Reflection on the Octalysis framework as a design and evaluation tool

Philip Weber [1], Laura Grönewald [1] and Thomas Ludwig[1]

[1] *Cyber-Physical Systems, University of Siegen, Germany*

Abstract

The Octalysis framework is a gamification framework used for the design and evaluation of "human-focused" systems. Although several practitioners have applied it within their daily work, only a few academic articles have reflected on its applicability. With this study, we present how and where the framework is currently applied based on a large-scale literature study and reflect on the potentials and obstacles of using it within a Human Computer Interaction (HCI) master's class. Our empirical findings show that the use of the Octalysis framework is often simplified and can also be overwhelming. The results further reveal that the framework itself can be helpful in the creation and evaluation of concepts, especially when extensive user research is not possible (e.g., due to time constraints). We contribute to the field of gamification by critically reflecting on the use of the Octalysis framework.

Keywords

Octalysis framework, gamification frameworks, human computer interaction

1. Introduction

Even if there is no agreed definition of the term gamification, the most popular agreed definition is "the use of game design elements in non-game contexts" [7]. A great part of the academic work is aimed at making the effects of this "use" measurable (e.g.: through increased user satisfaction, retention rates, productivity, engagement) and thus informing the selection of adequate design elements. It is common for practitioners to use popular gamification frameworks such as the "Octalysis Framework" [4] or the "Playful Experience Framework" (PLEX) [22] to decide which design elements are suitable for which kind of use case [28].

With this paper we would like to focus more on the design process of gamification using such frameworks and investigate how one of these frameworks translates into the "real world" as well as which impact such a gamification framework has on the design practices. Since we see that this particular discourse currently plays a rather underrepresented role in gamification research, we would like to pave the way for fostering this discussion. We therefore examine the Octalysis Framework as it gains a lot of attention among practitioners [28]. We ourselves have already used the framework a few times in projects and thus gained hands-on experience with it.

Although the Octalysis framework is attracting attention and adoption among practitioners [27,40], we are not aware of any academic study that has reflected on its usage and on its real-world applicability as well as impact on the design of gamified systems. We consider this an important research gap that we would like to address with this paper.

2. Octalysis framework

The Octalysis framework is a gamification framework developed by Yu-kai Chou [4]. The

6th International GamiFIN Conference 2022 (GamiFIN 2022), April 26-29 2022, Finland
EMAIL: philip.weber@uni-siegen.de (A. 1); laura.groenewald@uni-siegen.de (A. 2); thomas.ludwig@uni-siegen.de (A. 3)
ORCID: 0000-0003-4020-6321 (A. 3)

© 2022 Copyright for this paper by its authors. Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).
CEUR Workshop Proceedings (CEUR-WS.org)

CEUR-WS.org/Vol-3147/paper8.pdf

framework is used to design gamified systems and evaluate applications in terms of their motivational drivers, referred to as core drives (CD) in the framework [4]. The framework consists of eight core drives: (1) Epic Meaning and Calling, (2) Development and Accomplishment, (3) Empowerment of Creativity and Feedback, (4) Ownership and Possession, (5) Social Influence and Relatedness, (6) Scarcity and Impatience, (7) Unpredictability and Curiosity, and (8) Loss and Avoidance.

Chou identified and collected more than 100 game design elements that he mapped to one or more core drives to increase the motivational affordances of specific core drives. As an example, the use of "Easter Eggs/Sudden Rewards" addresses and increases the core drive of "Unpredictability and Curiosity" (CD7). The strength of the motivation based on the individual core is measured by the Octalysis Score ranging from 0 to 10, where 0 indicates that the core drive is not addressed within a system and 10 means that there is no potential for further improving the core drive. This results in differently shaped octagons as the height of the Octalysis Scores can be illustrated for each core drive (Figure 1). There are many other nuances that go beyond the scope of this paper (e.g., a distinction between extrinsic/intrinsic motivation within the individual core drives, black and white hat gamification, implicit and explicit gamification, and a very briefly covered ninth "hidden" core drive called "sensation").

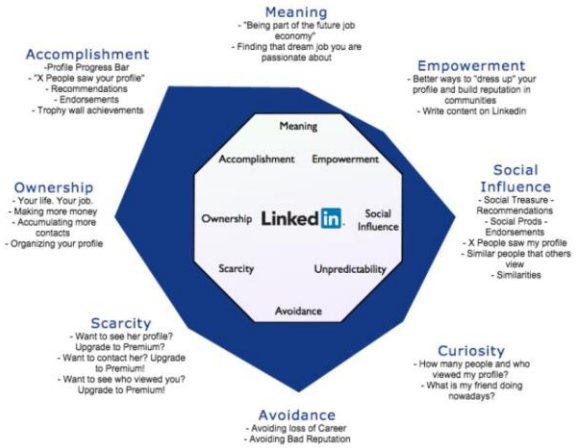

Figure 1: Visualization of the gamification elements for the LinkedIn platform along the core drives [4].

The examination of the eight core drives can be broken down into four phases of a user journey (Discovery, Onboarding, Scaffolding, Endgame) which are labeled as Octalysis Level 2. In addition, if different needs of diverse target groups are considered, Octalysis Level 3 can also be used, in which the four phases are linked to an individual user group [4].

3. Methodology

To investigate the Octalysis framework from a scientific point of view, we have chosen a two-step methodology. First, we present a large-scale literature review on the applicability of the Octalysis framework within different domains. Here, we will outline why the framework was used (reasons for using the model) and summarize the scattered articles on its usage. To better reflect on the use of the framework, we then introduced the Octalysis framework to a Human Computer Interaction (HCI) master's course at our home university. The ten students of this course evaluated existing apps based on the Octalysis framework and afterwards designed and justified their own gamified app experience. Afterwards, students shared their experiences with the framework in a focus group before handing in written reports, where we asked them to reflect on the role of the Octalysis framework during their design processes. Based on the students' experiences and our assessment of their created designs, we discuss the benefits and drawbacks of using the Octalysis framework.

3.1. Literature review

To obtain a complete picture of the current use of the Octalysis framework, we conducted a large-scale literature review (Figure 2). For this purpose, we examined in total 344 results found in Google Scholar using the search term "Octalysis framework" on October 1, 2020. After excluding results that did not met minimum academic standards (e.g., presentation slides), 280 results remained. We further excluded results that we either could not understand due to language barriers or that only mentioned the Octalysis framework in passing (e.g., a mere explanation of the framework), resulting in 101 papers. As a final restriction to increase scientific rigor, we excluded undergraduate theses, narrowing down our analysis to 67 academic publications (and an additional four doctoral theses). We repeated the same steps again on November 10, 2021 for recently published papers, increasing the total

number of papers by 22 to 366 and the relevant papers by seven to a total of 78 publications.

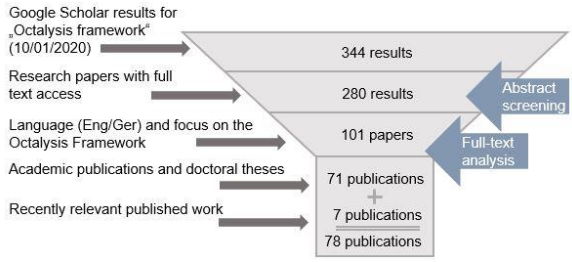

Figure 2: Paper selection process of the literature review

The 78 papers were evaluated and analyzed by the group of authors who collectively coded the first papers, thereby inductively establishing a coding system by mutual agreement. This was followed by individual coding of the remaining papers and the subsequent reconciliation of the results.

3.2. Classroom study

To test the applicability, learnability, and possible difficulties involved in the use of the Octalysis framework, we introduced the framework to a group of 10 master's students (seven males, three females) as part of an HCI master's course in summer 2020. The course, held entirely in English, was an elective in the respective HCI curriculum. Two of the authors prepared, taught, and supervised the course, which was held from mid-April of 2020 to the end of September 2020. Due to the ongoing Covid 19-pandemic, the course was held remotely.

Participating students had varying previous experiences due to their different academic backgrounds. Most of the students came from the fields of psychology, interaction design, and computer science. While some of the students had a basic knowledge of gamification as well as motivation and design models, none knew or had used the Octalysis framework previously. Most of them were aware of the difference between intrinsic and extrinsic motivation and had a general knowledge of the self-determination theory of Ryan and Deci [36]. Thus, the students could be described as "young professionals" who had already been exposed to related motivational and HCI topics due to their interest and expertise but who were not yet familiar with the Octalysis framework.

The course consisted of several introductory sessions to explain the Octalysis framework, particularly the different core drives, levels 2 and 3 of the framework, and most of the major game techniques [4]. The students were then given the task of using the framework as a tool of analysis to examine various food-related apps and identify existing design patterns and potential design spaces. The results of the analyses were discussed by the entire group and were then made accessible to all course participants.

Based on these discussions, all students had to develop their own idea, flesh out a concept with a UX story [33], create a video prototype [23], and justify the key design decisions using the Octalysis framework [4]. Subsequently, the students presented the results and submitted a project report, which documented the project work, outlined further developments of an idea, and, in particular, reflected on the use of the Octalysis framework. In the last meeting, the students discussed their experiences and opinions about the framework in a focus group moderated by us.

This exercise was audio-recorded, and key passages were partially transcribed. The verbatim quotes used in this paper are attributed to the students (P01 to P10) and are taken from the project reports as well as from these documentations. The resulting material was iteratively coded and verified in several meetings among the authors.

4. Results of the literature study

To understand in detail how the Octalysis framework was previously utilized, we identified in the literature the different application domains in which the Octalysis framework was used (Table 1). The framework is predominantly used in the context of gamified educational experiences. Examples are Rohr and Fischer [35], who used the framework to generate qualitative-empirical user requirements from students to better understand the target group and derive appropriate requirements for a gamified e-learning platform and Mårell-Olsson [25], who introduced the framework to university students, enabling them to act as cocreators to design gamified teaching activities for middle-school students.

Table 1
Publications by application domain

Application domain	No. of publications
Education	35
No specific domain	8
Healthcare	7
Marketing	6
Organizational management	5
Other domains	17

Some of the papers we analyzed did not focus on a specific domain but rather investigated the Octalysis framework and gamification from a rather holistic perspective. Tondello et al. [38] used the framework as a starting point for the development of their gameful design heuristics and compared the Octalysis framework with other well-known frameworks and methods, such as the "Hexad" framework by Marczewski [24], the "Kaleidoscope of effective gamification" by Kappen and Nacke [19], the motivational design lenses by Deterding [6], the six different motivational dimensions for meaningful gamification by Nicholson [29], or the "Super Better" design method by McGonigal [27]. Morschheuser et al. [28] interviewed 25 gamification experts, in which four experts stated that they made use of the Octalysis framework and considered this and other gamification frameworks to be important in their ideation phase.

Seven papers were related to the domain of healthcare, where the Octalysis framework was used, for example, to increase the motivation of patients with physical disabilities to perform exercises [9,10]. Six studies were in the area of marketing, e-commerce, and customer loyalty, an example of which is the use of the Octalysis framework by Fathian et al. [13] to develop a model that maps the relationship between game mechanics and elements of customer loyalty.

Additionally, some papers address topics of organizational management. For instance, Ellenberger et al. [12] used the Octalysis framework to analyze the integration of gamification in a company and its influence on company culture. While Korn et al. [21] used the Octalysis framework as a foundation to develop a model for the description and analysis of recrutainment applications, Sanchez-Gordón et al. [37] investigated the compatibility of the Octalysis framework with the human factors of ISO 10018.

Other specific topic areas were also identified, including social media [42], conversational agents [8], and promotion of pro-environmental behavior (e.g., [32]), where only one to three publications existed that were grouped under the label of "other domains".

4.1. Reasons for using the Octalysis framework

We analyzed how the Octalysis framework was approached and deployed within the reviewed studies. We discovered four primary practices (Table 2). Since the practices are not mutually exclusive, we marked in a few cases papers with more than one practice. In most cases, we identified a paper as addressing only one of the practices.

Table 2
Identified practices with the Octalysis framework

Reasons	No. of publications
Create / Ideate / Justify new systems	31
Compare / Craft / Reflect on theory	22
Evaluate / Analyze existing systems	19
Understanding users	10

The most common practice is using the Octalysis framework for designing new ideas, systems, and applications and justifying the selection of game elements by assigning them to core drives. The ideation process usually takes place within the author's working group (e.g., [5,9,15]); there was only one exception to the understanding that the design process is explicitly a codesign process [25].

Another common practice is to use the Octalysis framework to align it with other models, frameworks, and methods, usually with the intent of deriving new methods (e.g., "gameful design heuristics" [38], or "gamification characteristics measurement scale for mobile application users" [1]), or more context-specific models (e.g., for recrutainment applications [21], customer loyalty measures [13], or the smart home context [32]). It is striking here that either new approaches are developed based on the framework or that it is compared with existing models. However, no

reviewed paper dealt with the empirical validation with (sub)areas of the framework.

Furthermore, the framework was used to analyze existing applications, such as sports apps [40] or video-sharing platforms [42]. More rarely, the Octalysis framework was used to obtain insights about users. Here, the most common approach was to create questionnaires on the basis of the framework and use them to conduct quantitative surveys (e.g., [1,26]). Less frequently, it was used for qualitative studies, such as focus groups or interviews (e.g., [14]).

4.2. Reflections on usage

The literature shows that reflections on the use of the Octalysis framework as a methodology, the reasons for its selection, or remarks on the exclusion of the framework are rare. Only 13 of the 78 publications mentioned those reasons; but often only with a sentence or short paragraph. One reason to use the Octalysis framework could be its good reputation among gamification practitioners [28], as it bridges psychology and game elements [3]. Recently, the framework has also been used in academic publications, which Karać and Stabauer [20] mention as a reason for their choice.

On the other hand, the framework is sometimes criticized for not being context-specific. Korn et al. [21], for example, see a lack of "'serious' business-related components" that allow a proper evaluation of existing recrutainment systems. Yfantis and Tseles [41] argue that in the public sector, it might be useful to consider additional right brain core drives to further boost intrinsic motivation.

Another criticism is the strong influence of the subjective perception when assessing core drives and game elements [3,12,30], which depends on personal experiences and intuition [3], making any objective comparisons between gamification approaches based on the Octalysis Gamification Score rather difficult [12]. Similarly, it is not possible to estimate the extent to which a design element has an impact on the fulfillment of a single core drive [3]. In addition, the framework could lead to implementing rather "fashionable" game elements without a prior understanding of customer needs through appropriate user research [20].

Broer [2] criticizes the Octalysis framework for its lack of scientific evaluation, and Tondello [39] views gamification frameworks, including the Octalysis framework, as unsuitable for evaluating gameful applications due to the high level of needed familiarity with the frameworks.

5. Insights from the classroom study

Within the classroom study, students identified and communicated several advantages and disadvantages of using the Octalysis framework. In addition, we as lecturers made some interesting observations, which will be subsequently shared.

The overarching design principle of the Octalysis framework that puts human needs above functional aspects was appreciated (P8). Through analysis of the three different Octalysis levels (Levels 1, 2, and 3), one gets a new perspective on human motivation and the user journey (P8). The ideation phase appeared more structured; thus, ideas could be brought up more easily (P1, P5). The many different game techniques were particularly helpful in generating ideas (P2, P8) and were easy to understand through real-life scenarios that seemed to be transferable to many contexts (P5, P10). In addition, P4 and P10 said that the Octalysis framework made them aware of blackhat gamification techniques (such as "doom scrolling" [31]) and that they want to use them more consciously in their future designs. P5 describes the framework as a solid guideline that can help inspire new ideas. In general, most students saw the usefulness of the framework for developing new ideas instead of for evaluating existing concepts and ideas. However, P7 expressed a positive opinion of the framework for evaluation purposes, emphasizing the objectivity it provides: *"Designing such an experience was considered to be subjective but with the Octalysis framework you can somehow evaluate the application."*

However, students (P5, P8) criticized the apparent objectivity of the framework when evaluating other concepts. P5 considered that even similar concepts could not be meaningfully evaluated and compared with the framework. This is due to the subjective nature of quantifying the individual design elements in a single gamification score, which was criticized by P8.

In relation to the conceptualization of applications using the Octalysis framework, students found that it is too general and does not sufficiently consider the design context (P2, P5). P2, for example, would still prefer to use the 6D framework [11] in the business context because it is specifically designed to be applied in this domain. Other students (P8, P10) expressed their

fear that that the Octalysis framework could make them blind to key design challenges. In particular, CD5, where intrinsic elements (social relatedness) and extrinsic elements (social pressure) are combined under one core drive ("Social Influence and Relatedness"), is a big concern as it can lead to an oversimplification of human motivations. "*Putting two very different types of motivation into the same category seems to oversimplify the nature of motivation and could lead to unintended user experiences if a distinction is not drawn during the design process"* (P8). Furthermore, P5 notes that the framework did not help her select an appropriate number of game techniques or to link them in a meaningful way, nor did it provide much particular guidance on how to design and implement these elements.

Half of the students (P2, P4, P6, P8, P10) complained that the user perspective is not placed in a key position within the framework when designing with it. In particular, a *"practice-based user research study"* is missing (P6); this could have been achieved by conducting interviews beforehand (P2, P4) or by evaluating the prototype through usability tests (P6) and improving it by other types of user feedback (P8, P10).

One of the biggest criticisms mentioned by the students (P5, P8, P10) is the lack of scientific grounding of the Octalysis framework. This is expressed by a statement of P5: *"Scientific approaches and references are seldom used within the framework."* P10 criticized that many passages in the book are either anecdotal or barely cited. For example, P10 sees strong similarities with the different types of "nudges" described by Thaler and Sunstein [34] and the game techniques of the Octalysis framework. P8 commented on the individual core drives and considers core drives 2, 5, and 7 to be particularly problematic for various reasons, referring to the works of Ryan and Deci [36] and Hassenzahl et al. [18], which partly overlap with the Octalysis framework.

Despite the criticisms mentioned, most students concluded that the Octalysis framework helped them better understand human motivation in their design practice. Even P8, who raised some concerns, concluded that: *"Ultimately, however, the Octalysis framework can be a helpful tool, if used with critical reflection and in combination with motivation frameworks that are scientifically more grounded."* (P8)

From the role of the lecturers and with a close look at the concepts and prototypes that were created, we made two complementary observations. It is striking that most of the students created their concepts only with the game techniques mentioned in the framework (even though we deliberately said that the core drives are more relevant and that new game techniques and ideas may also be explored and innovated within the course). In the end, this could lead to a decrease in creativity and diversity in future designs, perhaps hindering the development of novel approaches and thinking out of the box.

Although we were satisfied with the quality and elaboration of the work, it was noticeable, especially in the weaker projects, that students tried to incorporate as many game techniques as possible into their own concept, that way hoping to create an engaging experience. As a result, the individual elements of the concept sometimes seemed somewhat detached. One specific example is the game technique of mentorships, which was used in many concepts but was rarely conceived in a context-specific way or meaningfully integrated into the overall systems. The idea that more design elements will lead to more engagement might be a misconception, especially if the additional elements are poorly thought out.

6. Discussion

Our classroom study confirmed all the mentioned criticisms from the literature review and portrayed them in greater detail. Only the statement that the framework is difficult to use for the evaluation of gameful applications [39] was not apparent since all of the students were able to communicate and justify their concepts through the lens of the Octalysis Framework very well. However, this was probably due to the rather experienced participants and the teaching format, which entailed several sessions to introduce the Octalysis framework to the students.

In addition to the existing literature, we identified some advantages and disadvantages of using the framework. We see it as problematic to become less innovative if designers only follow the given structure of the Octalysis framework for a project and does not think about other new game elements that are not (yet) included in the Octalysis framework. Here, other creative techniques could continue to be used and we see the empirical investigation of user needs and the unconstrained analysis of the given design space as highly important. Similar to [28], long-term research on the design practices of gamification

practitioners and academics would be required to understand this dynamic.

Equally problematic is the potential misconception that having as many gamification elements as possible will necessarily result in higher engagement and a better user experience. To be fair, the gamification framework does not mention it [4], but it was misunderstood by several students in the classroom study and was recognizable in the approaches of some academic publications. We are aware that this is in contrast to a series of recent experimental studies by Groening and Binnewies [17], which demonstrated, in a small controlled setting, that motivation and performance tend to increase as more game elements are added. In any case, we see a need for empirical-based research in this area, with a particular focus on investigating practice-oriented implications for the design of gameful applications and systems.

The Octalysis framework sensitizes for elements of black hat gamification. Therefore, the Octalysis framework could potentially be used as a model to educate and raise awareness about black hat gamification elements and closely related concepts such as dark patterns [16].

7. Limitations and future work

It is important to point out some limitations of our work. These are mainly related to the conducted classroom study, in which we do not deal with objectively quantifiable outcomes, but rather with the articulation of subjective experiences of the participating students and our own perceptions. The style of didactic presentation, especially in the case of complex frameworks such as the Octalysis, definitely has some influence on the appraisal of this framework. With respect to this, we tried to introduce the majority of the framework to the students and did this in a way that was as non-judgmental as possible.

Furthermore, there was no control group in our study (e.g., a second course with students who could have tackled the same challenge without the Octalysis framework). Also, in terms of fundamental understanding of gamification and user experience, it was a rather homogeneous group of HCI master's students. It would be interesting to examine the influence of the Octalysis framework on the design practice of more digital-distant target groups and of gamification experts.

With regard to other widely used gamification frameworks, we also consider it useful to subject these frameworks to methodologically similar studies, in order to better understand and compare the design practices that result from the use of the respective frameworks. Only after extensive discussion along these lines it seem reasonable to us to derive practical implications and condense them into design guidelines for the use of these frameworks.

8. Conclusion

Since no academic studies on the use of the Octalysis framework as a design and evaluation tool exist, we have addressed this research gap in this paper. Based on a comprehensive literature study and the application of the Octalysis framework in the context of a master's program course, we were able to show the challenges and the potential of the use of the Octalysis framework. We believe that the framework supports the design process, particularly for idea generation. However, there is an important need for empirical-based validation of the Octalysis framework. We also see the need for ongoing methodological reflections while using the framework to inform and guide the design practice of researchers and practitioners; this also holds true for other gamification frameworks and methods. We hope that our study has contributed to making the applicability of the Octalysis framework academically plausible and, thereby, providing benefits in the selection of gamification frameworks.

9. Acknowledgments

This work was carried out within the scope of the project Rendezfood (EFRE-0801425), which is funded by the European Regional Development Fund. We sincerely thank Lea Michel for her contribution to this work and the anonymous reviewers for their constructive feedback, which has improved our paper. Furthermore, we would like to thank all participants who took part in the study.

10. References

[1] Richard D'arc da Silva Brito, Luis Hernan Contreras Pinochet, Evandro Luiz Lopes, and Mauri Aparecido de Oliveira. 2018.

Development of a gamification characteristics measurement scale for mobile application users. *Internext* 13, 1: 01–16. https://doi.org/10.18568/1980-4865.1311-16.

[2] Jan Broer. 2017. The Gamification Inventory An Instrument for the Qualitative Evaluation of Gamification and its Application to Learning Management Systems. University of Bremen.

[3] Philipp Busch. 2018. „Spielerische Ansätze in der Internationalen Zusammenarbeit Gamification und Serious Games als Alternative zum traditionellen Methodenportfolio?“. Johannes Gutenberg University Mainz. Retrieved from http://books.google.com/books?id=SskI0HMwck4C&pgis=1.

[4] Yu-kai Chou. 2015. *Actionable Gamification*. Octalysis Media, Fremont.

[5] Mário Cruz. 2018. “Chicos, Sacad El Móvil De Vuestras Mochilas Porque Lo Vamos A Usar”: Empowering Spanish As Foreign Language Students Through Mobile Devices Mário. *The Turkish Online Journal of Educational Technology* 1: 282–298.

[6] Sebastian Deterding. 2015. The Lens of Intrinsic Skill Atoms: A Method for Gameful Design. *Human–Computer Interaction* 30, 3–4: 294–335. https://doi.org/10.1080/07370024.2014.993471.

[7] Sebastian Deterding, Dan Dixon, Rilla Khaled, and Lennart Nacke. 2011. From Game Design Elements to Gamefulness: Defining “Gamification.” In *Proceedings of the 15th International Academic MindTrek Conference on Envisioning Future Media Environments - MindTrek ’11*, 9. https://doi.org/10.1145/2181037.2181040.

[8] Ioannis Doumanis and Serengul Smith. 2015. A Framework for Research in Gamified Mobile Guide Applications using Embodied Conversational Agents (ECAs). *International Journal of Serious Games* 2, 3. https://doi.org/10.17083/ijsg.v2i3.79.

[9] Martina Eckert, Ignacio Gomez-Martinho, Cristina Esteban, Yadira Peláez, Mónica Jiménez, Maria-Luisa Martín-Ruiz, Maite Manzano, Alicia Aglio, Victor Osma, Juan Meneses, and Luis Salgado. 2018. The Blexer system – Adaptive full play therapeutic exergames with web-based supervision for people with motor dysfunctionalities. *EAI Endorsed Transactions on Game-Based Learning* 5, 16: 155085. https://doi.org/10.4108/eai.13-7-2018.155085.

[10] Martina Eckert, Mónica Jiménez, María-Luisa Martín-Ruiz, Juan Meneses, and Luis Salgado. 2018. Blexer-med: A Medical Web Platform for Administrating Full Play Therapeutic Exergames. In *Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering (LNICST)*, Barbara Guidi, Laura Ricci, Calafate Carlos, Gaggi Ombretta and Johann Marquez-Barja (eds.). Springer International Publishing, 289–299. https://doi.org/10.1007/978-3-319-76111-4_29.

[11] Karla L. Egan, M. Christina Schneider, and Steve Ferrara. 2011. The 6D Framework: A Validity Framework for Defining Proficient Performance and Setting Cut Scores for Accessible Tests. In *Handbook of Accessible Achievement Tests for All Students*, Stephen N Elliott, Ryan J. Kettler Kettler, Peter A. Beddow and Alexander Kurz (eds.). Springer Science+Business Media, New York, 275–292. https://doi.org/10.1007/978-1-4419-9356-4_16.

[12] Thomas Ellenberger, Deane Harder, and Brechbühler Pešková. 2020. Gamification in Unternehmen. In *Digitale Transformation und Unternehmensführung*, Jochen Schellinger, Kim Oliver Tokarski and Ingrid Kissling-Näf (eds.). Springer Fachmedien Wiesbaden, Wiesbaden. https://doi.org/10.1007/978-3-658-26960-9.

[13] Mohammad Fathian, Hossein Sharifi, and Faranaksadat Solat. 2019. Investigating the Effect of Gamification Mechanics on Customer Loyalty in Online Stores. *Journal of Information Technology Management* 11, 4: 1–23. https://doi.org/10.22059/jitm.2019.287056.2390.

[14] Helge Fischer, Matthias Heinz, Lars Schlenker, and Fabiane Follert. 2016. Gamifying Higher Education. Beyond Badges, Points and Leaderboards. In *Workshop Gemeinschaften in Neuen Medien (GeNeMe) 2016*, 93–104.

[15] Sergio A. A. Freitas, Edna D. Canedo, Cristóvão L. Frinhani, Maurício F. Vidotti, and Marcia C. Silva. 2017. Evaluation of an Automatic Essay Correction System Used as an Assessment Tool. In *Universal Access in Human–Computer Interaction*, Margherita

Antona and Constantine Stephanidis (eds.). Springer International Publishing, 579–592. https://doi.org/10.1007/978-3-319-58700-4_18.

[16] Colin M. Gray, Yubo Kou, Bryan Battles, Joseph Hoggatt, and Austin L. Toombs. 2018. The Dark (Patterns) Side of UX Design. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, 1–14. https://doi.org/10.1145/3173574.3174108.

[17] Christopher Groening and Carmen Binnewies. 2021. The More, the Merrier? - How Adding and Removing Game Design Elements Impact Motivation and Performance in a Gamification Environment. *International Journal of Human–Computer Interaction* 37, 12: 1130–1150. https://doi.org/10.1080/10447318.2020.1870828.

[18] Marc Hassenzahl, Sarah Diefenbach, and Anja Göritz. 2010. Needs, affect, and interactive products – Facets of user experience. *Interacting with Computers* 22, 5: 353–362. https://doi.org/10.1016/j.intcom.2010.04.002.

[19] Dennis L. Kappen and Lennart E. Nacke. 2013. The Kaleidoscope of Effective Gamification: Deconstructing Gamification in Business Applications. In *Proceedings of the First International Conference on Gameful Design, Research, and Applications*, 119–122. https://doi.org/10.1145/2583008.2583029.

[20] Jovana Karać and Martin Stabauer. 2017. Gamification in E-Commerce A Survey Based on the Octalysis Framework. In Fiona Fui-Hoon Nah and Chuan-Hoo Tan (eds.). Springer International Publishing, Cham, 41–54. https://doi.org/10.1007/978-3-319-58484-3_4.

[21] Oliver Korn, Florian Brenner, Julian Börsig, Fabio Lalli, Maik Mattmüller, and Andrea Müller. 2018. Defining Recrutainment: A Model and a Survey on the Gamification of Recruiting and Human Resources. In *Advances in Intelligent Systems and Computing*, L.E. Freund and W. Cellary (eds.). 37–49. https://doi.org/10.1007/978-3-319-60486-2_4.

[22] Andrés Lucero, Jussi Holopainen, Elina Ollila, Riku Suomela, and Evangelos Karapanos. 2013. The playful experiences (PLEX) framework as a guide for expert evaluation. In *Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces - DPPI '13*, 221. https://doi.org/10.1145/2513506.2513530.

[23] Wendy E. Mackay and Anne Laure Fayard. 1999. Video Brainstorming and Prototyping: Techniques for Participatory Design. In *CHI '99 extended abstracts on Human factors in computer systems - CHI '99*, 118. https://doi.org/10.1145/632780.632790.

[24] Andrzej Marczewski. 2015. User Types. In *Even Ninja Monkeys Like to Play: Gamification, Game Thinking and Motivational Design*. CreateSpace Independent Publishing Platform, 65–80.

[25] Eva Mårell-Olsson. 2019. University Students as Co-creators in Designing Gamification Teaching Activities using Emergent Technologies in Swedish K-12 Education. *Interaction Design and Architecture(s)* 42: 47–69.

[26] Fitri Marisa, Sharifah Sakinah Syed Ahmad, Zeratul Izzah Mohd Yusoh, Anastasia L. Maukar, Ronald David Marcus, and Anang Aris Widodo. 2020. Evaluation of Student Core Drives on e-Learning during the Covid-19 with Octalysis Gamification Framework. *International Journal of Advanced Computer Science and Applications* 11, 11: 104–116. https://doi.org/10.14569/IJACSA.2020.0111114.

[27] Jane McGonigal. 2015. *SuperBetter: A revolutionary approach to getting stronger, happier, braver and more resilient*. Penguin Books, New York.

[28] Benedikt Morschheuser, Lobna Hassan, Karl Werder, and Juho Hamari. 2018. How to design gamification? A method for engineering gamified software. *Information and Software Technology* 95: 219–237. https://doi.org/10.1016/j.infsof.2017.10.015.

[29] Scott Nicholson. 2015. A RECIPE for Meaningful Gamification. In *Gamification in Education and Business*. Springer International Publishing, Cham, 1–20. https://doi.org/10.1007/978-3-319-10208-5_1.

[30] Tania Ouariachi, Chih-Yen Li, and Wim J. L. Elving. 2020. Gamification Approaches for Education and Engagement on Pro-Environmental Behaviors: Searching for Best Practices. *Sustainability* 12, 11: 4565. https://doi.org/10.3390/su12114565.

[31] Jay Peters. 2021. Google is making it easier to doomscroll through search results . *The Verge*. Retrieved December 1, 2021 from https://www.theverge.com/2021/10/14/22726625/google-search-results-continuous-scrolling-mobile-doomscroll.

[32] Pedro Ponce, Alan Meier, Juana Isabel Méndez, Therese Peffer, Arturo Molina, and Omar Mata. 2020. Tailored gamification and serious game framework based on fuzzy logic for saving energy in connected thermostats. *Journal of Cleaner Production* 262: 121167. https://doi.org/10.1016/j.jclepro.2020.121167.

[33] Whitney Quesenbery and Kevin Brooks. 2010. *Storytelling for User experience: Crafting Stories for Better Design*. Rosenfeld Media, New York.

[34] Richard H. Thaler and Cass R. Sunstein. 2008. *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press.

[35] Fabiane Rohr and Helge Fischer. 2014. Mehr Als Spielerei! Gamedesign-Elemente in Der Digitalen Lehre. In *Proceeding, Workshop on E-Learning, Hochschule Zittau/Görlitz*, 1–9.

[36] Richard M. Ryan and Edward L. Deci. 2000. Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. *American Psychologist* 55, 1: 68–78. https://doi.org/10.1037/0003-066X.55.1.68.

[37] Mary-Luz Sanchez-Gordón, Ricardo Colomo-Palacios, and Eduardo Herranz. 2016. Gamification and Human Factors in Quality Management Systems: Mapping from Octalysis Framework to ISO 10018. In *Computer Standards and Interfaces*, C. Kreiner (ed.). Springer International Publishing, 234–241. https://doi.org/10.1007/978-3-319-44817-6_19.

[38] Gustavo F Tondello, Dennis L Kappen, Marim Ganaba, and Lennart E Nacke. 2019. Gameful Design Heuristics: A Gamification Inspection Tool. In *Human-Computer Interaction. Perspectives on Design. HCII 2019.*, Masaaki Kurosu (ed.). Springer International Publishing, Cham, 224–244. https://doi.org/10.1007/978-3-030-22646-6_16.

[39] Gustavo Fortes Tondello. 2019. Dynamic Personalization of Gameful Interactive Systems. University of Waterloo. Retrieved from http://hdl.handle.net/10012/14807.

[40] Áron Tóth and Bálint Szabó. 2018. A Pilot Research on Sport application's Usability and Feedback Mechanics. In *2018 9th IEEE International Conference on Cognitive Infocommunications (CogInfoCom)*, 000075–000080. https://doi.org/10.1109/CogInfoCom.2018.8639870.

[41] V. Yfantis and D. Tseles. 2013. Exploring Gamification In The Public Sector Through The Octalysis Conceptual Model.

[42] Yuxiang Zhao and Jian Tang. 2016. Exploring the Motivational Affordances of Danmaku Video Sharing Websites: Evidence from Gamification Design. In Masaaki Kurosu (ed.). Springer International Publishing, Cham, 467–479. https://doi.org/10.1007/978-3-319-39513-5_44.