Design Principles for the Design of Digital Badge Systems: Supporting Learning in Informal Science Programs

Theresa Horstman, University of Washington Bothell, thorst@uw.edu
Gavin Tierney, California State University, Fullerton, gtierney@fullerton.edu
Carrie Tzou, University of Washington Bothell, tzouct@uw.edu

Abstract: Though digital badges are used in a variety of educational settings; the widespread and rapidly changing landscape makes it difficult to track design practices that lead to a successful and sustainable combination of digital badges and learning. In this paper, we focus on two areas of badge design that impact learner experience: (1) the value and meaning of badges outside of their original context, and (2) badge function and platform functionality that impact learner experience.

Keywords: Digital badges, informal learning settings, science education, design-based research

Major issues addressed

Digital badges, sometimes called micro-credentials, have been used in a variety of settings as a tool to engage and motivate participants. However, the standards to design digital badges remain elusive as do the benefits to learners (Hickey, Otto, Itow, Schenke, Tran, & Chow, 2014; Hickey & Willis, 2017). In addition, there are documented issues that can adversely affect learners' experiences. Two of these issues are: (1) the value and meaning of badges outside of their original context (Hickey et al., 2014, Hickey & Willis, 2017), and (2) factors, such as platform functionality, that impact badge design decisions and subsequent learner experience (Hickey & Willis, 2017).

Potential significance

If badges are trying to be used across contexts in which the shared values and meanings are not *clearly defined*, then owning the badge itself loses meaning as the identity of the community is also bound up in the meaning of the badges. The design principles in this paper aim towards helping educational program developers create meaningful learning experiences *through the construct* of a digital badge system (Tierney, Horstman, & Tzou, 2019).

Theoretical approaches

We draw from Gameful Design (Deterding, Dixon, Khalad, & Nacke, 2011) as guiding principles for analyzing badge criteria. Deterding argues that these principles help preserve playful qualities of "gamified" spaces: Autonomy, Trusted safety space, Shared focus and attitude, Generative tools/toys, Feedback, Clear goals to indicate progress, and Challenge. Alongside Gameful Design, we take a learning ecology framework perspective (Barron, 2006) to understand the roles that badges can play in supporting learning in designed environments.

Methodological Approaches

The work presented in this paper is part of a 4-year design-based research project that partnered a four-year university with three informal science learning organizations to design badge systems connected to informal programs (an environmental educational center, an aerospace museum, and an aquarium) that ultimately lead to college credit. For this paper, we analyzed components of the badge system, using Badge Criteria and System analysis (Tzou & Horstman, 2015) to identify characteristics of learning experiences in each program. Badge Criteria and System analysis data were captured into spreadsheets by program. Data were then sorted into the following categories based on core categories: place, story, roles, teaching/mentoring, values and tasks/skills. Discussion and refinement of codes took place after each round of open and axial coding.

Major findings: Design principles for designing badge systems

We have compiled the following eight badge design principles (Table 1) for both the design of the *badge system* itself and corresponding design principles for *badge criteria*.

Table 1: Design principles for badge systems and badge criteria

Badge System
1S. Badges should be nested together to create clear *learning pathways* for learners (Barron, 2006; Hickey et al., 2014).
2S. Badges should give learners opportunities to *build connections* between badge criteria based on the proximity of badges to each other (Barron, 2006).
3S. The badge system should serve as a framework for creating a *complex (re)combination* of program activities that align with: (1) program goals and (2) engagement with disciplinary knowledge and practice, indicating *significant milestones*.
Badge Criteria
4C. Badge criteria should contain the attributes of Gameful Design (Deterding, 2011).
5C. Badge criteria should serve as metacognitive cues, prompting learners to reflect and see possible future identities.
6C. Badge criteria should incorporate activities and tasks that are *intrinsically motivating* (Blair, 2011).
7C. Community, program, and learning *values are represented* in how the criteria are composed (Deterding, 2011).
8C. *Blends* disciplinary-specific content knowledge with non-disciplinary-specific skills.

Addressing the primary issues badges face in educational settings means a great deal more time is spent in the front-end designing badge criteria and system. The design process that utilizes these design principles must also be prepared to revisit their badge system regularly over time. Badges may become more effective educational tools if they adjust as the program grows and develops and as the needs of the learners change over time. With this work, we challenge the conventional use of badges for simply increasing learner engagement by illustrating that the badge design and development process can improve program design and subsequent learner experience rather than serving purely as a learner motivational tool. This opens up the possibility that digital badges are perhaps best used as a conceptual, organizing framework for educational programs.

References

Barron, B. (2006). Interest and Self-Sustained Learning as Catalysts of Development: A Learning Ecology Perspective. *Human Development*, *49*(4), 193–224.

Blair, L. (April 27, 2011). The cake is not a lie: How to design effective achievements. *Gamasutra*. Retrieved from http://www.gamasutra.com/view/feature/134729/the_cake_is_not_a_lie_how_to_.php

Deterding, S. (May 27, 2011). *Don't Play Games With Me: Promises and Pitfalls of Gameful* Design. Retrieved from http://www.slideshare.net/dings/dont-play-games-with-me-promises-and-pitfalls-of-gameful-design

Deterding, S., Dixon, D., Khalad, R., & Nacke, L. (2011).: *From Game Design Elements to Gamefulness: Defining "Gamification".* Paper presented at MindTrek. Tampere, Finland: ACM.

Hickey, D. T., Otto, N., Itow, R., Schenke, K., Tran, C., & Chow, C. (2014). Badges design principles documentation project. *Center for Research on Learning and Technology.* Indiana University.

Hickey, D.T., & Willis, J. (2017). Where Open Badges Appear to Work Better: Findings from the Design Principles Documentation Project. *Center for Research on Learning and Technology*. Indiana University.

Tierney, G., Horstman, T., Tzou, C. (2019). Involving youth as educational program co-designers: Disrupting hierarchy and empowering youth. *CoDesign: International Journal of CoCreation in Design and the Arts.*

Tzou, C. & Horstman, T. (2015, June) Digital Badges for College Credit: Motivating Learning in Informal Science Programs Through Digital Badges. Proceedings from DML 2015. *Digital Media and Learning* conference. Los Angeles, CA.

Acknowledgements

This work was supported by the National Science Foundation under grant NSF AISL DRL- 1322512. All opinions expressed are those of the authors and do not represent the positions of NSF.