Just Not The Usual Workplace: Meaningful Gamification in Science

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Abstract

Gamification is known as motivational tool that can increase engagement and performance. And while its application in corporate work environments has received significant research attention, little focus has been placed on gamification of tools employed in the scientific workplace. As is well understood, meaningful gamification needs to appeal to intrinsic motivations of users, requiring a deep understanding of their needs and practices. As we lack research on gamification design models adapted to scientific work environments, we have no structured way of considering researchers as a unique type of employee. We motivate the need for future research on gamification design for tools employed in the scientific workplace, which should take into account unique practices, needs and ambitions of scientists. We highlight how a structured design process can profit from social scientists' field studies.

1 Relevance and Research Questions

Gamification is most commonly defined as "use of game design elements in non-game contexts" (Deterding, Dixon, et al., 2011) and sparks great interest and expectations, as it proves to be a valuable tool for engaging users and motivating desired behaviors (Cavusoglu et al., 2015). Numerous studies discuss the application of gamification in the workplace (Swacha and Muszyńska, 2016; Oprescu et al., 2014). They indicate that gamification mechanisms are expected to increase the motivation of employees to collaborate with colleagues, to document project-related knowledge (Schacht et al., 2014), and highlight the opportunity to engage more enterprise users in the pursuit of business goals (Dale, 2014). However, little focus has been placed on scientific work environments, even though questions on the role of gamification in research have been raised (Deterding, Canossa, et al., 2015). In particular, we are missing

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systematic design processes for tools employed in the scientific workplace. So far, gamified interaction in science mostly focused on designing engaging experiences in citizen science, motivating the general public to contribute to scientific knowledge through micro tasks (Eveleigh et al., 2013; Bowser et al., 2014), and supporting the learning process of students (Ibanez et al., 2014). In this paper, we highlight the opportunity for gamification research to study the needs, opportunities and constraints of scientific environments as a special type of workplace and scientists as unique type of employee. There is unexplored potential in designing gamification for motivating researcher behavior, as they are typically bound by a unique mix of motivations, scholarly communication practices and organizational structures that are hardly matched in corporate environments.

We report on our two-stage research, investigating the relevance of dedicated gamification research for tools employed in the scientific workplace. First, we aimed to learn about the impact of unique scientific practices and frameworks on the gamification of tools employed in this environment. To do so, we conducted a literature review of: research practices in High Energy Physics (HEP); and existing gamification design models. We particularly aimed to understand if and how structural differences between scientific and corporate work environments, as well as scientific and corporate work practices, impact: the need for dedicated gamification research; and the application of existing gamification models in a scientific environment. Second, we set out to build an understanding of challenges and opportunities for gamification in scientific environments. In particular, we were interested in building an early understanding of how a structured gamification design model for the scientific work place might adapt and enhance existing design models. Thus, we address two research questions:

RQ1. What unique characteristics of scientific workplaces are relevant for the gamification of tools employed in this environment?

RQ2. What are challenges and opportunities for the gamification design of scientific tools?

2 Findings

In this section, we present early findings through the lenses of our research questions. Those reflect in particular research practices in High Energy Physics (HEP). We chose to focus on one scientific domain in this brief paper, in which we try to motivate future research on the role of gamification in the scientific workplace.

RQ1. What unique characteristics of scientific workplaces are relevant for the gamification of tools employed in this environment?

Scientists often underlie a less stringent organizational hierarchy than corporate employees. For example, Merali (Merali, 2010) reports on practices within LHC experiments, which are major HEP collaborations that consist of thousands of scientists. She highlights that those are different from other complex organizations, typically encountered in industry or government. Merali refers to Karin Knorr Cetina, a sociologist who has been studying the collaborations at CERN, a key laboratory in HEP and the host of the LHC experiments, for almost 30 years.

Knorr Cetina agrees that "the industrial model cannot work." Top-down decision making is given up in favor of numerous highly specialized teams. As Merali's work shows, also the common practice of cooperation and inclusion of various different institutes plays a role in the employment framework of scientists. Dozens and hundreds of institutes are involved within the various LHC collaborations[1]. A spokesperson of one of the two biggest collaborations notes, that "in industry, if people don't agree with you and refuse to carry out their tasks, they can be fired, but the same is not true in the LHC collaborations." That is because "physicists are often employed by universities, not by us." This absence of a strong, enforcing command structure also establishes a special need for motivational design.

Studying gamification research for corporate environments, we see that suggested approaches might not directly apply to scientific workplaces. For example, (Swacha and Muszyńska, 2016) propose several patterns for gamification of work, one of which they call *Sense of progress*. They state that when an "employee sees no direct result of his/her actions (and considers) them futile and fruitless", we have to make him/her "aware that every action he/she performs is a step in progress." While this is certainly as true for researchers as for any other professionals, the proposed solutions are difficult to map to researchers' workflows that are characterized by novelty and creativity. The authors propose to reward "points even for simple routine tasks, define point levels marking stages of progress (and to) visualize progress bars showing the distance to the next level." Of course, we have similar mechanics in academia: students have to attend lectures and pass exams to get credit points. And also in HEP, researchers have to earn points, for example for their community work within the big research collaborations. Yet, such simple, extrinsic rewards cannot evaluate the process of scientific knowledge creation as a whole. Scoring a highscore or advancing to a certain level does not earn a PhD. Scientific progress includes demonstrating failure, postulating hypotheses and preparing research data for reuse in their community. Those are advancements in science that are hard to quantify by an algorithm.

RQ2. What are challenges and opportunities for the gamification design of scientific tools?

It becomes increasingly evident that gamification is much more than the application of point-based rewards, leaderboards and badges, but instead profits from a holistic design process that appeals to the intrinsic motivation of the players (Brito et al., 2015; Dale, 2014). If we think about a design model for gamification in science, we must keep in mind that meaningless game elements not only lack motivational benefits, but rather alienate users (Nicholson, 2015). This certainly applies as well to scientific employees who are trained to think critically. Meaningful gamification design requires a deep understanding of the users, their contexts, practices and needs (Kumar and Herger, 2013; Werbach and Hunter, 2012). Proposed gamification design models reflect the need for user - or player - research. For example, in their six step design process, Werbach and Hunter (Werbach and Hunter, 2012) devote one step to: *Describe your players*. Kumar and Herger (Kumar and Herger, 2013) describe the Player Centered Design model that requires designers to: *Know your player*; and *Understand human motivation*. Design processes for scientific tools might particularly profit from reflecting scientists' practices and motivations within this layer.

[1] LHC Research Programme: Institutes. https://greybook.cern.ch/greybook/researchProgram/detail?id=LHC

As mentioned previously, scientific environments differ from corporate ones. But also within the scientific community, fields differ significantly from each other when it comes to scientists' practices, employment structures and scholarly communication. It is this diversity in science that represents an opportunity for gamification research in scientific work environments. We can profit from the work of social scientists who map field practices and describe field differences. Their work provides a valuable source of information on the needs and motivations of scientists within a domain. A dedicated gamification design model for tools employed in the scientific workplace could extend existing models by emphasizing the value of social scientists' studies that map field practices and scholarly communication in the target domain.

3 Discussion and Outlook

In this brief paper, we highlighted challenges and opportunities of gamification research for tools employed in the scientific workplace. We studied unique characteristics of researchers' work environments that motivate the need for dedicated investigations. Less stringent hierarchical structures in science might make it more difficult to promote and encourage target behaviors, but provide opportunities for meaningful motivational design. Designing meaningful gamification requires to move beyond simple game elements like leaderboards, levels and points. It requires, as researchers and practitioners have been arguing, a holistic design that reflects the users' practices and motivations. As pointed out in "Rethinking Gamification" (Fuchs et al., 2014), we might profit from moving conceptions "from using game design elements to motivational design."

Future studies are needed that take into account the unique characteristics, needs, practices and motivations of scientists. Studying opportunities for gamification design in professional scientific environments in RQ2, we highlighted the value of existing field studies, mapping practices, differences, and scholarly communication in the target domain. In the context of HEP, we plan to further study the impact of gamification on research documentation and sharing practices on dedicated platforms, thus supporting independent verification and reuse of scientific outputs. This study scenario also represents a strong case for future studies on gamification in scientific work environments, as it aims to impact prevalent scientific challenges.

Reviewing field studies on HEP and LHC researchers, as we proposed in RQ2, we find that experimental scientists have a particularly strong identification with their collaboration. In her article, Merali (Merali, 2010) devotes an entire section to researchers sacrificing their identity to their respective LHC collaboration. Knorr Cetina further observes "the erasure of the individual epistemic subject in HEP experiments" (Cetina, 2009, S.171). Given this knowledge about the strong identification of HEP physicists with their detector, or respectively their collaboration, we plan to design and evaluate mechanisms that provide clear feedback on the impact of individual documentation efforts on the overall knowledge base of the respective collaboration.

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References

Bowser, A., Hansen, D., Preece, J., He, Y., Boston, C., & Hammock, J. (2014). Gamifying citizen science: A study of two user groups. In *17th acm conference on computer supported cooperative work and social computing, cscw 2014* (pp. 137–140). doi:10.1145/2556420.2556502

Brito, J., Vieira, V., & Duran, A. (2015). Towards a Framework for Gamification Design on Crowdsourcing Systems: The G.A.M.E. Approach. *2015 12th International Conference on Information Technology - New Generations*, 445–450. doi:10.1109/ITNG.2015.78

Cavusoglu, H., Li, Z., & Huang, K.-W. (2015). Can Gamification Motivate Voluntary Contributions? *Proceedings of the 18th ACM Conference Companion on Computer Supported Cooperative Work & Social Computing - CSCW'15 Companion*, 171–174. doi:10.1145/2685553.2698999

Cetina, K. K. (2009). *Epistemic cultures: How the sciences make knowledge*. Harvard University Press.

Dale, S. (2014). Gamification: Making work fun, or making fun of work? *Business Information Review*, *31*(2), 82–90. doi:10.1177/0266382114538350

Deterding, S., Canossa, A., Harteveld, C., Cooper, S., Nacke, L. E., & Whitson, J. R. (2015). Gamifying research: Strategies, opportunities, challenges, ethics. In *Proceedings of the 33rd annual acm conference extended abstracts on human factors in computing systems* (pp. 2421–2424). CHI EA '15. doi:10.1145/2702613.2702646

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. In *Proceedings of the 15th international academic mindtrek conference: Envisioning future media environments* (pp. 9–15). ACM.

Eveleigh, A., Jennett, C., Lynn, S., & Cox, A. L. (2013). "I want to be a captain! I want to be a captain!": gamification in the old weather citizen science project. *Proceedings of the First International Conference on Gameful Design, Research, and Applications - Gamification '13*, 79–82. doi:10.1145/2583008.2583019

Fuchs, M., Fizek, S., Ruffino, P., Schrape, N. et al. (2014). *Rethinking gamification*. meson press.

Ibanez, M.-B., Di-Serio, A., & Delgado-Kloos, C. (2014). Gamification for Engaging Computer Science Students in Learning Activities: A Case Study. *IEEE Transactions on Learning Technologies*, *7*(3), 291–301. doi:10.1109/TLT.2014.2329293

Kumar, J., & Herger, M. (2013). Gamification at work: Designing engaging business software. In *International conference of design, user experience, and usability* (pp. 528–537). Springer.

Merali, Z. (2010). Physics: The large human collider. doi:10.1038/464482a

Nicholson, S. (2015). A recipe for meaningful gamification. In T. Reiners & L. C. Wood (Eds.), *Gamification in education and business* (pp. 1–20). doi:10.1007/978-3-319-10208-5_1

Oprescu, F., Jones, C., & Katsikitis, M. (2014). I PLAY AT WORK-ten principles for transforming work processes through gamification. *Frontiers in Psychology*, *5*(JAN). doi:10.3389/fpsyg.2014.00014

Schacht, S., Morana, S., & Maedche, A. (2014). The project world - Gamification in project knowledge management. *Proceedings of the 22nd European Conference on Information Systems (ECIS)*, (June), 1–10. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84905845466%7B%5C&%7DpartnerID=40%7B%5C&%7Dmd5=b2a043d491a9af35a1f2969f4314394a

Swacha, J., & Muszyńska, K. (2016). Design patterns for gamification of work. *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality - TEEM '16*, 763–769. doi:10.1145/3012430.3012604

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press. Retrieved from https://books.google.ch/books?id=abg0SnK3XdMC