Overcoming Privacy-Related Challenges for Game Developers

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Abstract. Design and development practitioners such as those in game development often have difficulty comprehending and adhering to the European General Data Protection Regulation (GDPR), especially when designing in a private sensitive way. Inadequate understanding of how to apply the GDPR in the game development process can lead to one of two consequences: 1. inadvertently violating the GDPR with sizeable fines as potential penalties; or 2. avoiding the use of user data entirely. In this paper, we present our work on designing and evaluating the "GDPR Pitstop tool", a gamified questionnaire developed to empower game developers and designers to increase legal awareness of GDPR laws in a relatable and accessible manner. The GDPR Pitstop tool was developed with a user-centered approach and in close contact with stakeholders, including practitioners from game development, legal experts and communication and design experts. Three design choices worked for this target group: 1. Careful crafting of the language of the questions; 2. a flexible structure; and 3. a playful design. By combining these three elements into the GDPR Pitstop tool, GDPR awareness within the gaming industry can be improved upon and game developers and designers can be empowered to use user data in a GDPR compliant manner. Additionally, this approach can be scaled to confront other tricky issues faced by design professionals such as privacy by design.

Keywords: Privacy · GDPR · Game development · Game design · Gamification

1 Introduction

The European General Data Protection Regulation (GDPR) was implemented by the European Parliament in 2018 to give individual users more rights in how their data is processed [1]. The GDPR has strict rules that are complex and hard to understand [2]. The punishment for noncompliance consists of hefty fines that can reach upwards of 20 million Euros [1]. At the same time, the GDPR contains legal jargon that is difficult for non-legal experts, such as game developers, to understand and implement. Therefore, game developers struggle with designing in a privacy-sensitive way [3].

The use of data and analytics is common in the online gaming industry as it improves game design and user testing procedures [4]. Video game developers and/or designers often collect data from users in order to improve or add new features [5] or to create adaptive games [6]. Lack of GDPR understanding among game developers, combined with their fear of receiving large non-compliance fines, can deter them from using this valuable data to optimize games. Consequently, the games that are developed either inadvertently violate privacy [7] or underutilise user data - as a defensive maneuver to avoid noncompliance fines [8]. Therefore, we must identify what is preventing game developers from understanding and complying with the GDPR and devise solutions to address those issues so that game developers can confidently utilise user data without violating user privacy under the GDPR. This research explores these obstacles through a user-centered design case and introduces a potential solution in the form of a gamified questionnaire; The GDPR Pitstop tool. With the design of the GDPR Pitstop tool we explored how game practitioners could be empowered to better apply the GDPR in the game development process.

2   Related Work

2.1   Understanding and Implementing GDPR for Game Developers

The changes brought about by GDPR legislation have had severe impacts on businesses and organizations in the EU territory [9]. Organisations are having difficulties understanding what compliance is and how to properly implement it [10]. The complex nature of the GDPR causes uncertainty about its content and scope [11]. According to Sirur, Nurse and Webb [2], deciphering the semantics behind the words of GDPR is a burden for organisations. In this study [2], respondents expressed that without a legal background or assistance from a legal professional, implementing the regulations would prove challenging.

This is also true for developers, Alhamazi & Arachchilage [12] cite developers' lack of familiarity with GDPR principles as a cause for their inability to create applications that comply with GDPR principles. Research shows that most game developers do not know enough about the GDPR and the risks that occur when it is not properly adhered to [3, 13]. These studies also show that even developers with a bit of knowledge of the law still struggle to properly implement it.

User data collection is a common practice in the gaming industry. The online gaming industry deals with a lot of transmission of information between networks, making the proper handling of user data paramount to user privacy [7]. According to Kröger et. al [14] the amount and richness of personal data collected by (video) games is often underestimated. Examples of personal data collected through games include specifics of a user's device including type of device and browsing history and personally identifiable information such as name, email address, and geolocation [15]. Even if users do not provide personal data, personal information can be inferred based on data collected from in-game behaviour [14]. Therefore, the GDPR's legislature encapsulates gaming as well, and game developers may not even be aware of how much personally identifiable data their game designs are collecting. Game development practitioners' understanding

of the GDPR law is often limited, leading to illegal or alternatively overly self-regulated data collection practices [7, 8].

3   Design Case

To come up with a solution to help game developers combat their uncertainty, we employed a user-centered design process [16]. As an initial attempt to solve this problem, we created a GDPR decision tree, in collaboration with legal scientists and gaming practitioners. The decision tree became overly complex and had 21 levels, the first four are depicted below in Fig. 1.
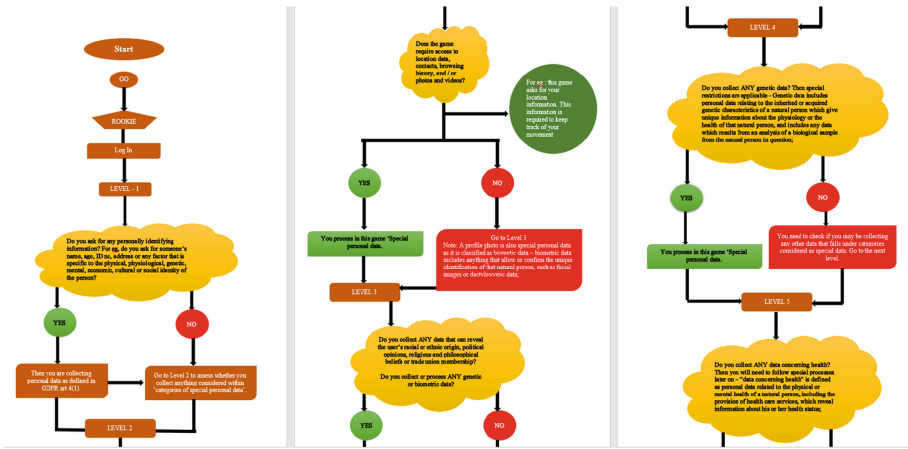

Fig. 1. Decision Tree levels 1–4

The decision tree framed compliance as a linear problem; however, walkthroughs with game developers showed this type of solution had fundamental flaws. Seeing as non-compliance with one GDPR principle does not necessarily imply non-compliance with the other principles, a more versatile solution was needed. Since game development is multifaceted [17] there is not a 'one size fits all' solution. Even the legislators for the GDPR deliberately avoided recommending specific technical frameworks or methods for implementing the GDPR legal requirements, since technical innovations are always evolving [9]. It became clear that a more flexible and user friendly solution was needed to solve this problem, so we developed the GDPR Pitstop tool [18]. The GDPR Pitstop tool is a gamified questionnaire that simplifies the complex legal jargon of the GDPR and delivers it in easily implementable bits of information.

3.1   Stakeholder Workshops and Interviews

To gain a better understanding of the game development process, we organised workshops with a group of six game developers to determine when GDPR knowledge is required during the game development process. These sessions provided insights into

how game developers are currently working with the GDPR, how information is gathered and what sources are used, and when key decisions regarding privacy, data collection and data processing are made. In these sessions it was discovered that the game development process is not linear, that client desires, or design choices evolve during the development process and therefore there are multiple moments throughout this process in which GDPR compliance should be checked. It was also discovered that many, specifically smaller game development organisations, attempt to avoid data collection due to lack of legal understanding and fear of violating the GDPR. Therefore it is vital that the tool is flexible and employs language and design choices that game developers are familiar with.

We followed up with individual interviews conducted with nine game developers and four legal experts to gain a comprehensive understanding of the game development process and GDPR challenges from industry professionals. These further revealed that game developers need an adaptable, legally substantiated decision aid that presents a risk analysis in regard to GDPR compliance. These expert interviews led us to discover four GDPR themes that are highly relevant to the game development process. These themes are; necessity, consent, data subject rights, and security & storage. The GDPR Pitstop tool focuses on these themes and addresses them in the seven quick scan questions and quick scan result. Each question in the quick scan relates to one of the four themes. For example; Question 2: *How do you decide whether to collect / process the data or not?* Relates to the theme of necessity.

3.2   Flexible Design Structure

Having a sense of the most important areas of privacy concern in the game development process opened the possibility for a layered solution. We could provide a quick scan enabling the designer to check the areas of concern and a deep scan to enable a more thorough diagnosis of this area. We quickly check all four relevant GDPR themes (necessity, consent, data subject rights, and security & storage) in a quick scan by asking users seven questions. Users are then provided with a quick scan result with specific control points indicated (Fig. 2). Any of those areas that may be problematic, based on the answers of the quick scan, can then be further investigated with more detailed questions in the deep scan.

The combination of a quick scan and a deep scan was implemented to limit the number of initial questions and give users a quick sense of overview and detail. The user is shown the major themes that need to be re-evaluated. Then, within each area, the user is provided with the details that require attention in order to comply with GDPR. They can select a theme (highlighted in the quick scan) and will be presented with more questions on the topic (in the deep scan). The user is then presented with tips and tricks on how to solve the non-compliant parts of the different themes. They are then guided through the different possibilities and given examples for the questions and solutions from other games. This setup allows game developers and designers to focus on the areas or themes that need the most attention for their game. Instead of addressing the entirety of the GDPR, the flexible design of the tool draws attention to the themes that the user needs to address.

3.3   Careful Language Crafting

Much effort went into crafting the questions. The goal of the tool is to make the complex GDPR law comprehensible for game developers who have little to no legal expertise, thus, the questionnaire's questions must bridge the gap between legal jargon and game developers' understanding. It has long been known that legal jargon is difficult to understand [19]. However, successful questionnaire design requires that questions use clear and unambiguous language [20, 21]. Cognitive interviews are an effective method for pre testing questionnaire understanding, specifically for complex questions [22], therefore this is the method we used to carefully craft the language in the GDPR Tool questionnaire.

The questions were drafted in close collaboration with legal experts to ensure that they maintained legal relevance. To determine whether the questions in the quick scan and deep scan were comprehensible, we conducted cognitive interviews with 10 communication and design experts who had no prior legal experience. In these interviews, the questions and answers were tested for legibility and clarity amongst lecturers of the Communication and Multimedia Design programme at the Utrecht University of Applied Sciences recruited via convenience sample. Since the main goal of the tool is clarity for the user, it is vital that the questions and related advice are understandable and unambiguous for non-legal experts. These lecturers were used as a proxy for game developers since they have no legal knowledge of the GDPR but have knowledge of communication and design. The results of the cognitive interviews showed that the simplified legal text was still too complex for non-legal experts to understand and apply. Therefore, the questions were rewritten to increase comprehension levels amongst game developers. The quick scan and deep scan questions went through three rounds of such language revision. For each round of revision, two legal experts assisted in the rewriting of the questions to ensure that rephrasing did not compromise the legal validity of the content.

An example of question rephrasing can be shown using quickscan question number 5. This question pertains to the 4th GDPR theme addressed in the tool; security and storage. The legal text of the GDPR states:

"Taking into account the state of the art, the costs of implementation and the nature, scope, context and purposes of processing as well as the risk of varying likelihood and severity for the rights and freedoms of natural persons, the controller and the processor shall implement appropriate technical and organisational measures to ensure a level of security appropriate to the risk, including inter alia as appropriate…" [1]. The law goes on to list conditions and requirements. For the GDPR Pitstop Tool the section of this law was simplified to pertain to gaming practitioners which resulted in the following question: *"Do you have knowledge about the requirements and standards that apply to the storage of data, as described in the GDPR?"*. In the first round of cognitive interviews, participants suggested a simplification to this question and in collaboration with legal experts it was updated to *"What do you need to know about proper data storage under the law?"* In the second round of cognitive interviews it was still experienced as unclear and was therefore updated as follows: *"Where is the collected data stored? Is that within the EU?"*. The final version of the question asks only what is relevant to game developers and further details can be elaborated upon in the deepscan.

3.4 Gamification

We opted for a gamified questionnaire because gamification and game elements such as challenge, theme, reward, and progress can be used to make non-game products more enjoyable and increase user retention [23, 24]. Game elements have successfully been used to teach software developers about privacy and how to embed it into designs [12, 13]. Therefore, we found it was an appropriate method to teach game developers and designers about privacy.

The metaphor of a pitstop was chosen because regular user privacy maintenance is required and there is an association of danger if it is not done correctly, much like a pitstop in automobile racing. In the pitstop tool, the users first go through a quick scan which checks for compliance in the four GDPR areas by asking users questions about how their game collects and handles user data. These four areas coincide with the four GDPR themes relevant to game developers; necessity, consent, data subject rights, and security & storage. The areas include data purpose limitation (necessity), procedure of permission for using data (consent), data integrity and confidentiality (data subject rights), and location of data storage (security & storage). After a quick scan, the game developer is shown a dashboard with the four broader GDPR themes colour coded according to the GDPR compliance of the developers quick scan answers, as shown in Fig. 2.
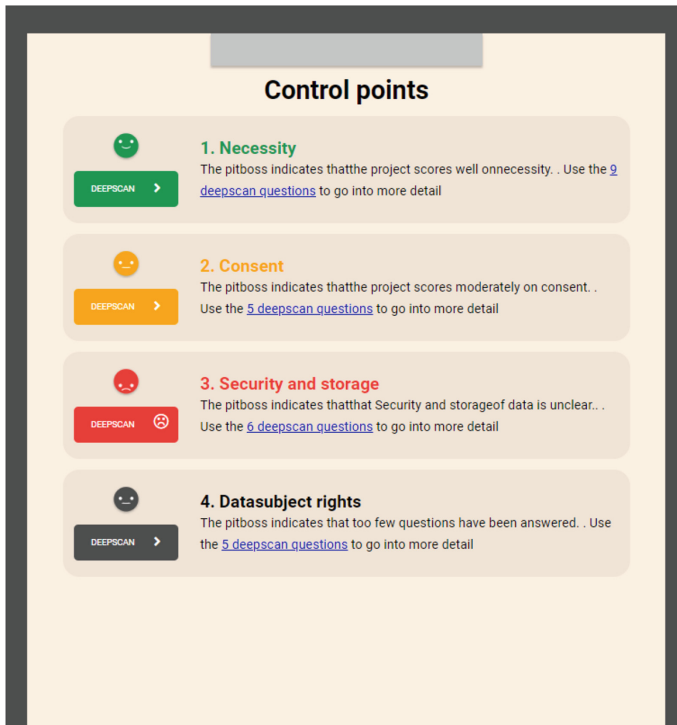

Fig. 2. GDPR Pitstop tool quick scan result

Some of the themes are green, which signals to the user that they do not require immediate attention. Some themes are greyed out, meaning more questions need to be answered to provide a result. Some themes are orange, which indicates that there are some problems in this theme. And some of the themes may be red, which indicates that there are issues with noncompliance in this theme. There are also corresponding smiley icons to indicate whether the theme needs more attention. The user should then conduct a deep scan on the themes that are red, orange, or grey to better understand how he or she can improve these areas in the games' data collection and processing methods. The quick and deep scan results should not be taken as legal advice, rather they can be used as a guide to help developers become more aware of where in their game designs they are at risk of violating user privacy. Game elements, specifically challenge (completing all the quick scan questions with a green result) and theme (the racing theme and pit boss character) are used in the GDPR Pitstop tool to increase motivation and questionnaire stamina.

3.5   User Testing

The look and feel of the GDPR Pitstop tool was tested with five game developers recruited via convenience sampling from game development firms in the Netherlands. The game developers were asked to use one of their games as an example and to run through the GDPR Pitstop tool to check the GDPR compliance of their game. The developers reported that they found the content of the tool (the quick scan and deep scan questions) more relevant than the racing theme. So, yet another round of question revision was conducted to increase comprehension of the tool. The users also felt that there was a lack of context for the questions, so short explainers were incorporated into the questions. After rephrasing the questions and adding explanations, the content of the tool was reviewed once again by legal experts to ensure the questions and related advice were still GDPR compliant.

After the tool's content was updated, two game developers participated in a final round of user testing. They were asked to use the tool to check the compliance of one of their games, and they were able to navigate through it successfully, appreciating the simplification of the GDPR language. However, they didn't feel the gamification helped much in making the law accessible. It was the translation of the legal terminology that they appreciated most.

Additionally an editorial team consisting of journalists connected with our research group interviewed game design students and gaming practitioners in the Netherlands. The interviews with gaming students revealed that students don't know much about the GDPR and have even inadvertently violated the GDPR resulting in fines for the University [25]. In the interviews with gaming practitioners the main themes that came forward were that game developers are generally; not very involved in the legal side of game development, not explicitly aware of the amount/ type of user data their games collect, and inadvertently violating privacy laws due to lack of in-house regulation (specifically smaller game development organisations) [26]. The GDPR Pitstop Tool, according to the practitioners and students surveyed, might raise GDPR awareness within the game sector and make compliance more manageable.

4 Discussion and Conclusion

The complex jargon combined with the non-linear nature of the GDPR makes developing GDPR compliant games challenging for those without legal expertise. Game developers are in need of tools that help them adhere to complex legal regulations within their game designs. The GDPR Pitstop tool offers a low-threshold, hands-on way of accessing this information space. Professional gaming practitioners have been involved in the design throughout the whole design process to ensure that the tool is useful and relevant for game developers. Although there are areas that can be improved upon, overall, the tool was well received by the community. There are three design choices that worked for this target group: 1. Careful crafting of the language of the questions; 2. a flexible structure; and 3. a playful design.

4.1 Careful Crafting of the Language of the Questions

Frequent collaboration with the game development field revealed that the most important aspect of the tool was the content (the questions). Therefore, this was the focus of the GDPR Pitstop tool - to speak the language of the game developers, while remaining valid in terms of the GDPR. The process of breaking down the GDPR law for game developers began by identifying four main GDPR themes (necessity, consent, data subject rights, security & storage) that are especially relevant to the game development process. The questions in the GDPR tool all relate to one of these four themes. The questions and answers for the quick scan and deep scans were crafted through workshop sessions, cognitive interviews, user testing, and collaboration with legal experts to be understandable for game developers while remaining legally valid. From this process we learned that questions should be drafted with an iterative process that incorporates feedback from users. This allows for the recontextualization of legal terms into language and context that game practitioners are familiar with. By doing this, we were able to take general legal text and craft it to refer to specific background knowledge and goals. The benefit is that gaming practitioners can actually understand the questions and how they apply to their game designs; the disadvantage is that the topics are oversimplified. While the GDPR Pitstop tool can raise GDPR awareness in the gaming industry by drawing attention to it, the simplification of complex legal texts may cause gaming practitioners to undervalue the topics.

4.2 Flexible Design Structure

The structure of the tool allows the users to adapt their journey based on the needs of the specific case study the game developers use. By guiding users through the quick scan first, they can identify the areas of the GDPR they need to improve on and dive deeper into the deep scan. This flexible design allows users to focus on problem areas specific to their game rather than addressing the GDPR in its entirety, which has proven to be overwhelming and difficult for non-legal experts. During the user tests, game developers mentioned that since game development is an iterative process, the tool can be useful as a 'check-up' to be used occasionally throughout the development process. The flexible design structure facilitates an easy checkup process, allowing game developers to quickly

identify areas that require improvement via a quick scan and then zoom in on only the areas that require attention as needed.

4.3   Playful Design

Gamification can be an effective method for increasing user retention and enjoyment, specifically when it comes to complex topics such as privacy. Therefore, we decided to incorporate gamification elements into the tool. Gamification has been used in surveys and questionnaires to increase user enjoyment and attention [27]. While users were successfully able to complete the questionnaire within the GDPR Pitstop tool, the user testing resulted in mixed reviews about the playfulness of the design. Some professionals were not interested in the theme at all, and others appreciated the gamification elements. Therefore, there was less focus on the gamification and game elements of the tool, and more focus on testing and improving the content - the questions. The gamification elements in the tool are simple and only aim to increase user attention and enjoyment. Additionally, the game itself was not user tested as thoroughly as the quick scan and deep scan questions. Therefore, as a next step, user tests with more game developers should be conducted.

4.4   Discussion

Overall, gaming practitioners appreciated the GDPR Pitstop tool and felt it could be useful to raise awareness of GDPR requirements for game developers. The tool's simplified GDPR language, flexible structure, and playfulness have the potential to raise GDPR compliance awareness within the gaming industry and empower game developers and designers to use user data in a GDPR compliant manner without fear of facing substantial fines. Additionally, this approach can be scaled to confront other tricky issues faced by design professionals such as privacy awareness outside the scope of gaming. Privacy by Design (PbD) refers to a proactive integration of technical privacy principles in a system's design in order to prevent privacy risks before they happen [28]. According to Spiekermann [29], even if organisations are committed to PbD, there are many challenges that make implementation difficult including an unclear methodology for its implementation and insufficient knowledge of the pros and cons related to privacy and privacy breaches. The same is true for privacy in game development. Therefore, a similar flexible solution could be implemented to increase awareness of privacy and PbD outside the scope of gaming.

References

1. Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Da.) Official Journal of the European Union (2016). http://data.europa.eu/eli/reg/2016/679/oj
2. Sirur, S., Nurse, J.R., Webb, H.: Are we there yet? Understanding the challenges faced in complying with the General Data Protection Regulation (GDPR). In: Proceedings of the 2nd International Workshop on Multimedia Privacy and Security (MPS 2018), pp. 88–95 (2018). https://doi.org/10.1145/3267357.3267368

3. Alhazmi, A., Arachchilage, N.A.G.: I'm all ears! Listening to software developers on putting GDPR principles into software development practice. Pers. Ubiquit. Comput. **25**(5), 879–892 (2021). https://doi.org/10.1007/s00779-021-01544-1

4. Bauckhage, C., Kersting, K., Sifa, R., Thurau, C., Drachen, A., Canossa, A.: How players lose interest in playing a game: an empirical study based on distributions of total playing times. In: 2012 IEEE Conference on Computational Intelligence and Games (CIG), pp. 139–146 (2012). https://doi.org/10.1109/CIG.2012.6374148

5. Drachen, A., Thurau, C., Togelius, J., Yannakakis, G.N., Bauckhage, C.: Game data mining. In: Seif El-Nasr, M., Drachen, A., Canossa, A. (eds.) Game Analytics, pp. 205–253. Springer, London (2013). https://doi.org/10.1007/978-1-4471-4769-5_12

6. Charles, D.K., Black, M., Moore, A., Stringer, K.: Player-centred game design: player modelling and adaptive digital games. In: Proceedings of DiGRA 2005 Conference: Changing Views – Worlds in Play. Digital Games Research Association: DiGRA, pp. 285–298 (2005)

7. Zhao, C.: Cyber security issues in online games. In: AIP Conference Proceedings, vol. 1955, p. 040015, 1–5 (2018). https://doi.org/10.1063/1.5033679

8. Holl, A., Theuns, M., Pieterman, N.: Schiet uit de privacykramp! Hoe technologie privacy eenvoudiger kan maken. Retrieved from Trends in Veiligheid 2021 (2021). https://www.trendsinveiligheid.nl/wp-content/uploads/2020/08/TiV-2020_Schiet-uit-de-privacykramp.pdf

9. Politou, E., Alepi, E., Patsakis, C.: Forgetting personal data and revoking consent under the GDPR: challenges and proposed solutions. J. Cybersecur. **4**(1), 1–20 (2018). https://doi.org/10.1093/cybsec/tyy001

10. Tankard, C.: What the GDPR means for business. Network Security, 8. The Centre for Information Policy Leadership. 2017. 2nd GDPR Organisational Readiness Survey Report (2016). https://www.informationpolicycentre.com/global-readiness-benchmarks-for-gdpr.html

11. Bygrave, L.A., Yeung, K.: Demystifying the modernized European data protection regime: cross-disciplinary insights from legal and regulatory governance scholarship. Regul. Gov. **16**, 137–155 (2022)

12. Alhazmi, A.H., Arachchilage, N.A.: A serious game design framework for software developers to put GDPR into practice. In: ARES 2021: The 16th International Conference on Availability, Reliability and Security, Article no. 64, pp. 1–6 (2021). https://doi.org/10.1145/3465481.3470031

13. Arachchilage, N.A., Hameed, M.A.: Designing a serious game: teaching developers to embed privacy into software systems. In: Proceedings of the 35th IEEE/ACM International Conference on Automated Software Engineering Workshops, pp. 7–12. Association for Computing Machinery, New York (2020). https://doi.org/10.1145/3417113.3422149

14. Kröger, J.L., Raschke, P., Campbell, J.P., Ullrich, S.: Surveilling the gamers: privacy impacts of the video game industry. Entertainment Comput. **44**, 100537 (2023). https://doi.org/10.1016/j.entcom.2022.100537

15. Moon, S., Reidenberg, J.R., Russell, N.C.: Privacy in Gaming and Virtual Reality Technologies: Review of Academic Literature (2017)

16. Abras, C., Maloney-Krichmar, D., Preece, J.: User-centered design. In: Bainbridge, W. (ed.) Encyclopedia of Human-Computer Interaction, vol. 37, no. 4, pp. 445–456. Sage Publications, Thousand Oaks (2004)

17. Petrillo, F., Pimenta, M., Trindade, F., Dietrich, C.: What went wrong? A survey of problems in game development. Comput. Entertain. **7**(1), 22, Article no. 13 (2009). https://doi.org/10.1145/1486508.1486521

18. Human Experience and Media Design (2018). GDPR Pitstop Tool. https://www.avgtool.org/index.html

19. Miner, R.J.: Confronting the communication crisis in the legal profession. NYL Sch. L. Rev. **34**, 1 (1989)

20. Conrad, F., Blair, J., Tracy, E.: Verbal reports are data! A theoretical approach to cognitive interviews. In: Proceedings of the Federal Committee on Statistical Methodology Research Conference, Tuesday B Sessions, Arlington, VA, pp. 11–20 (1999)
21. Dillman, D.: Mail and Internet Surveys: The Tailored Design Method, 2nd edn. Wiley, New York (2000)
22. Drennan, J.: Cognitive interviewing: verbal data in the design and pretesting of questionnaires. J. Adv. Nurs. **42**(1), 57–63 (2003)
23. Deterding, S., Dixon, D., Khaled, R., Nacke, L.: From game design elements to gamefulness: defining "gamification". In: Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments (MindTrek 2011), pp. 9–15. Association for Computing Machinery, New York (2011). https://doi.org/10.1145/2181037.2181040
24. Flatla, D., Gutwin, C., Nacke, L., Bateman, S., Mandryk, R.: Calibration games: making calibration tasks enjoyable by adding motivating game elements. In: Proceedings of the 24th Annual ACM Symposium on User Interface Software and Technology (UIST 2011), pp. 403–412. Association for Computing Machinery, New York (2011). https://doi.org/10.1145/2047196.2047248
25. Human Experience and Media Design (2022). https://hemdmissies.nl/hanze-university-groningen-avg-wetgeving-voorlichting/
26. Human Experience and Media Design (2022). https://hemdmissies.nl/gdpr-pitstop-op-dutch-media-week/
27. Triantoro, T., Gopal, R., Benbunan-Fich, R., Lang, G.: Would you like to play? A comparison of a gamified survey with a traditional online survey method. Int. J. Inf. Manag. **49**, 242–252 (2019)
28. Cavoukian, A.: Privacy by design (2009)
29. Spiekermann, S.: The challenges of privacy by design. Commun. ACM **55**(7), 38–40 (2012)