Nudging Developers to Participate in SE Research

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***Abstract*—Software engineering (SE) research seeks to create, investigate, and improve tools and processes for developing and maintaining software applications. To conduct such research, it is valuable for researchers to find and recruit participants representative of their target audience to complete experiments. However, participants in most SE user studies are not professional software engineers—but Computer Science students, anonymous users, or no humans. This work aims to improve the recruitment of developers to participate in research experiments by proposing a novel online system, *SE Participants*, that *nudges* software engineers to participate in studies by acknowledging their efforts and contributions to SE research.**

I. Introduction

Recruiting professional developers to participate in software engineering (SE) research is valuable for providing ecologically valid results on the strengths and weaknesses of SE tools and practices. However, finding study subjects with expertise matching the intended audience for SE evaluations is a challenging endeavor for researchers designing experiments [8].

To that end, researchers often turn to less ideal solutions. For example, using students in empirical SE research has challenges for students, instructors, researchers, and industry [5], crowd-sourcing platforms like Mechanical Turk provide inconsistent results [14], and no subjects leads to unusable tools and ignored findings. Ultimately, the lack of representative sampling in SE studies leads to generalizability issues [2], validity concerns [8], and irrelevant research contexts [11].

To support the recruitment of relevant participants, we propose using *nudge theory* to encourage developers to participate in studies. A *nudge* is any factor seeking to improve human behavior without providing incentives or banning alternative actions [15]. Prior work proposes digital nudges as a mechanism to improve developer behavior [4]. To nudge software engineers to join studies, we plan to use *digital badges*. Digital badges, or badges, are virtual displays of accomplishment or achievement in online environments [12]. Badges also fit into the nudge theory framework by encouraging recipients to adopt specific behaviors without payments or forcing behavior.

Our goal is to create an online system, *SE Participants*, that uses badges to nudge software engineers to engage in research studies. This paper motivates the use of digital badges as a means for encouraging research participation, posits a preliminary design for *SE Participants*, and proposes a methodology for evaluating the projected system on recruiting and sustaining developers as participants in SE research.

II. Background

A. Digital Badges

Digital badges have been shown to improve human behavior in a variety of domains. For example, education research shows badges are useful for increasing learning motivation [12] and attendance [7] among students, in addition to professional development for teachers [6]. Badges have also been shown to to be effective for boosting activities and skills for job-seekers on Linkedin [13][1] and improving workplace culture [1]. Finally, they are also used in many games [10] and social media platforms [9] to encourage user engagement.

B. Software Engineering

In SE contexts, research shows digital badges can also be useful for influencing developer behavior. For instance, Trockman et al. show badges on have been widely adopted on GitHub and the presence of badges on project repositories improves the quality of code related to the signals indicated [16]. Barik and colleagues also explored badges as a gamification mechanism for improving developer behavior in programming environments [3]. This work aims to further explore the impact of badges on human behavior by using them to encourage software engineers to participate in SE research studies.

III. Proposed System Design

The goal of *SE Participants* is to nudge software professionals to participate in research experiments. To that end, we aim to design a system that does not force users to contribute to research nor provide incentives[2] to those who participate in studies. A prototype for a user profile on this online platform can be found in Figure 1. Users will have unique identifiers and each badge will provide details about the published findings of the study (see Fig. 1C) including the title, authors, publication venue, and, when applicable, a link to a pdf of the paper. To respect user privacy, we will define rules to protect users on the system, including: not releasing or misusing user contact information; not spamming users with solicitations for studies; and keeping specific contributions anonymous by not linking participants to their responses or work completed for the research. To encourage developers to continue participating in SE research, we plan to incorporate a listing of other human-subjects approved studies recruiting participants on the platform for users to earn additional badges. Lastly, we will implement additional features including more advanced badges to earn for achieving miscellaneous milestones, such as surpassing a specified number of studies completed.

IV. Research Questions and Proposed Methodology

To develop and evaluate the *SE Participants* system, we aim to answer the following research questions in two phases:

[1] https://linkedin.com/

[2] The *SE Participants* system will not incentivize users to join studies, however specific solicitations may or may not offer payments to volunteers.

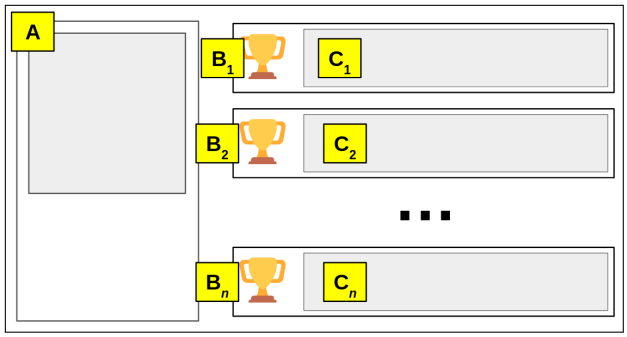

Fig. 1. Mock-up of *SE Participants* profile with user information (A), badges representing studies completed (B), and publication details (C).

A. Phase 1: Recruit Software Professionals

RQ1: What are the main motivations and challenges preventing developers from participating in SE research studies? The foundational step for this work is to empirically analyze the current state of software engineers participating in research studies. To answer RQ1, we plan to survey software professionals to understand their motivations and challenges for participating in SE studies and gain knowledge on how they encounter participant solicitations, how often they choose to participate, why they decide to contribute, and what barriers prevent them from participation in SE studies.

RQ2: Are developers more likely to participate in research if they are acknowledged for their efforts? To answer RQ2, the survey will also seek to determine if developers would be more likely to participate in SE research studies if they received acknowledgement for their efforts. Survey respondents will also have the opportunity to sign up to be initial users of the digital badging system. After compiling the results, consenting participants will be awarded the first badges for completing this survey—pending publication.

B. Phase 2: Evaluate SE Participants System

RQ3: How do developers perceive a digital badging system for SE study participation? To evaluate the effectiveness of the *SE Participants* system, we first seek to collect feedback from users. We will answer RQ3 by conducting a follow-up study with the initial participants to collect qualitative feedback on the advantages and disadvantages of the system. To encourage participation, users will have an opportunity to earn another badge for completing this portion of the study.

RQ4: How does *SE Participants* impact developer participation in SE research studies? After updating *SE Participants* based on feedback from RQ3, the last research question seeks to discover the impact of *SE Participants* on developers' decisions to participate in studies. To answer this question, we will design a longitudinal study to observe users on the system. Working with other SE researchers to provide opportunities, we aim to investigate whether badges motivate users to persist in research by contributing to more experiments and explore other factors influencing participation in SE research studies.

C. Preliminary Results

Phase 1 of this research is currently in progress. Our very early ($n = 5$) results suggest social media, i.e. Twitter, is the most frequent way developers encounter solicitations for studies. Personal relationships and "*research karma*" are the main motivations for participation in SE studies, while a lack of time is the primary barrier. Furthermore, three participants (60%) agreed to join the *SE Participants* system.

V. Conclusion

Recruiting qualified software engineers to participate in research experiments is valuable for advancing the field, but challenging for researchers. To encourage developer participation, we propose *SE Participants*, an online platform that uses digital badges to acknowledge the effort and participation of developers in research. Our goal is for *SE Participants* to be a tool to help SE researchers find representative subjects and motivate software engineers to participate in research studies.

References

[1] M. Aberdour. *Transforming Workplace Learning Culture with Digital Badges*, pages 203–219. Springer International Publishing, Cham, 2016.

[2] S. Baltes and P. Ralph. Sampling in software engineering research: A critical review and guidelines, 2021.

[3] T. Barik, E. Murphy-Hill, and T. Zimmermann. A perspective on blending programming environments and games: Beyond points, badges, and leaderboards. In *2016 IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC)*, pages 134–142, 2016.

[4] D. C. Brown Jr. *Digital Nudges for Encouraging Developer Behaviors*. PhD thesis, North Carolina State University, Raleigh, NC, USA, 2021.

[5] J. Carver, L. Jaccheri, S. Morasca, and F. Shull. Issues in using students in empirical studies in software engineering education. In *Proceedings. 5th International Workshop on Enterprise Networking and Computing in Healthcare Industry (IEEE Cat. No.03EX717)*, pages 239–249, 2003.

[6] W. M. Jones, S. Hope, and B. Adams. Teachers' perceptions of digital badges as recognition of professional development. *British Journal of Educational Technology*, 49(3):427–438, 2018.

[7] M. A. Joseph, J. Natarajan, J. Buckingham, and M. Al Noumani. Using digital badges to enhance nursing students' attendance and motivation. *Nurse Education in Practice*, 52:103033, 2021.

[8] A. J. Ko, T. D. LaToza, and M. M. Burnett. A practical guide to controlled experiments of software engineering tools with human participants. *Empirical Software Engineering*, 20(1):110–141, 2015.

[9] K. H. Kwon, A. Halavais, and S. Havener. Tweeting badges: User motivations for displaying achievement in publicly networked environments. *Cyberpsychology, Behavior, and Social Networking*, 18(2):93–100, 2015. PMID: 25684610.

[10] R. McDaniel. *What We Can Learn About Digital Badges from Video Games*, pages 325–342. Springer International Publishing, Cham, 2016.

[11] E. Murphy-Hill, G. C. Murphy, and W. G. Griswold. Understanding context: Creating a lasting impact in experimental software engineering research. In *Proceedings of the FSE/SDP Workshop on Future of Software Engineering Research*, FoSER '10, page 255–258, New York, NY, USA, 2010. Association for Computing Machinery.

[12] R. Shields and R. Chugh. Digital badges–rewards for learning? *Education and Information Technologies*, 22(4):1817–1824, 2017.

[13] E. Stone. Digital badges: A hot career booster. *Strategic Finance*, 96(12):19, 2015.

[14] P. Sun and K. T. Stolee. Exploring crowd consistency in a mechanical turk survey. In *Proceedings of the 3rd International Workshop on CrowdSourcing in Software Engineering*, CSI-SE '16, page 8–14, New York, NY, USA, 2016. Association for Computing Machinery.

[15] R. H. Thaler and C. R. Sunstein. *Nudge: Improving decisions about health, wealth, and happiness*. Penguin, 2009.

[16] A. Trockman, S. Zhou, C. Kästner, and B. Vasilescu. Adding sparkle to social coding: an empirical study of repository badges in the npm ecosystem. In *Proceedings of the 40th International Conference on Software Engineering*, pages 511–522. ACM, 2018.