

Xiphias: Using a Multidimensional Approach towards Creating Meaningful Gamification-Based Badge Mechanics

Jonathan DL. CASANO^{a*}, Jenilyn L. AGAPITO^a & Nicole Ann F. TOLOSA^{ab}

^a*Ateneo de Manila University, Philippines*

^b*Samsung R&D Institute, Philippines*

*jcasano@ateneo.edu

Abstract: This paper shows the design and initial testing of three new Xiphias Badges -- Presence, Mastery, and Antifragility – based on the merging of the salient features from James Clear’s Behavior Change model (2016), Johann Hari’s Lost Connections model (2018), and Jordan Peterson’s recent interpretation of the Big Five model of Personality Traits (2007). This multidimensional approach is an attempt to cater to the multidimensionality of a user and aims to be a more universal gamification approach that taps into internal motivations. The badge mechanics were tested on 69 undergraduate students using a Low-Fidelity Gamified Tracker. The results of a survey that sought their insights on the utility of the badges showed their potential to be motivating factors in the classroom.

Keywords: Gamification, meaningful gamification, xiphias, online distance learning

1. Introduction

One of the early definitions of gamification in the context of education is the addition of game-like elements and mechanics to a learning process (Deterding et. al, 2011). This early definition had been carried out by teachers through incorporating the use of points (Neve et al, 2014), badges (Ibáñez et al., 2014; Neve et al, 2014) and leaderboards (PBL) in the conduct of their face-to-face classes. These implementations reported positive outcomes such as increased engagement (Hamari et al., 2014), small but significant increase in short-term test scores (Bakkes et al., 2012) and generally positive user experience (Garner et al., 2005). Over time, criticisms for PBL gamification grew stronger as researchers noted some adverse effects of doing PBL. For instance, there are reports of attrition and disengagement among the students who see themselves at the bottom 25% of the leaderboards (Christy & Fox, 2014). Hence, initiatives towards Meaningful Gamification were started, where, in contrast to the PBL framework, the game mechanics applied to the learning process seeks to activate internal motivation (Sailer & Homner, 2020). In recent years, Yu-kai Chou, the pioneer of the Octalysis Gamification Framework (Chou, 2019) observed that these meaningful gamification attempts fail to capture the multi-dimensionality and deeper-rooted motivations of players/students receiving the gamification intervention.

This work responds to Yu-kai Chou’s invitation by designing three new Xiphias badges namely, the Presence badge, the Antifragility badge and the Mastery badge whose mechanics were built around the interfusion of the salient features of James Clear’s Behavior Change model (2016), Johann Hari’s Lost Connections model (2018), and Jordan Peterson’s recent interpretation of the Big Five model (2007). Results from an initial testing of the badge mechanics on undergraduate classes are then presented. In light of the above, the paper tries to answer the following research questions: RQ1: How will Meaningful-Gamification badge mechanics look if designed using a multi-dimensional approach? and RQ2: To what extent did the new Xiphias badges affect the student learning experience?

2. Theoretical Framework

2.1 The Behavior Change Model

In a recent meta-review, Clear (2018) presented the Behavior Change Model (BCM) as a framework to understand and facilitate enduring behavior change among learners.



Figure 1. The layers of the Behavior Change Model (Clear, 2018).

In Clear’s model, an Outcomes-Based Intervention is one which focuses on using the Outcomes to motivate: “I need to pass the quiz (outcomes/motivation), so I will review for the quiz (process), and if I pass the quiz, I can say that I am a good student (identity)” – The motivation is from an external source. An identity-based intervention on the other hand is that which focuses on honing the Identity layer and using it to motivate: “I believe that I am a good student (identity), to keep this identity (motivation), I will review for the quiz (process) so I can pass the quiz (outcome)” – The motivation is internalized. The design of the new set of Xiphias Badges follows an Identity-based approach.

2.2 The Lost Connections Model

The Lost Connections Model of Hari (2019) posits that there are nine (9) common causes for Non-clinical Depression (NCD) among individuals (also cited in Song & Bonk, 2016). Among the nine common causes, four (4) are fixable through Social Prescription, or the method of merely exposing the individual to structured activities that allow the interaction with other individuals. These four Social-Prescription-fixable causes are (1) Disconnection from Meaningful Work, (2) Disconnection from Others, (3) Disconnection from Meaningful Values and (4) Disconnection from Status or Respect. The new Xiphias badges seek to incorporate the four Social-Prescription-fixable disconnects in its design.

2.3 The Big Five Personality Traits Model

The authors tried finding a model of personality whose categorizations are decently universal (Satow, 2021) and whose correlations to motivation are also well established and documented (John & John, 2020). The Big Five Personality Traits are namely Openness (O), Conscientiousness (C), Extraversion (E), Agreeableness (A) and Neuroticism (N). A capacity for extended motivation among others may be classified and extrapolated from these five traits (Watson, 2019). We tried designing the new badges such that the mechanics would appeal to at least one extreme in the OCEAN spectrum.

2.4 The New Xiphias Badge Mechanics

Table 1. The New Xiphias Badge Mechanics Vis-a-vis the Multidimensional Framework.

Badge	Badge Mechanics	Behavior Change Layer (Clear, 2018)	Lost Connection Addressed (Hari, 2018)	Big Five Target Personality Trait (Peterson,2007)
Presence	See 3.4.1 paragraphs 1 and 2	Identity	Reconnection to Status and Respect	High Conscientiousness
Antifragility	See 3.4.1 paragraphs 3 and 4	Process	Reconnection to Meaningful Values	Low Neuroticism
Mastery	See 3.4.1 paragraph 5	Outcome	Reconnection to Meaningful Work	High Conscientiousness

2.4.1 Presence, Antifragility, and Mastery Badges

The Presence Badge tracks the degree to which the teacher was able to feel the presence of a student either through (1) attendance during live lectures, (2) submitting code to programming-type assessments or (3) in case the student is having a hard time understanding the exercises and cannot submit, presence may be secured through submitting summaries of the slides given for the week. The teacher prepares a weekly report of the students' presence and informs the student through a private profile. We associate this mechanics with the Identity layer of behavior change because giving students access to how their teacher perceives their presence while giving students a weekly chance to change how their presence is appraised or seen (identity) is connected to identity building. This act of identity building aligns with Hari's reconnection to status and respect concept, where it is explained that both are gained when a person is able to see the capability to produce consistent output (in this case, the output is weekly presence). This mechanic also aligns with High-Conscientiousness people as these personality types "enjoy participating in social rules that happen in a set time/interval".

Antifragility is a concept recently that speaks of the ability of a person to not only recover from an unpleasant experience but become better for it (Taleb, 2012). In the context of academia, a student who is antifragile may be someone who would get a B+ on a third quiz after getting unsatisfactory marks on quizzes one and two. In the context of this paper, the antifragility badge is levelled up when a student is able to submit a correct solution/code to the online judge after submitting at least 1 incorrectly judged code submission. We associate this mechanics with the Process layer of behavior change as it directly encourages the (process) of revision. The ability to "bounce back from defeat or stressful events" is also a trademark of Low-Neuroticism individuals. We can also argue that the concept of anti-fragility is a proper subset of a meaningful value more commonly known as perseverance.

Finally, the Mastery badge tracks the number of competitive programming problems solved for the duration of the class. It reconnects the student to meaningful work as correctly answering such exercises validates the command of a relevant skill. It is designed for High-Conscientiousness individuals as "high attention to detail" (programming) and "focus on important tasks" (i.e. tasks that score points) are appealing to this personality type.

3. Methodology

3.1 Low-Fidelity Gamified Tracker

A low-fidelity prototype of a gamified tracker was implemented to test the design of the badge mechanics. In this prototype, each student has their own corresponding sheet that simulates a user profile. It has their name, photo, and the class activities with their scores. It also has a Presence Card -- an alternative way of checking attendance -- and a Trust Rating -- a mechanism for teachers to communicate with their students their perceived legitimacy of their submitted work (Casano & Agapito, 2021 in press). The student trackers also housed the badges earned by the student. The badge information includes the badge name, badge level (e.g. bronze, silver), and a description of how the badge was earned and what is needed to rank up the badge to the next level. See Figure 2 for a closer look of the badges earned by a student.



Figure 2. Sample Badges and Gamified Low-Fidelity Tracker.

This prototype was manually updated by the teacher at the end of each school week. A student's "profile" (i.e., their corresponding sheet) was only shared with the profile's owner. They did not have access to the profiles of their classmates.

3.2 Testing

The low-fidelity gamified tracker was implemented in three (3) undergraduate classes in Ateneo de Manila University (ADMU), Manila, Philippines -- one (1) section of CSCI 20 - Introduction to Computing (section A) and two (2) sections of CSCI 30 - Data Structures and Algorithms (sections A & B). These were held during the first and second quarters (Q1 & Q2), respectively, of the school year 2020-2021. The quarterly setup was adopted by ADMU to help students cope with online learning during the pandemic to allow them to take fewer classes each quarter. Ideally, each quarter is 7-8 weeks long. However, due to schedule adjustments because of COVID-19 and other unforeseen circumstances such as typhoons, Q1 had only six (6) weeks while Q2 had eight (8). Both classes had programming activities and were handled by the same teacher.

The tracker was used in both classes to provide a more gameful method of tracking their class progress. It was also used as a tool to test the design of the different badge mechanics. At the end of their respective quarters, a short survey was conducted to collect the students' feedback about the use of the gamified tracker. It asked whether they were using/checking the tracker, their perceived utility of the badges, and their suggestions for improvement. It also sought their insights about the specific badges with the following items: (1) Would you say that the Language Mastery badge was a motivator for you to engage (look at, code a solution, make a submission) with the asynchronous online problem set? (2) Would you say that the Anti-fragility badge was a motivator to keep trying to code a solution towards full points? (3) Would you say that the Anti-fragility badge was helpful in letting you cope with (and/or bounce back from) an incorrect submission? (4) Would you say that the Presence badge was a motivator to engage with the learning material/or online problem set even when you felt you were stuck?

Nineteen (19) of the twenty-six (26) CSCI 20 students and nineteen (19) of the forty-four (44) CSCI 30 students responded to the survey. Results are presented in the next section.

4. Results and Discussion

To determine how the Xiphias badges affected student learning experiences (RQ2), we (1) attempted to look at any patterns in the badges earned by students with respect to their final letter grades; and (2) summarize the insights collected through the survey.

4.1 Badges Earned and Final Letter Grades

In this study, we looked at the badges earned by the exceptional students (letter grade of A) and those who received satisfactory grades of C or C+ in the two classes.

Nine (9) of the twenty-six (26) (35%) CSCI 20 students received a final letter grade of A, all of which earned Gold for Language Mastery. For CSCI 30, twenty-one (21) of the forty-four (44) (48%) students got an A and all of them received high Language Mastery (15 Ethereal, 5 Shadow, and 1 Gold). Additionally, most of the A-graded students earned the three badges. This shows that A students generally perform well in the programming exercises/assignments which were the primary basis for their grade. Also, a common thread among them is the ability to correct an incorrect submission. They take advantage of the opportunity to re-attempt failed work and such behavior allows them to gain mastery in the skills taught in these classes. Sustained presence in class either synchronously or asynchronously likewise characterizes these students.

The students who received a satisfactory grade of either C or C+ had patterns quite distinct from the A students. The one student who received a C+ in CSCI 20 got a Bronze Language Mastery Badge and did not receive a Presence Badge or an Antifragility Badge. For CSCI 30, four (4) students received a C and none of them received a Presence Badge. In terms of Language Mastery, three (3) of them got Silver while one (1) got Gold. Two (2) of these students did not earn the Antifragility Badge while one (1) got gold and one (1) got silver. There were two (2) students who got a C++ and both of them earned Bronze Presence Badges. One of them did not receive the Language Mastery and Antifragility Badges.

The other got Silver in Language Mastery and Bronze in Antifragility. Most of the students who received a satisfactory grade did not receive Presence badges but received Silver or Gold Mastery badges. These students were not present on most of the weeks but have attempted to answer the problems around the end of the quarter. Only a few among the receivers of C and INC received the antifragility badge, as there was only a little attempt from these students to improve their solutions to receive a more satisfactory grade. There were also four (4) students who received an INC in CSCI 20 and all of them did not receive presence and mastery badges. Overall, most of the students who received passing marks have received at least two badges.

These results are not in any way conclusive and generalizable. This is an initial attempt at examining the badges earned by students with respect to the letter grades they received. A more in-depth exploration of the data would be necessary to make more sound insights about these patterns.

4.2 Student Insights

A total of 38 students responded to the survey (19 from CSCI 20 and 19 from CSCI 30). Thirty-one (82%) indicated that they were checking their respective trackers. More than half of those who checked (21/31 or 68%) were motivated by the Language Mastery Badge. One student found it nice to receive it as a form of validation but was explicit in saying that it did not necessarily motivate them. Seventy-four percent (23/31) said the Antifragility Badge was a motivator to keep trying to code a solution towards full points and that it was helpful in letting them cope with and/or bounce back from an incorrect submission. The Presence Badge was a motivator for 25 of the 31 students (81%) in terms of driving them to engage with learning materials and/or problem sets even when they were feeling stuck. Most of the respondents gave positive feedback on the badges as indicated by the numbers above. These results are further supported by students' responses when asked about their perceived utility of the badges. The students found them helpful and motivating. One student shared how "... it sorts of turns the task into a game with corresponding achievements and awards..." Another student "thought they were pretty useful, they motivated [them] to keep doing [their] best (and beyond) to get those badges (plus they looked cool so it motivated [them] even more to try and get them to look even cooler)." The students were also able to track their progress and helped them "understand where [they] stood with the class." Some found the badges as a nice touch to validate them on their progress as well as assured them that they were on the right track. One student suggested that perhaps a badge list (similar to an achievement list in games) would further motivate and engage students as this allows them to see what they can work for.

Feedback such as these indicate the potential of the new Xiphias badge mechanics to provide students with a more gameful experience. However, whether the motivation is driven internally (i.e. based on the design framework discussed above) or externally (i.e. purely because they wanted to earn the badge) is something that will require further exploration and analysis.

5. Conclusion

This study is an attempt to design a gamification framework that is more deeply rooted in user motivations. We designed three new Xiphias Badges -- Presence, Mastery, and Antifragility -- based on the merging of salient features of James Clear's Behavior Change model (2016), Johann Hari's Lost Connections model (2018), and Jordan Peterson's Big Five model (2007). Designing the badges using a multidimensional approach is an attempt to cater to the multidimensionality of a user and hopes to be a more motivating gamification approach that taps into their internal motivation.

An initial prototype of the badges was implemented in undergraduate classes. Indicative patterns in the badges earned by students showed that A students are likely to receive the three badges with high levels in Mastery. These students were likewise antifragile in terms of choosing to re-attempt failed work to be able to get a better score. This behavior may imply that students who correct incorrect submissions are more likely to gain skill mastery. Satisfactory students (C or C+ student) did not have as much presence as the A students as depicted by the Presence Badge results. The results of a survey that sought their insights on the utility of the badges showed their potential to be motivating factors in the classroom. However, whether the motivation is intrinsic or extrinsic is something that needs to be

further investigated. Findings from this study are not conclusive nor generalizable. This is an initial attempt to test the new badge designs. Nonetheless, the positive feedback from students reaffirms the potential of gamification as a tool to make learning more fun and motivating.

Acknowledgements

We thank the University Research Council of the Ateneo de Manila University for the grant entitled “*Xiphias: Using A Multi-Dimensional Approach Towards Creating Meaningful-Gamification-Based Badge Mechanics*” and the students who participated in our data gathering process.

References

- Agapito, J. L., Martinez, J. C., & Casano, J. D. (2014, October). Xiphias: A competitive classroom control system to facilitate the gamification of academic evaluation of novice C++ programmers. *In Proceedings of International Symposium on Computing for Education, ISCE* (Vol. 14, pp. 9-15).
- Bakkes, S., Tan, C. T., & Pisan, Y. (2012, July). Personalised gaming: a motivation and overview of literature. *In Proceedings of the 8th Australasian Conference on Interactive Entertainment: Playing the System* (p. 4). ACM.
- Casano & Agapito (2021, in press). Towards the Design of an Adaptive Presence Card and Trust Rating System for Online Classes. *Adaptive Instructional Systems. Design and Evaluation*. Springer Nature Switzerland AG
- Chou, Y. K. (2019). Actionable gamification: Beyond points, badges, and leaderboards. *Packt Publishing Ltd*.
- Christy, K. R., & Fox, J. (2014). Leaderboards in a virtual classroom: A test of stereotype threat and social comparison explanations for women's math performance. *Computers & Education*, 78, 66-77.
- Clear, J. (2018). Atomic habits: An easy & proven way to build good habits & break bad ones. *Penguin*.
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). 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.
- Garner, S., Haden, P., & Robins, A. (2005, January). My program is correct but it doesn't run: a preliminary investigation of novice programmers' problems. *In Proceedings of the 7th Australasian conference on Computing Education-Volume 42* (pp. 173-180). Australian Computer Society, Inc.
- Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work? --a literature review of empirical studies on gamification. *In 2014 47th Hawaii international conference on system sciences (HICSS)* (pp. 3025-3034). IEEE.
- Hari, J. (2019). Lost connections: Uncovering the real causes of depression-and the unexpected solutions. *Bloomsbury Publishing Plc*.
- Ibáñez, 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.
- John, R., & John, R. (2020). The Big Five Personality Traits and Academic Performance. *Journal of Law & Social Studies (JLSS)*, 2(1), 10-19.
- Neve, P., Livingstone, D., Hunter, G., Edwards, N., & Alsop, G. (2014). More than just a game: Improving students' experience of learning programming through gamification. *Online*:< <http://www.heacademy.ac.uk/system/files/comp-224-p.pdf>>. Data dostępu, 13.
- Peterson, J. B., DeYoung, C. G., & Quilty, L. C., (2007). Between facets and domains: 10 aspects of the Big Five. *Journal of personality and social psychology*, 93(5), 880.
- Sailer, M., & Homner, L. (2020). The gamification of learning: *A meta-analysis*.
- Satow, L. (2021). Reliability and Validity of the Enhanced Big Five Personality Test (B5T).
- Song, D., & Bonk, C. J. (2016). Motivational factors in self-directed informal learning from online learning resources. *Cogent Education*, 3(1), 1205838.
- Taleb, N. N. (2012). Antifragile: Things that gain from disorder (Vol. 3). *Random House Incorporated*.
- Tondello, G. F., Wehbe, R. R., Diamond, L., Busch, M., Marczewski, A., & Nacke, L. E. (2016, October). The gamification user types hexad scale. *In Proceedings of the 2016 annual symposium on computer-human interaction in play* (pp. 229-243).
- Tondello, G. F., Mora, A., Marczewski, A., & Nacke, L. E. (2019). Empirical validation of the gamification user types hexad scale in English and Spanish. *International Journal of Human-Computer Studies*, 127, 95-111.
- Watson, D., Nus, E., & Wu, K. D. (2019). Development and validation of the Faceted Inventory of the Five-Factor Model (FI-FFM). *Assessment*, 26(1), 17-44.