

Social Debugging Game for Learning & Engagement

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Abstract—The dramatically changing availability and sharing of information online has created new opportunities for informal, discretionary learning, particularly for teenagers. This, along with the rise in online gaming across all ages and genders give rise to questions about how these resources can be used effectively for learning. In my work, I will investigate how social features such as achievement broadcasting, teamwork, and puzzle sharing in an online game can sustainably engage teens and their friends in social learning of programming concepts.

I. INTRODUCTION

The availability of resources on the internet is dramatically changing the way teenagers learn after school. Assignments and textbooks are moving online [6], social games engage teenagers in informal social learning about marketplaces [2], and the biggest and most accessible repositories of learning materials are no longer found in physical locations such as libraries, but on websites such as Wikipedia and the Open Learning Initiative [12]. Discretionary learning is now less about books and more about self-paced, engaging, social experiences using digital resources. Computing education has been slow to adapt to these trends, focusing instead on engagement, instruction, or scalability independently, but not on how to combine the three. For example, computer science distance education efforts such as Udacity.com, while scalable and instructive, can be isolating for students [2] and have high attrition rates. Similarly, Codecademy.com, an interactive programming tutorial site, is scalable, but its effectiveness remains an open question because of its lack of evidence based instruction and assessment. Constructivist learning technologies such as Alice and Scratch [7], while engaging, require costly and unsustainable instruction through camps and after-school programs to promote learning [21]. Recent efforts have also effectively used game based narratives [19] and computing puzzles [17], but these are often solitary experiences.

I believe that social debugging games can be used to address these limitations by being engaging, instructive, and scalable for the following reasons. Social experiences are a fundamental part of engaging teens; this is particularly true for girls, who are chronically underrepresented in computing [15]. Experiences that involve friends and avoid isolating teen girls in competitive, male dominated learning settings are far more successful than those that do not [13]. Next, debugging is a fundamental computational thinking skill and necessary for writing a correct program [8]. In fact, the inability to understand program behavior is one of the primary reasons that people disengage in learning [9]. Our approach will be the first learning technology to teach debugging both explicitly before teaching programming. Finally, games are now a universal form of play for everyone: 91% of U.S. kids aged 2-17 play

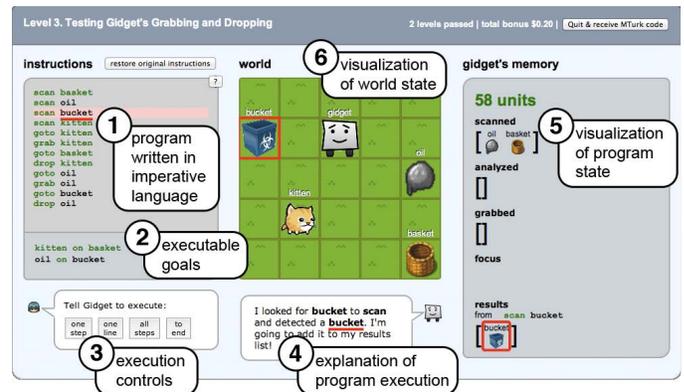


Figure 1. The Gidget game (with annotations), where learners help a damaged robot fix its programs by debugging its code.

video games [3]. Social games are particularly popular among teen girls [16], who play them for an hour or more a day for fun, stress relief, mental workout, and to connect with friends [3]. Interestingly, girls enjoy both cooperative and competitive puzzle and strategy games such as FarmVille [18]. Games are now also widely thought of as effective instructional tools [4], because they can provide concrete feedback about success and failure at reaching well-defined goals [5].

I will use a puzzle game as an instrument to investigate the potential of combining the aforementioned elements. To solve the puzzles, players will need skills that mirror those in debugging, including hypothesis formation and testing, mental simulation of programs, and evidence gathering. These skills will be taught explicitly through the game. Social features including pair debugging, achievement broadcasting, and puzzle sharing could entice and engage teens via integration with social networking websites such as Facebook.

II. BACKGROUND

Our work focuses on teaching programming concepts through debugging using an online video game called Gidget (shown in Figure 1). Players are encouraged to help a robotic teammate fix its problematic code to complete missions. Our earlier work with Gidget has shown that it is possible to translate debugging into engaging puzzle game mechanics, and also that the game is appealing for a broad demographic [10,11]. Nearly 500 players between 18 and 66 years old, across genders and ethnicities, have played the current version of the game across two studies. Players voluntarily played for hours (median of 35min), with many requesting more puzzles, more learning, and more opportunities to design their own puzzles to engage their friends and family. Nearly 50%

provided optional feedback, 90% of which praised the game as fun and engaging [10]. In particular, female players without any programming background expressed a wide range of positive experiences, even when they encountered difficulties.

Although our work has demonstrated novices' engagement in learning programming concepts through a debugging game, little is known how adding social elements to the game may affect learning and engagement. Similar to the educational literature about introductory programming courses, we found that many players of Gidget struggled with concepts such as conditionals, and were likely to become disengaged when they encountered difficulties. We suspect that adding social elements to the game will provide extrinsic motivation and social incentives for players to attempt difficult levels, ask for help when necessary, and share/create content for their friends.

III. SOCIAL GAMING AND LEARNING

Including the feedback I received from my past two studies, my future work will re-imagine the existing Gidget system as a collaborative, social game, including some of the ideas below. In designing and adding these features, I will consider literature on known gender differences, which show that supporting a variety of motivators and problem-solving approaches can keep both males and females engaged in a task.

A. Achievement Broadcasting

Gidget will leverage social motivators to keep players engaged, intertwining the game with teens' social lives and their use of social networking websites such as Facebook. In particular, a variety of social motivators will be used to create an online community to attract and engage a diverse range of players, including: social approval, social status, social reciprocity, curiosity, challenges, and rewards.

B. Pair Debugging/Programming

Players who are having difficulty completing a level will have the option to play the level cooperatively with a friend through a pair debugging feature. This idea is inspired by pair programming and peer tutoring in formal educational settings, which have been shown to eliminate gender differences [14], and have strong, positive effects on motivation and achievement [20]. Players will be encouraged to provide and receive help by broadcasting their team activities.

C. Puzzle Sharing

After a player has demonstrated some mastery of the concepts and language of the game, the system will provide the means for the player to author and publish their own puzzles to a sharable repository. Creating puzzles will not only require the player to understand the Gidget language, but also how to design the grid, objects, object interactions, goals, the solution to the puzzle, and the defective version of the code. We expect puzzle sharing to engage many learners who would not have otherwise played, particularly friends, parents, and siblings.

IV. DISCUSSION AND FUTURE WORK

The core, complementary elements discussed in this paper – social, debugging, and games – are potentially transformative elements of discretionary computing education for both teenage boys and girls. As more people turn to discretionary learning resources online, it will become increasingly important to understand the role and impact these core elements have on

learners. I aim to show that social gaming features such as achievement broadcasting, pair debugging, and puzzle sharing can sustainably engage teens and their friends in social learning. These contributions will provide a strong research base for the design of online discretionary computing education pedagogy.

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