Designing Gamification Technology for and with Students with Behavioral Disorders

Aidan Toole
Drexel University
apt34@drexel.edu

Allison Nicole Spiller
Drexel University
ans333@drexel.edu

Karina Caro
Drexel University
karinacaro@drexel.edu

Gabriela Marcu
Drexel University
gmarcu@drexel.edu

ABSTRACT

Ubiquitous computing has previously demonstrated its ability to streamline the processes of data collection and analysis for practitioners. However, little has been said about designing technology where students with behavioral disorders are the primary users. In this position paper, we use previous research to identify the need for students with behavioral disorders to be more involved with their data and the potential positive outcomes that could arise with their involvement. We present our first iteration of a human-centered design process for creating *Tadpole*, an interactive digital media experience designed for students with behavioral disorders. This platform enables students and their guardians to interact with and monitor their behavioral progress in the classroom through data driven incentives in the form of interactive visuals and avatar features. As a second iteration design, we present our research proposal to involve students with behavioral disorders in the design process. We reflect on the challenges we face in designing with this population.

ACM Reference Format:
Aidan Toole, Allison Nicole Spiller, Karina Caro, and Gabriela Marcu. 2018. Designing Gamification Technology for and with Students with Behavioral Disorders. In *Proceedings of 12th EAI International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth 2018).* ACM, New York, NY, USA, 5 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

1 INTRODUCTION

Students with behavioral disorders might act out or display emotional upset in different ways, which would also vary from child to child. If students are not treated in childhood, these disorders can negatively affect an individual's ability to hold a job and maintain relationships [6]. Behavior disorders programs exist in special education to support this populations. Some of them consist in recording students's behaviors and reinforce positive ones. However, maintaining proper and positive behavioral traits in a classroom setting with students with behavior disorders is a continuous challenge.

Classroom technology can support school practitioners to motivate and encourage positive behavior among students inside and outside the classroom. Technology can supplement current educational systems in order to improve student behavior and encourage motivation, as well as keep parents well-informed about their child's performance [9]. Studies have shown that supplementing standard classroom curriculum with online educational games encourages achievement growth and personal improvement [7, 9]. For more than two years, our research team has been working in a behavior disorder program in the integration of a data collection tool to support integrated care for chronic conditions (e.g., behavioral disorders) [cite here wish 2017 paper, ribbit]. During our research process, we identify the opportunity to design technology to connect behavior and performance in school with student data tracking and motivation outside of a school setting. Currently, school practitioners (e.g., special education teachers, social workers and behavior analysts) are the ones in charge to collect the behavioral data. However, the sharing and reflection of these behavioral data only happen verbally from school practitioners to students. Thus, students do not have the opportunity to track or be constantly aware of their behavioral data, diminish their opportunity to self-reflect and hopefully, enhance their behavior.

In this position paper, we describe an initial design iteration of a prototype for supporting students with behavioral disorders to track their behavioral data outside the school setting. human-centered design methodologies highlight the importance of involving end users in the design process to obtain a solution that meets the needs of all the involved stakeholders [10]. We present a proposal for a second design iteration involving students with behavioral disorders in the design process.

2 *TADPOLE*: INITIAL DESIGN ITERATION

For over more than two years, we have deployed a data collection tool in a behavioral disorder program across two classrooms (24 students, 12 practitioners). Practitioners use

PervasiveHealth 2018, May 2018, New York, NY, USA
2018. ACM ISBN 978-x-xxxx-xxxx-x/YY/MM…$15.00
https://doi.org/10.1145/nnnnnnn.nnnnnnn

our data collection tool during the school periods to collect different behaviors (e.g., body and voice control). More specifically, practitioners use a token economy where they can give out or remove tokens in three behavioral categories: body control, voice control, and task completion. These tokens are collected using our data collection tool, *Lilypad*. Practitioners can track students' tokens on a daily, weekly or monthly basis. Practitioners communicate with the students about how many tokens they have so far, since students can exchange their tokens for different rewards. Students are able to exchange their earned token for rewards whenever they reach the amount of tokens that unlocks their desired reward. However, after school hours, students are not able to track their tokens. The practitioners start each student with a clean slate at the beginning of every day, and most of the time students cannot remember how many tokens they have earned in total, disrupting the motivation factor of the rewards. For that reason, our overall goal is to design an interactive system to encourage positive behavior reinforcement, by giving students the ability to track their tokens and provide gamified reinforcement outside of the school setting. The ability to track tokens after the school day can encourage more parent and guardian involvement in the behavior management and reinforcement process for their students. Parents and guardians can support practitioners by encouraging positive behaviors both inside and outside the school, with the hope that students will generalize theses positive behaviors across all settings. With this, we hope to encourage positive behavior by helping students be more aware of their earned tokens and show them how many more tokens are needed to attain their desired reward (e.g., lunch with their favorite teacher). Our ultimate goal is to supports students' self-management of their behaviors through our interactive system.

Gamification has demonstrated that it can encourage positive behavior change and can increase or maintain an individual's motivation to reach a goal [1]. Based on our experience, we identified that to design a system for students that *encourages positive classroom behavior via gamification and positive reinforcement*, the system should (1) *enable students to self-monitor their classroom performance (i.e., tokens) after school*: (2) *enable parents to monitor their child's behavioral progress by means of child-parent discussion and data visualizations.*

Design Process

Tadpole was designed to allow students in *Lilypad*-enabled classrooms to view their behavioral performance without practitioners' assistance, after school hours. The first design iteration of *Tadpole* involved five design sessions with our research team (including graphic and product designers, HCI researchers, and psychologists). The design was made based on all of our observations and interviews conducted in the school that *Lilypad* is deployed, as well as, the literature on token economies (e.g., [9]) and gamification for educational and healthcare systems (e.g., [5]).

Design Concept

Tadpole is an online application where students can monitor their behavioral data (i.e., tokens earned), keep track of how many tokens are needed to reach their desired in-school reward, and unlock avatar features via the website when they reach certain accomplishments. All of *Tadpoles* interactions take place online and outside of school hours. *Tadpole* functions as an after school activity where students log on to their individual profile to view their behavioral performance. For every token earned in the classroom each day, their avatar advances on the map. The map serves as a visualization of their overall performance and source of motivation. For every checkpoint a student reaches on the map, they unlock features to customize or interact with their avatar. Likewise, students can see how they are performing in relation to their overall class score through the use of the firefly jar visualizations.

There are three core features within *Tadpole*: (1) the map; (2) performance dialog; (3) avatar and firefly jars.

The Map: The map feature of *Tadpole* serves as a overall progress visualization for students to see their earned tokens (Figure 1), and displays behavioral progress in a way that motivates students by means of advancing on the board and unlocking new avatar features along the way [11]. For every token a student earns per day, the student's avatar advances the equivalent amount of spaces on the map.

There is an additional progress bar at the bottom of the map(Figure 1). While the map itself shows overall progress with respect to the end of the map, the progress bar shows performance in respect to the next checkpoint on the map. There are several checkpoints throughout the map. At each checkpoint, the student unlocks a new feature to customize their avatar with. Checkpoints are calculated on a student by student basis using machine learning, to set the checkpoints at appropriate and attainable places on the map, so each student feels personally motivated and accomplished.

When a student reaches the end of the map, the board resets and the student starts over on a new and different map. The status of starting on a new board is dependant on the students' performance.

Performance Dialog: At the end of each school day a dialog box pops up in *Tadpole* to prove the students with feedback about how they behaved that day in school. Instead of showing students' performance as a numerical value, *Tadpole* displays this information as a positive message. The positive dialog consists of one of five messages, depending on how the student performed (e.g. "You did toadally awesome today,

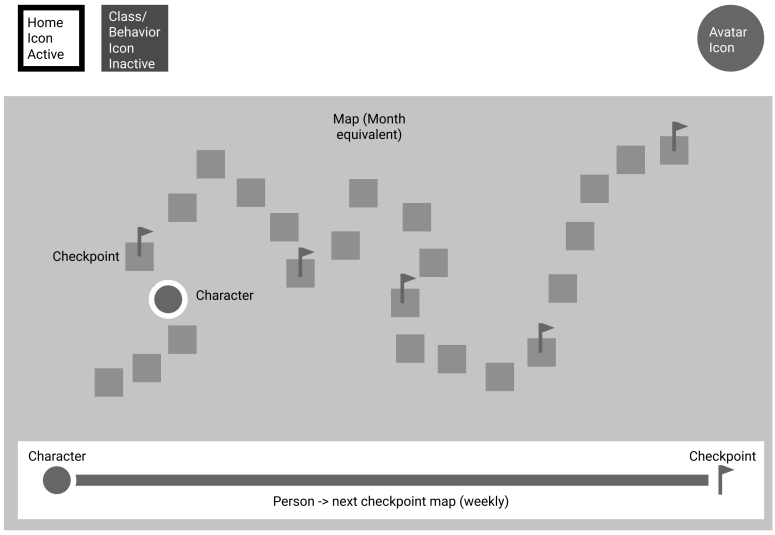

Figure 1: Home Section - Map wireframe based on iteration of initial sketches.

keep up the great work!" or "Ribbitting performance today, but let's try to do a little better tomorrow!"). This feature generates one of five dialog responses based on the students number of tokens earned that day.

Avatar and Firefly Jars: On the map, there are various checkpoints, which are determined on a student by student basis. When a student reaches a checkpoint, they unlock new features for their avatar. These features can be physical adaptations for their avatar- which is a frog (e.g. new colors, patterns, and facial expressions), or interactive games to play with their avatar. The more tokens are student earns, the sooner they reach the checkpoints, and unlock these new avatar features.

In addition to monitoring progress via the map, students as well as their guardians can view data on a the students' specific behavioral categories by using *Tadpole's* firefly jars. The firefly jars show how the students are performing in each of their behavioral categories that their practitioner is tracking, using their classroom data collection tool, *Lilypad*. There are four firefly jar visualizations: Three smaller jars, one for each behavior being tracked on *Lilypad*, and one larger jar, representing the classroom token totals. At the end of each day, a certain amount of fireflies appear in each personal jar, representing the number of tokens earned by that student in each behavioral category. These jars reset each day, representing by the students "setting free" the fireflies and any behavioral issues they had that day, allowing them to start fresh each day.

3 INVOLVING STUDENTS WITH BEHAVIORAL DISORDERS IN THE DESIGN OF *TADPOLE*

Our first design iteration was conducted only with our research team. For this second iteration, we plan to involve students with disorders in the design process. Next, we describe how we plan to involve this population in the design process.

A low-fidelity prototype of *Tadpole* consisting of printed paper mock-ups would be given out to students. Markers, paper and other materials will be available to enable students to create or modify features of *Tadpole*. We plan to create or adapt an available survey for testing technology with students from the literature such as the Fun Toolkit [8] to obtain feedback about the different features of *Tadpole*. The goal of this second iteration is to obtain students' input in the design, through different design activities, such as completing tasks using the paper mock-ups, and by using the think-aloud method to investigate how the students describe the use of the system (from their perspective, how they think it works). At the end of this iteration, we expect to have a redesign of *Tadpole* that meets the needs and likes of its primary users, students with behavioral disorders.

Design process plan

For involving students with behavioral disorders in our second design iteration, we propose to conduct the following activities based on our experience and in the literature of participatory design with students with developmental disorders.

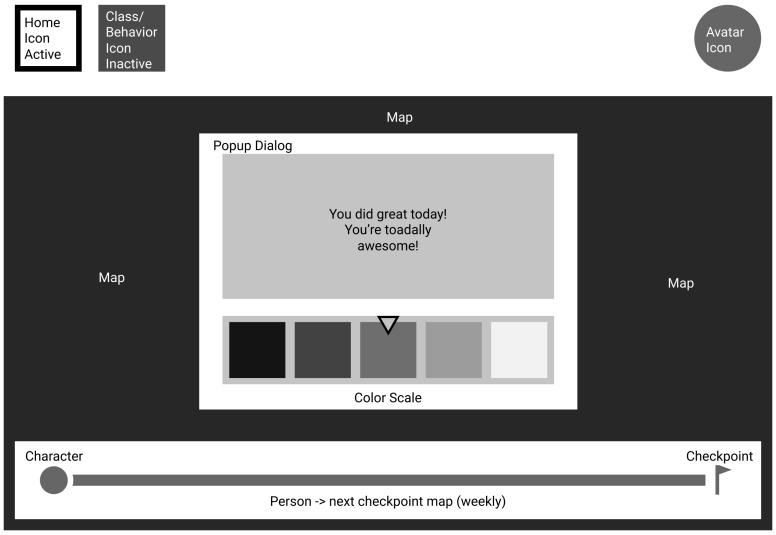

Figure 2: Dialog wireframe based on iteration of initial sketches.

- **Building rapport:** Participation will be made via proxy. Direct interaction with the students is seen as too intense for this population, so adults who know the child and have an established rapport, serve as a liaison between the participants and researchers [3, 13]. We plan to use practitioners as proxies to obtain students' feedback on *Tadpole*. This method can create less stress for the child, appeases the IRB, and utilizes a preexisting relationship between child and adult, where rapport has already been established. The use of this method also saves researches the time and energy they would otherwise spend building mutual trust with each participant in this population.
- **Prompts:** Stories and scenarios could be useful tools to use with this population because many of them have communication delays or challenges. The use of a story or scenario may help the participant to better understand the information being presented, as well as elicit possible design solutions. Tapping into the child's imagination and creativity are also important ways in triggering design potentials from them. Fictional Inquiry can also be used as a way of evoking ideas for designs through the use of fictional situations [2].
- **Activities:** Participatory design sessions within this population produce the best results when activities are structured. Students with disabilities tend to struggle with open-ended questions or tasks that provide too little guidance [4]. So creating activities that provide them with a goal and structured tasks, would help this population provide more insight for researchers.
- **Tools/Artifacts:** Van Rijn et al., [12] found that the use of toys can help promote empathy and encourage communication with students, especially those with special needs. We plan to encourage the practitioners to use different toys to start creating a dialog between the child and them, and to help explain the overall functionality of *Tadpole* to this population.
- **Technology experience:** Since we are planning to use participation via proxy, practitioners should be trained and provided a structured protocol for what to do and say while conducting the design sessions with students. practitioners should have prior experience working with all of the technology that will be used during the participatory design session, and should be provided with with a set protocol to follow which they have been briefed on by the researchers.
- **Allies:** For designing with students with behavioral disorders, practitioners should be used as proxies for this population because behavior incidents occur very often and they are most experienced people to handle these kinds of situations. Also, they have already established a relationship built on mutual trust, which could take a researcher months to acquire. Using proxies when working with a vulnerable population is more advantageous because the rapport they have already established can elicit better and more input from participants.

4 CONCLUSION

In this position paper, we describe our first design iteration of *Tadpole*, an online application where students with behavioral disorders can monitor their behavioral data (i.e., tokens earned in the classroom), keep track of how many tokens are needed to reach their desired in-school reward, and unlock avatar features via the website for their accomplishments. All of which takes place online and outside of school hours. In addition, we present our initial ideas to involve students with behavioral disorders in the second iteration of *Tadpole*. We hope that our position paper can generate positive discussions around how to design for and with students with behavioral disorders. We look forward to seeing how this workshop can provide us with valuable feedback from experienced researchers on our preliminary plan to involve behavioral disorder populations in design activities.

REFERENCES

[1] Tuomas Alahäivälä and Harri Oinas-Kukkonen. 2016. Understanding persuasion contexts in health gamification: A systematic analysis of gamified health behavior change support systems literature. *International journal of medical informatics* 96 (2016), 62–70.

[2] Christian Dindler and Ole Sejer Iversen. 2007. Fictional inquiryâĂŤdesign collaboration in a shared narrative space. *CoDesign* 3, 4 (2007), 213–234.

[3] Christopher Frauenberger, Judith Good, and Alyssa Alcorn. 2012. Challenges, opportunities and future perspectives in including children with disabilities in the design of interactive technology. In *Proceedings of the 11th International Conference on Interaction Design and Children*. ACM, 367–370.

[4] Christopher Frauenberger, Judith Good, and Wendy Keay-Bright. 2011. Designing technology for children with special needs: bridging perspectives through participatory design. *CoDesign* 7, 1 (2011), 1–28.

[5] Karl M Kapp. 2012. *The gamification of learning and instruction: game-based methods and strategies for training and education*. John Wiley & Sons.

[6] James M Kauffman. 1997. *Characteristics of emotional and behavioral disorders of children and youth*. ERIC.

[7] Maya Lopuch. 2013. The Effects of Educational Apps on Student Achievement and Engagement. (2013).

[8] Janet C Read and Stuart MacFarlane. 2006. Using the fun toolkit and other survey methods to gather opinions in child computer interaction. In *Proceedings of the 2006 conference on Interaction design and children*. ACM, 81–88.

[9] Cassie M Robacker, Christopher J Rivera, and Sandra H Warren. 2016. A token economy made easy through ClassDojo. *Intervention in School and Clinic* 52, 1 (2016), 39–43.

[10] Yvonne Rogers, Helen Sharp, and Jenny Preece. 2011. *Interaction design: beyond human-computer interaction*. John Wiley & Sons.

[11] Paul Toprac. 2011. Motivating by Design: Using Digital-Game Based Learning. *Handbook of Research on Improving Learning and Motivation through Educational Games: Multidisciplinary Approaches: Multidisciplinary Approaches* (2011), 283.

[12] H Van Rijn, F Sleeswijk Visser, and P Stappers. 2009. Connecting through interacting: Toys that help designers learn from children with autism by playing with them. *International Association of Societies of Design Research* (2009), 2055–2064.

[13] Michael T Yeganyan, Meg Cramer, Lou Anne Boyd, and Gillian R Hayes. 2010. vSked: an interactive visual schedule system for use in classrooms for children with autism. In *Proceedings of the 9th International Conference on Interaction Design and Children*. ACM, 319–322.