likely to receive the learning situation as less efficient. Following the same logic, one could argue that the more game-like the intervention, the higher the possibility that students consider it to be inefficient (chapter 3). In turn, this would forecast a higher likelihood of non-use of the GBL-strategy. The interaction between play and learning should thus be in balance. The interaction between play and learning can therefore be hypothetically (and simplified) considered to work as a seesaw, the serious act of learning on the one end and play on the other (figure 2) (and perhaps only fun when going up and down as the GBL-strategy continues). The playful distracts form the serious but engages to continue learning while the serious ensures that the efficiency of learning is guaranteed. Educators interested in using GBL should balance the seesaw if needed by adding play or seriousness (e.g. learning). If the seesaw is already in balance, the learning act is considered efficient and sufficiently pleasurable. Adding play in such a situation will disturb and tilt the seesaw

towards the playful. In such a scenario, students might consider the game-based learning material inefficient, and they might rather resort to previous learning material e.g. reading from a book. However, if the learning is considered too serious (or too tedious and dry) the seesaw tilts towards the serious and could be counterbalanced by adding play. This might subsequently increase the efficiency of learning. This is not a new idea. A considerable amount of prior research has focused on this "paradoxical" relation between autonomous, purposeless, autotelic play and mandatory, telic, intentional learning. [16–19] However, whereas most of the existing studies consider this paradox/tension from a designers perspective [19,20], we found that students themselves (as players) also perceive or imagine this tension. This finding is novel and more careful contextualisation seems therefore warranted by future research.

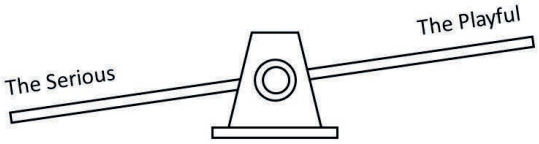


Figure 2. The seesaw of play and the serious.

Third, since GBL can be digital or analogue (chapter 2), an educator can choose between a digital or analogue strategy, or a combination of them. Educators must carefully consider whether the added value of instant feedback and the flexibility of distance learning in digital GBL outweigh the possible social isolation [21]. We found no indication as to why there should be a tendency toward a digital learning strategy. On the contrary, findings in chapter 5 indicate that female students in particular strongly prefer analogue over digital games. This might be in line with the technology acceptance model (TAM) [22]. TAM is a widely acknowledged model to explain technology acceptance by individuals and adopts variables such as 'perceived usefulness' and 'perceived ease of use' theorized to lead to (the intention to) use a technology [23]. Studies using the TAM found on many occasions (e.g. using e-learning modules [23,24], blended learning formats [25], e-mail usage [26]) a higher tendency to use technology in men as compared to women [27]. This warrants caution in prematurely selecting a digital solution, which harks back to the problem statement of this thesis. If men are more likely to fall behind due to motivational or attitudinal issues, it might be reasonable to select a digital environment. On the other hand, if women fall behind it might be more effective to select an analogue strategy. Interestingly, the majority of students in medical school (and other areas of health professions education) are female [28] while the majority of gamification and serious game applications are digital [29].

Fourth, although they are tendencies towards play preferences by specific groups (e.g. the liking of digital solutions by men) educators should understand that play remains an individual attribute. Female students attending Dutch medical universities were more prone to load on social player types. This might explain why women tend to like analogue games. Analogue games are predominantly played in company of others, yet, importantly, men can also like social play just as much (chapter 5). Thus, although individual variables such as student characteristics are important, they do not show the full picture because of the variability of play preferences within each group.

Player types: an evidence-based model?

The conceptual framework and accompanied factor arrays with statements could provide a meticulous tool for educators that want to understand their future users. This possibly creates the opportunity to design tailored education, by, for instance, ensuring that that the most prevalent player types are represented in GBL, that every player type is represented in the GBL environment, or that the GBL is adjusted based on a game-preference. Understanding these game-preferences might convey the understanding how we can optimally motivate our students to learn those difficult and tedious subjects that help them to become better health care professionals.

The scientific methods that we applied and that are described throughout this thesis ensured an evidence-based creation of a player typology. Our player typology revolves on two themes salient in play and playertype literature (sociability and achievement). The player-type model from chapter 4 depicts dimensionality or even dichotomy in being a player type (e.g. achievement low/high). Yet, the accompanying factor arrays display that the two salient themes are oversimplified and are therefore of utmost importance when considering the model. Making it even more complex, chapter 5 showed that student can load on multiple player types which might even appear conceptually inconsistent especially when, according to the model, some playertypes are mutually exclusive (e.g. competitor and socializer player type). In this regard it is important to note the remarks in chapter 5, that state that perhaps students can alter/switch player types depending on the context or game-design.

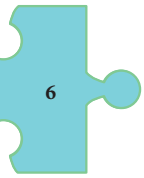
So what does this say about our player type? Does this mean that we can conclude that our player type model and the accompanying factor arrays will create an optimal GBL-design? It is still too early for this. There are at least two caveats, which also provide opportunities for future directions.

First, our player taxonomy is based on play preferences indicated by way of forced choice. The method used to find and analyse player types required participants to choose between play preferences. We do not know what participants would have answered without the

need for choice. Likewise, as stated above, choices could be context-dependent, varying in space and time. Perhaps one could have subconsciously chosen to be a competitor when filling out the questionnaire but could be a socializer in the next when thinking of a different game. Likewise one player could be more flexible in switching between different types (e.g. one could imagine that socializer could easily change between player types in order just to have fun). Therefore, we cannot say that someone 'is' a certain player type, or that a player type connected to someone at a certain point in time is the singular best way for to design GBL optimal for that individual. It might be just a preference which could be context depended, and we do not know what deviating from that preference in GBL design will result in. Of note, we never received feedback that participants were not able to choose, and our player types were somewhat comparable by other player typologies that did not use such methods.

Second, we considered player types, not game-based learning types (or even learning types for that matter). We contend that player types reflect motivation more than learning, but at this stage we do not know whether they reflect play motivation, GBL motivation or even farther stretched, learning motivation, simply because we have yet to connect this concept directly to education and test its validity there.

An adequate way to address both issues and to understand whether play-preference might indicate GBL effectiveness would be to perform a randomized crossover experiment in which students perform the sorting procedure beforehand and are allocated to their befitting or contradicting GBL-design based on their player type. Such an experiment could highlight whether providing students with optimal GBL design according to their player type increases learning or that adherence to player types might not provide any difference in learning outcomes. On a critical note, player types show some similarities with learner types; both postulate that students differ in regard to what mode of instruction is most effective for them. When learner types were put to the test in a randomized crossover trial, students were allocated to their desired or apposed learner types [30]. Results of this study showed no differences in improving learning outcomes by adhering to learner types. Other (un)controlled studies showed similar results [31,32]. Future research will therefore need to address whether adhering to player types in GBL design will result in consistent positive effects on student motivation (and, therefore, perhaps learning outcomes too).



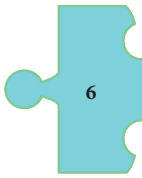
Play. An integral part of life.

So far, this paper has focused on GBL in the context of health professions education. A caveat that I have identified on multiple occasion in this thesis is that GBL research generally seems to have little connection to play theory. Still, if we want to start to understand, or somehow infer, the validity of some of the play-related concepts that we propose, such theory is instrumental.

The following section will therefore discuss play. We will come to learn that play can be seen a philosophical construct, theorized to be deeply rooted throughout all spheres of culture. Following this, it can be hypothesized that education falls under the same assertion. If this theory is right, player types might be more broadly applicable than only towards GBL.

In 1938 Huizinga published his major theoretical work Homo Ludens: A study of the Play Element in Culture [33]. Since then it is considered a landmark in the expanding literature on play with great relevance to human affairs [34]. It paved the way for influential play-scholars such as Callois [35] and Suits [36]. Building on philosophers dating back to antiquity (e.g. Heraclitus[37], Plato [38]) but also modern philosophers such as Heidegger, Nietzsche, Marx, Hegel and others [33,34,39,40] Huizinga asserts that man, as a species, is a *homo ludens* (playing man). By defining formal characteristics of play (Box 1) it is theorized that many higher forms of culture (e.g. religion, language, law, philosophy and arts) display characteristics of play.

Religion for example displays all the characteristics of his definition [34]. A sacred place (e.g. church or mosque) is hedged of from ordinary life in which religious ceremonies take place. A certain delimitation from the ordinary is provided by artificial seclusion of performing rites of consecration and initiation (e.g. taking vows or oaths), certain customs need to be adhered to and, just as in play, participants are absorbed in the ceremony, carrying them to another world. Huizinga's ideas are not undisputed ([35,41], [29) , but there is consensus that his view on the civilizing force of play is a landmark in play theory.



Box 1. The formal characteristics of play according to Huizinga.

"a free activity standing quite consciously outside 'ordinary' life as being 'not serious,' but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social groupings which tend to surround themselves with secrecy and to stress their difference from the common world by disguise or other means."

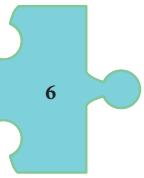
Education as a playful construct

Might Huizinga's principles also apply to our education system? Let us for a moment consider what this means. If we conclude they do, we might infer that player types are applicable beyond GBL and may hold relevance for other aspects of education as well.

Interestingly, the entire education system seems as if it were constructed from a ludic point of view. A school or university consciously stands out of the ordinary life and promotes the formation of social groupings. The seriousness of life outside of school is

secluded and, at the same time, a student is absorbed intensely and utterly by it. It has its own boundaries of time and space, there are fixed rules and it proceeds in an orderly fashion. Lee and Hamer provocatively alluded to this way of thinking in their review on gamification [38]; in their view, completing assignments in school might be seen as an ability to score points translating into "badges" (more commonly known in education as grades). Using these badges as reward system for desired behaviour (or punishment for undesirable behaviour) students will level up (or more commonly known as proceeding to the next academic year) or will have to redo the level (also known as grade repetition) [38]. In line with the play-philosopher Suits' definition of play, these modalities can also be theorized to be a voluntary acceptance (one goes to school/university voluntarily) of unnecessary obstacles (theoretically we can all learn without the need for grades) [36].

People generally view education as something serious, and perhaps quite the opposite of play. Yet, by hypothesizing that higher forms of civilization, like education systems, are structured like play [34,42] we get the interesting opportunity to speculate about the relevance of player types for the way we design our educational system. Just as currently is the case within game-based learning research [29], our educational system is predominantly assessment/achievement based. Tests, grades, school years all underlie a principle of assessment/achievement. Yet, the findings in this thesis suggest that, at least based on play preferences reported by health professions students, this is not the optimal method to motivate a good portion of students. While some prefer assessment, others are more interested in sociability or exploration. This implies that the standard of assessment and achievement in our current educational system is not inclusive towards all students. By extrapolation, there may be a mismatch between how our educational system is constructed and the human behavioral mechanisms that are most elementary to motivation at the individual level.

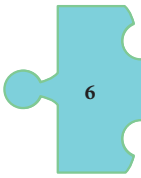


"Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid." This quote is often credited to Albert Einstein but a true origin remains unknown [43]. It alludes to a long-standing belief that it is inappropriate to judge a creature on a skill that it does not possess. Perhaps competitors and social achievers thrive within our educational systems due to the abundance of assessment elements, while explorers or socializers stay behind because they are less concerned with achievement/assessment and therefore might be evaluated (for their future life) in a suboptimal way and "*live their whole life believing that they are stupid*".

Conclusion

The power of GBL is to overcome behavioural or attitudinal problems in students, not to overcome bad instructional content created by teachers. For GBL to be successful, the targeted behavioural or attitude change should influence learning. Play is highly variable as is the liking of it. In this thesis, I have described how we identified and validated five patterns of game preferences that represent player types across dimensions of *achievement* and *sociability*. The player type taxonomy and accompanying player type configurations (factor arrays) that we proposed hold promise to be used in tailoring game-based learning design to students' game preferences to optimize game-based learning effectiveness. Many studies investigating GBL focus on achievement game-elements while most of the students may be motivated better by social game-elements. This warrants especially more GBL research and design toward social elements.

Finally, modern students are digital natives but that does not necessarily mean they are inclined towards digital technology. Some like board games others likes them digital. Everybody likes to play in a different way but, from a philosophical point of view, we might be all play native. We only forget it from time to time by getting caught up in the seriousness of life. The use of game-based learning is not new, it is ancient dating back to antiquity. Why so serious? Let's play!



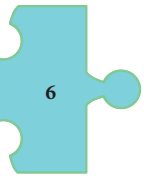
References

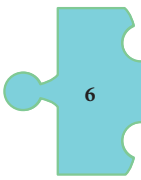
1. Monterrat B, Lavoué É, George S. Adaptation of Gaming Features for Motivating Learners. *Simul Gaming*. Published online 2017. doi:10.1177/1046878117712632
2. Harviainen J. Critical challenges to gamifying education: A review of central concept. In: *Proceedings of the Game On! Conference*. ; 2014.
3. Burgers C, Eden A, Van Engelenburg MD, Buningh S. How feedback boosts motivation and play in a brain-training game. *Comput Human Behav*. Published online 2015. doi:10.1016/j.chb.2015.01.038
4. Yee N. Motivations of Play in Online Games. *J CyberPsychology Behav*. 2007;9:772-775. doi:10.1089/cpb.2006.9.772
5. Eberle SG. The Elements of Play Toward a Philosophy and a Definition of Play. *Am J Play*. Published online 2014.
6. Glynn MA, Webster J. The Adult Playfulness Scale: An Initial Assessment. *Psychol Rep*. Published online 1992. doi:10.2466/pr0.1992.71.1.83
7. Yee N. Facets: 5 motivation factors for why people play MMORPGs. *Http://WwwNickyeeCom/Facets/HomeHtml*. Published online 2002.
8. Quaiser-Pohl C, Geiser C, Lehmann W. The relationship between computer-game preference, gender, and mental-rotation ability. *Pers Individ Dif*. Published online 2006. doi:10.1016/j.paid.2005.07.015
9. Hamari J, Tuunanen J. Player Types: A Meta-synthesis. *Trans Digit Games Res Assoc*. Published online 2014. doi:10.26503/todigra.v1i2.13
10. Bruckman A. Can Educational Be Fun? *Game Dev Conf*. Published online 1999.
11. DiSalvo B. Pink Boxes and Chocolate-dipped Broccoli: Bad Game Design Providing Justifications for Reluctant Learners. In: *11th Games + Learning + Society Conference*. ; 2015.
12. Carini RM, Kuh GD, Klein SP. Student engagement and student learning: Testing the linkages. *Res High Educ*. Published online 2006. doi:10.1007/s11162-005-8150-9
13. Zhao CM, Kuh GD. Adding value: Learning communities and student engagement. *Res High Educ*. Published online 2004. doi:10.1023/B:RIHE.0000015692.88534.de
14. Paas F, Tuovinen JE, Van Merriënboer JJG, Darabi AA. A motivational perspective on the relation between mental effort and performance: Optimizing learner involvement in instruction. *Educ Technol Res Dev*. Published online 2005. doi:10.1007/BF02504795
15. Landers RN. Developing a Theory of Gamified Learning: Linking Serious Games and Gamification of Learning. *Simul Gaming*. Published online 2014. doi:10.1177/1046878114563660
16. Deterding S. Contextual autonomy support in video game play: A grounded theory. In: *Conference on Human Factors in Computing Systems - Proceedings*. ; 2016. doi:10.1145/2858036.2858395
17. Franzwa C, Tang Y, Johnson A, Bielefeldt T. Balancing fun and learning in a serious game design. *Int J Game-Based Learn*. Published online 2014. doi:10.4018/ijgbl.2014100103
18. Harteveld C. *Triadic Game Design: Balancing Reality, Meaning and Play*.; 2011. doi:10.1007/978-1-84996-157-8
19. Jacob Habgood MP, Ainsworth SE. Motivating children to learn effectively: Exploring the value of intrinsic integration in educational games. *J Learn Sci*. Published online 2011. doi:10.1080/10508406.201

0.508029

20. Squire K. From Content to Context: Videogames as Designed Experience. *Educ Res*. Published online 2006. doi:10.3102/0013189X035008019
21. Moran J, Briscoe G, Peglow S. Current Technology in Advancing Medical Education: Perspectives for Learning and Providing Care. *Acad Psychiatry*. Published online 2018. doi:10.1007/s40596-018-0946-y
22. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q Manag Inf Syst*. Published online 1989. doi:10.2307/249008
23. Tarhini A, Hone K, Liu X. Measuring the moderating effect of gender and age on E-learning acceptance in England: A structural equation modeling approach for an extended Technology Acceptance Model. *J Educ Comput Res*. Published online 2014. doi:10.2190/EC.51.2.b
24. Ong CS, Lai JY. Gender differences in perceptions and relationships among dominants of e-learning acceptance. *Comput Human Behav*. Published online 2006. doi:10.1016/j.chb.2004.03.006
25. Padilla-Meléndez A, Del Aguila-Obra AR, Garrido-Moreno A. Perceived playfulness, gender differences and technology acceptance model in a blended learning scenario. *Comput Educ*. Published online 2013. doi:10.1016/j.compedu.2012.12.014
26. Gefen D, Straub DW. Gender differences in the perception and use of e-mail: An extension to the technology acceptance model. *MIS Q Manag Inf Syst*. Published online 1997. doi:10.2307/249720
27. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: Toward a unified view. *MIS Q Manag Inf Syst*. Published online 2003. doi:10.2307/30036540
28. Bleakley A. Gender matters in medical education. *Med Educ*. Published online 2013. doi:10.1111/j.1365-2923.2012.04351.x
29. van Gaalen AEJ, Brouwer J, Schönrock-Adema J, Bouwkamp-Timmer T, Jaarsma ADC, Georgiadis JR. Gamification of health professions education: a systematic review. *Adv Heal Sci Educ*. Published online 2020. doi:10.1007/s10459-020-10000-3
30. Cook DA, Thompson WG, Thomas KG, Thomas MR. Lack of interaction between sensing-intuitive learning styles and problem-first versus information-first instruction: A randomized crossover trial. *Adv Heal Sci Educ*. Published online 2009. doi:10.1007/s10459-007-9089-8
31. Cook DA, Smith AJ. Validity of index of learning styles scores: Multitrait-multimethod comparison with three cognitive/learning style instruments. *Med Educ*. Published online 2006. doi:10.1111/j.1365-2929.2006.02542.x
32. Cook DA, Gelula MH, Dupras DM, Schwartz A. Instructional methods and cognitive and learning styles in web-based learning: Report of two randomised trials. *Med Educ*. Published online 2007. doi:10.1111/j.1365-2923.2007.02822.x
33. Huizinga J. *Homo Ludens: A Study of the Play-Element in Culture*.; 1938. doi:10.4324/9781315824161
34. Anchor R. History and Play: Johan Huizinga and His Critics. *Hist Theory*. Published online 1978. doi:10.2307/2504901
35. Caillois R. *Man , Play , and Games*.; 1961.
36. Suits B. *The Grasshopper: Games, Life and Utopia, Bernard Suits*.; 1978. doi:10.1073/pnas.0703993104
37. Heidel WA. Herakleitos von Ephesos griechisch und deutsch . Hermann Diels . *Class Philol*. Published online 1910. doi:10.1086/359408

38. D'Angour A. Plato and Play: Taking Education Seriously in Ancient Greece. *Am J Play*. Published online 2013.
39. Fink E. *Spiel Als Weltsymbol*.; 1960.
40. Axelos K. *Vers La Pensée Planétaire*.; 1694.
41. Geyl P. Huizinga as Accuser of His Age. *Hist Theory*. Published online 1963. doi:10.2307/2504105
42. Huizinga J. *Homo Ludens: A Study of the Play Element in Culture*.; 1955. doi:10.1007/s13398-014-0173-7.2
43. Everybody is a Genius. But If You Judge a Fish by Its Ability to Climb a Tree, It Will Live Its Whole Life Believing that It is Stupid – Quote Investigator. Accessed March 16, 2022. https://quoteinvestigator.com/2013/04/06/fish-climb/




6

Mijn spelen is leren, mijn leren is spelen. En waarom zou mij dan het leren vervelen?
- Hiëronymus van Alphen

7

Synopsis

(Nederlande samenvatting)

Nederlandse samenvatting

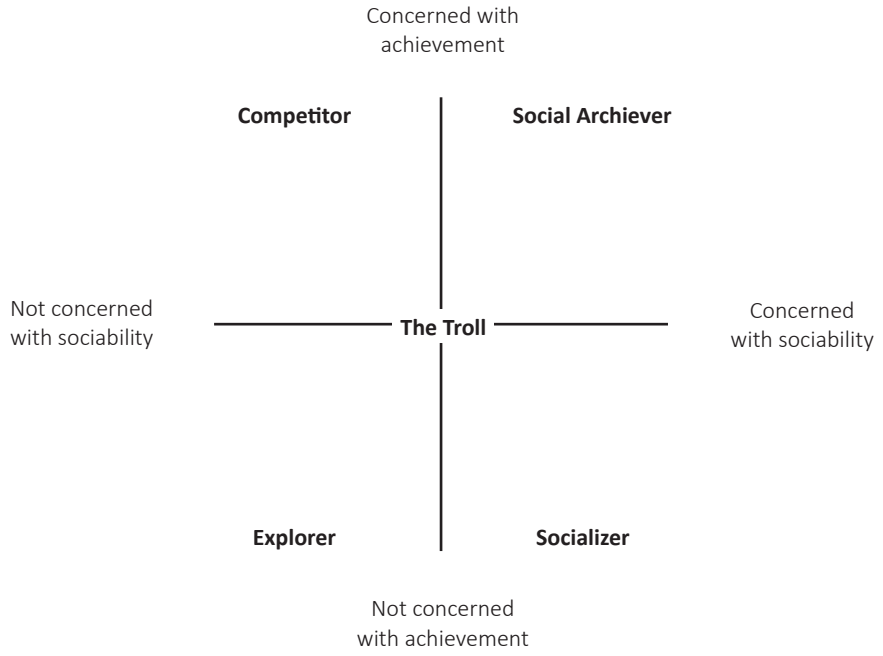
In **hoofdstuk 2** hebben we een uitgebreide systematische review uitgevoerd over de toepassing van gamification binnen het medisch onderwijs. We vonden dat er veel verwarring bestaat in de terminologie die wordt gebruikt om game-based learning (GBL) te beschrijven. Dit vergroot de complexiteit voor lezers en bemoeilijkt de overdraagbaarheid van onderzoek naar de onderwijspraktijk. Gamification en serious games zijn niet hetzelfde. Het meest onderscheidende kenmerk is of een leermethode wel (serious games) of niet (gamification) de indruk van een game geeft. Hoewel gamification spelelementen zoals beloningen toepast, is de geïsoleerde toepassing van dergelijke elementen onvoldoende om een spel te vormen. Onze systematische review toonde verder aan dat er geen gerapporteerde, beoordeelde of waargenomen negatieve effecten zijn geassocieerd met gamification-interventies in medisch onderwijs. We hebben echter ook aangetoond dat de kwaliteit van het bewijs over het algemeen laag is. Voornamelijk werden effecten gerapporteerd over de mate van tevredenheid en hoeveelheid van het gebruik. Zelden werd er gerapporteerd of gamification daadwerkelijk het leerresultaten verbeterde. Bovendien ontbraken controlegroepen vaak in interventiestudies, waardoor het in veel gevallen moeilijk was om effecten toe te schrijven aan gamification (in plaats van algemene effecten van een interventie). Interessant is dat in de weinige onderzoeken waarin wel een controlegroep was opgenomen, gamification kon worden gekoppeld aan een verbeterd gebruik van leermateriaal en (indien gerapporteerd) hogere leerresultaten. Met betrekking tot de gamification-elementen die in GBL worden gebruikt, zagen we een sterke voorkeur om beloning (bijvoorbeeld punten scoren) als spelelement te gebruiken. De meeste game-attributen die routinematig worden gebruikt bij het ontwerpen van "echte" spellen, zoals (het stimuleren van) sociale interactie, werden bijna nooit toegepast in GBL. Verder is er weinig interesse geweest in mogelijke mechanismen die ten grondslag liggen aan veronderstelde GBL-voordelen, bijvoorbeeld door theorieën of conceptuele kaders aan de orde te stellen of uit te werken. Het wel toepassen van een dergelijke aanpak kan verduidelijken waarom en onder welke omstandigheden gamification zou kunnen werken. Wanneer een theorie wel aan de basis leek te liggen van een onderzochte interventie, waren de meest voorkomende aannames dat gamification het leergedrag (bijvoorbeeld motivatie) positief zou kunnen veranderen, of dat het zou kunnen helpen bij het ontwikkelen van een positieve houding naar te lerende onderwerp. Helaas sloot bij dergelijke onderzoeken de gebruikte theorie of het concept niet aan bij de specifieke gekozen spelelementen. Opmerkelijk was dat in geen van de in de systematische review opgenomen studies een reden werd genoemd waarom een specifiek spelelement voor een bepaalde leersituatie werd gebruikt.

Om een wetenschappelijke onderbouwing te creëren voor het optimaal selecteren van spelelementen voor een specifieke onderwijssituatie, hebben we een focusgroeponderzoek

uitgevoerd in **hoofdstuk 3.** Focusgroeponderzoeken zijn groepsinterviews om percepties over een bepaald onderwerp te leren begrijpen. Eerder onderzoek naar gamedesign toonde aan dat wat mensen leuk vinden aan spelen en games (het game-design) een aanzienlijke variatie vertoont tussen individuen. Aangezien game-design een belangrijk (motiverend) deel is van GBL, is het belangrijk om de mening van studenten over games te begrijpen, evenals hun mening over de spel-leer-interacties. Door dit op een bottom-up, studentgerichte manier te doen, konden we informatie verzamelen relevant voor de motivatie van studenten bij het gebruik van GBL. Favoriete spel(elementen), percepties van spel en leerinteracties, en waargenomen gunstige (of belemmerende) omstandigheden om spelelementen te implementeren werden beschreven. Op deze manier hebben we veel verschillende speelvoorkeuren vastgesteld bij studenten geneeskunde en tandheelkunde. Onze bevindingen weerspiegelden suggesties uit eerdere studies buiten het veld van (medisch) onderwijsonderzoek: het leuk vinden van spellen en spelen is individueel en context afhankelijk. Toch konden we door middel van thematische analyse overkoepelende thema's construeren. Studenten geneeskunde en tandheelkunde speelden vooral met het doel plezier te beleven. Hoe plezier werd bereikt in spel verschilde aanzienlijk tussen studenten, en omvatte zowel positieve manieren (bijvoorbeeld sociaal spel) als emotioneel meer ambigue manieren (bijvoorbeeld een bijna onweerstaanbare drang om te winnen). Het enthousiasme over spel en spelen was groot tijdens de focusgroepsessies, maar werd getemperd toen de discussie over de implementatie van spel in een academische setting ging. De ernst en het serieuze van academisch leren en de lichtzinnigheid van het spel leken twee entiteiten die niet gemakkelijk met elkaar verzoend konden worden. Volgens deze steekproef van medische studenten is spelen mogelijk niet verenigbaar met academisch leren en zou het alleen moeten worden overwogen als een dergelijke aanpak de efficiëntie van het leren zou verhogen. Bijvoorbeeld, cursussen die studenten als moeilijk en vervelend beschouwden werden het meest waarschijnlijk geacht baat te hebben bij GBL. Belangrijk is dat volgens studenten de frivoliteit van het spel en de ernst van het onderwijs in evenwicht moeten zijn. Wanneer een bepaalde leersituatie te speels is, kan de student deze als inefficiënt ervaren en participatie volledig vermijden. Een van de belangrijkste stimulansen om te spelen was volgens studenten gezelligheid. Dit staat in schril contrast met de huidige stand van het GBL-onderzoek, waar de meeste studies een singleplayer- en score-elementbenadering toepassen (zoals besproken in hoofdstuk 2). Dit is belangrijk omdat onderzoek buiten het veld van medisch-onderwijs heeft aangetoond dat game-elementen studenten kunnen motiveren, maar tegelijkertijd ook anderen kunnen demotiveren.

In hoofdstuk 3 leerden we over het bestaan van aanzienlijke verschillen tussen studenten wat betreft hun houding ten opzichte van spel en GBL. Vervolgens gingen we verder met het uitwerken van het concept van individuele speelvoorkeuren als mogelijke indicator van student motivatie in GBL We brachten naar voren dat, als spelontwerpers

individuele spelvoorkeuren erkennen en deze gebruiken om succesvolle spellen te ontwerpen, ontwerpers van GBL dat mogelijk ook zouden moeten doen**. In hoofdstuk 4** hebben we de 'mixed method'-benadering van de Q-methodologie gebruikt om mogelijke patronen van spelvoorkeuren (zogenaamde spelertypes) te identificeren, als een wetenschappelijke manier om individuele verschillen te identificeren die relevant zijn voor GBL-ontwerp. Uit het onderzoek dat in hoofdstuk 3 is uitgevoerd, zijn uitspraken van studenten over spel gebruikt. We vonden vijf duidelijk te onderscheiden soorten terugkerende spelvoorkeuren, namelijk de social achiever (sociale presteerder), de explorer (de ontdekkingsreiziger), de socializer, de competitor en de trol. Elk van deze spelerstypes bevatte twee opvallende thema's: prestatie en gezelligheid. We ontwierpen een taxonomie gemaakt op basis van deze thema's, zoals hieronder afgebeeld in figuur 1.



Figuur 1. Theoretisch raamwerk dat spelerstypes illustreert in relatie tot de thema's sociability (gezelligheid) en achievement (prestatie).

Elk type speler heeft zijn eigen specifieke kenmerken. Social achievers spelen graag in teams en bereiken iets in een spel bij voorkeur in de vorm van competitie. Evenzo houden competitors van competitie, maar zijn ze liever niet afhankelijk van anderen. Ze lijken gezelligheid alleen nodig te hebben om te pronken met hun overwinningen. Explorers zijn, net als competitors, niet erg geïnteresseerd in gezelligheid. Explorers voelen zich

meer aangetrokken tot de verhaallijn van het spel, de meeslepende elementen en zijn geïnteresseerd in het opzoeken van de grenzen van een spel. Socializers spelen, net als social achievers, voor het gevoel van saamhorigheid en gezelligheid. Winnen wordt echter gezien als een middel om het doel van samenhorigheid te bereiken en niet als een doel (in tegenstelling tot de social achiever). Ten slotte zijn trollen enigszins ambivalent over spel. Ze lijken van spelen te houden, maar lijken meer in het spel te zitten om chaos tussen spelers op te roepen. Gezelligheid en prestatie (bijvoorbeeld winnen) leken voor hen niet erg belangrijk.

Zoals blijkt uit hoofdstuk 2, richten de huidige onderzoeken naar GBL in het medisch onderwijs zich voornamelijk op prestatieaspecten van het spel (bijv. punten en beloningen). De spelerstypes die we hebben geïdentificeerd, evenals de resulterende thema's in dit hoofdstuk, suggereren sterk dat GBL momenteel niet optimaal tegemoetkomt aan wat medische-studenten mogelijk motiveert. Inderdaad, de huidige verscheidenheid aan GBL-ontwerpen in het medisch onderwijs is mogelijk beperkt. Door te focussen op het alleen prestatieaspect van spelen, zouden veel studenten niet optimaal gemotiveerd kunnen worden (of zelfs mogelijk gedemotiveerd), althans op basis van hun gerapporteerde spelvoorkeur.

Hoewel de Q-methodiek (hoofdstuk 4) een uitstekende methode is om de meest uiteenlopende spelvoorkeuren te garanderen, kan het de bevindingen niet generaliseren naar een grotere groep (bijv. welk percentage van een groep is socializer?). Ook kan het niet helpen om spelertypen te karakteriseren (bijv. zijn vrouwen meer geneigd om explorer te zijn?). Dit is belangrijk omdat het begrijpen van het voorkomen van spelertypes richting kan geven voor verder onderzoek en ontwerp. We valideerden en zochten naar de prevalentie van de spelerstypes (of spelvoorkeuren) en identificeerden verdere kenmerken van elk spelerstype in **hoofdstuk 5**. Voor zover wij weten, was dit de eerste keer dat een studie patronen in meningen van een eerdere Q-methodologie onderzoek gebruikte om de prevalentie van dergelijke patronen bij een grotere populatie te meten. In dit landelijke onderzoek (uitgevoerd op bijna elke medische faculteit in Nederland) hebben we aangetoond dat onze taxonomie een adequate beschrijving kan geven van een medische studentenpopulatie. Bijna 90% van de speelvoorkeuren werd gevonden in ons spelertypemodel. Verdelingen van spelertypes waren verschillend tussen geslachtsgroepen. Vrouwen hadden een grotere neiging om social achiever en socializers te zijn. Mannen hadden meer de neiging om competitor en trol te zijn. De meeste studenten laadden significant op de social achiever (65%) en de socializer-spelertypes (37%; merk op dat studenten op meerdere spelerstypen kunnen laden). Deze oriëntatie op sociaal spel is van groot belang en staat in schril contrast met de huidige dominante benadering in GBL-onderzoek om de impact van solitaire elementen (bijv. scoren en beloningen) te bestuderen. Belangrijk is dat we ontdekten dat slechts 25% van

de studenten laadde op het type competitor (mensen die gedijen op competitie en scoren, maar liever niet samen met anderen). Dit komt overeen met onze eerdere analyse van GBL in HPE (gepresenteerd in hoofdstuk 2), waaruit blijkt dat sociale elementen maar heel weinig lijken te worden toegepast. Spelelementen gericht op het type competitior zijn dus aanzienlijk oververtegenwoordigd in GBL Spelelementen gericht op het sociale aspect van spel zijn sterk ondervertegenwoordigd. Derhalve zou er meer aandacht moeten gaan naar het mogelijk (motiverende) sociale aspect wat verscholen ligt in GBL.


7

"The sun went down with practiced bravado. Twilight crawled across the sky, loading with foreboding. I didn't like the way the show started. But they had given me the best seat in the house. Front row center. "
– Max Payne

8

Curtain call[7]

(Dankwoord)

7 A curtain call (often known as a walkdown or a final bow) occurs at the end of a performance when one or more performers return to the stage to be recognized by the audience for the performance. In musical theatre, the performers typically recognize the orchestra and its conductor at the end of the curtain call.

Dankwoord

Dit is het dan. Een boek. Geschreven door mij. Maar nooit voor elkaar weten te 'spelen' zonder de ander. Dit is dan ook de plek waar ik die mensen uit de grond van mijn hart wil bedanken. Zij hebben me gebracht tot waar ik nu sta. Zonder jullie had ik hier niet gestaan: *"front row center"*.

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Janniko. Co-promotor, sectie-hoofd, maar ook, vriend. De quote op de titel pagina van dit hoofdstuk is voor jou. De aanstichter. Ik kwam bij de afdeling anatomie, vers uit de schoolbanken en gepassioneerd over de anatomie. En alhoewel ik liever een PhD in de anatomie ambieerde opende jij mijn ogen voor onderzoek naar medisch onderwijs. "Is daar dan onderzoek over te doen?" – was mijn eerste gedachte. Door jou ging er een wereld voor me open. Een wereld die me niet alleen op werkniveau, maar ook op persoonlijk niveau, heeft verrijkt. Met jou als leider heb je me gestimuleerd wanneer nodig, maar ook weer naar binnen gevist als ik weer eens uit de bocht vloog tijdens het schrijfproces. Met jouw doortastendheid, humor en analytische blik heb jij gezorgd waar ik nu sta. **+100 Epic Guidance**

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De amices van de anatomie. Kosta: ik zal nooit vergeten dat wij op het gemaskerd bal van het NVMO congres als enige een half opgevouwen krant als masker hadden gefabriceerd (want die mooie maskers waren wel echt heel duur!). Gerben: bedankt voor al je input en wetenschappelijke doortastendheid, als (post-)gamer en academicus wist je de vinger soms mooi op de zere plek te leggen. Cyril, het was altijd ontzettend fijn om lekker onderling te kunnen spuien. Als mede "zwart-goud" drinker konden we elkaar mooi vinden. Lieve Greetje: de mater familias, als geen ander zorgde je met je warme hart voor verbinding tussen ons allen. **+50 Friendship, +20 Happiness, +20 Well-Being**

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8

All that is gold does not glitter,
Not all those who wander are lost;
The old that is strong does not wither,
Deep roots are not reached by the frost.
From the ashes a fire shall be woken,
A light from the shadows shall spring;
Renewed shall be blade that was broken,
The crownless again shall be king.

– J.R.R. Tolkien

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About the author

Biografie

Anne van Gaalen is geboren op 11 september 1988 in Oosterhout (Noord-Brabant). Na de basisschool behaalde hij eerst zijn VMBO diploma aan De Nassau Scholengemeenschap in Breda. Hierna behaalde hij op dezelfde school zijn HAVO diploma. Na een jaar bewegingstechnologie gestudeerd te hebben aan de Haagse Hogeschool besloot hij geneeskunde te gaan studeren. Om dit te bewerkstelligen behaalde hij de benodigde vakken op VWO-niveau aan het James Boswell Institute in Utrecht. Aansluitend (2010) werd hij via centrale selectie toegelaten tot de studie Geneeskunde aan de Erasmus Universiteit Rotterdam. Vanwege zijn passie voor anatomie en onderwijs werkte hij 6 jaar als anatoom en onderzoeker aan de Rijks Universiteit Groningen. Hier werd het grootste deel van dit proefschrift geschreven. In deze jaren werden er ook meerdere beurzen verworven om innovatief onderwijs op het gebied van game-based learning op te zetten. Geïnspireerd door de sociologische insteek van zijn promotieschrift, werkt Anne nu sinds 2021 als arts bedrijfsgeneeskunde.

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- GG [8] -

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8 (online gaming, slang) Good game; commonly used at the end of a gaming match; also sometimes used to end an argument.