

# **Greenify: Real-World Missions for Climate Change Education**

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**Abstract:** The literature on climate change education recommends social, accessible *action-oriented* learning (Cordero, 2008; Bell, 2005) that is specifically designed to resonate with a target audience's values and worldview (Leiserowitz, 2006; Nisbet, 2009). This paper discusses *Greenify*, a Real-World Action Game (RWAG) designed to teach adult learners about climate change and motivate informed action. Evidence suggests that gameplay helped players realize the magnitude of their personal actions, with reports of new behaviors and an increased desire to educate others on the website and beyond.

## **Why a Social Media/Gamification-Based Strategy to Address Climate Change?**

Despite effort spanning several decades to mobilize the public around the issue of climate change (e.g., Nisbet, 2009), few people take actions to mitigate personal emissions (Owens, 2000) and climate change remains low in voters listing of national priorities (Leiserowitz, 2006). This reluctance to take action is often explained by an *information deficit* model (Burgess et al., 1998), which cites gaps in knowledge including incomplete or erroneous understandings of the causes of global warming (Bord, O'Connor, & Fisher, 2000; Seacrest, Kuzelka, & Leonard, 2007; Fortner, 2001; Sundblad, 2008; Bostrom et al., 1994). However, achieving a better public understanding of climate change does not necessarily lead to the desired behavior change (Leiserowitz, 2006; McKenzie-Mohr, 2008; Owens, 2000; Finger, 1994). Some studies have even found, perhaps counter-intuitively, that *better-informed Americans are less likely to take personal action rather than more* (Kellstedt, Zahran, & Vedlitz, 2008; Moser, 2006).

Broadly, recommendations for future education efforts promote action-based learning and consideration of the individual within their socio-cultural contexts. First, major barriers to climate change education efforts include polarization of the issue across ideological lines (Nisbet, 2009) and distrust of institutional sources of information (Nisbet, 2009; Owens, 2000). As such, climate change messages should be tailored to resonate with the worldviews and values of each target audience, ideally developed and delivered by among peers (Leiserowitz, 2006; Nisbet, 2009; Owens, 2000). Second, effective behavior modification leverages normative and committing power of social groups rather than focusing on the individual (McKenzie-Mohr, 2008). Third, knowledge acquired in an action-based and meaningful context promotes behavioral change (Epstein, 1994; Cordero, 2008; McKenzie-Mohr, 2008) by building self-efficacy (Nisbet, 2009; Owens, 2000) and forming the individual and social basis of new behaviors (McKenzie-Mohr, 2008).

Social web-based applications hold promise for implementing these recommendations for climate change education. These sites enable the formation of online communities built upon common interests and values, which generate and share enormous varieties of relevant content. For instance, *Wikipedia* users have created one of the most extensive encyclopedias in the world with over 18 million articles in 279 languages and 400 million monthly users (Cohen, 2011). Importantly, the online interaction afforded by a crowdsourced environment like *Wikipedia* creates a community with a common purpose and relatedness, resulting in motivated contributors and senses of reciprocity and altruism (Kuznetsov, 2006).

Along with social web features, *gamification*, defined as the use of game design elements and principles to engage users in real-world activities, may be an important technique for motivating and scaffolding actions in everyday life (Schell, 2010; McGonigal, 2011). As an example, *Nike Plus* allows runners to set goals, join challenges, connect with friends in the online community, and, since its launch in 2006, has motivated users to run over 262 million miles (Malinowski, 2010). Principles of good game design are consistent with contemporary learning theories and can be used to build experiences that guide players to mastery of complex and difficult material (Gee, 2005). Echoing the promotion of action-based learning from the fields of climate change education (e.g., Cordero, 2008) and instructional design (e.g., Merrill, 2007), Gee (2011) argues that good games recruit good learning because they facilitate learning through completion of actions and authentic tasks. Additionally, the game *FoldIt* provides a powerful example of gamification-based crowdsourcing: its tens of thousands of players recently deciphered the physical structure of a protein implicated in AIDS, an optimization problem which had previously eluded the world's top supercomputers. This kind of strategy can be a useful way to get many people actively and creatively engaged in difficult problems.

## Greenify: User-Created, Crowdsourced Real-World Missions

Incorporating elements of both social media and gamification, an online, social Real-World Action Game (RWAG) called *Greenify* was created to teach about the causes and effects of climate change in terms relevant to players' everyday decisions and actions. *Greenify* provides (1) a mode of peer teaching and learning, moderated by climate science experts; (2) motivation to take action in the form of real-world missions, social recognition, game structures, and both in-game and real-world rewards; and (3) knowledge about climate change in the form of user-generated articles, news, scientific concepts, and multimedia.

The *Greenify* website is divided into three main sections: *Explore*, *Take Action*, and *Create* (see Figure 1 below for an overview). In addition, the website features a *Recent Activity* feed and a *Wall of Fame*. Details of each section are provided below.

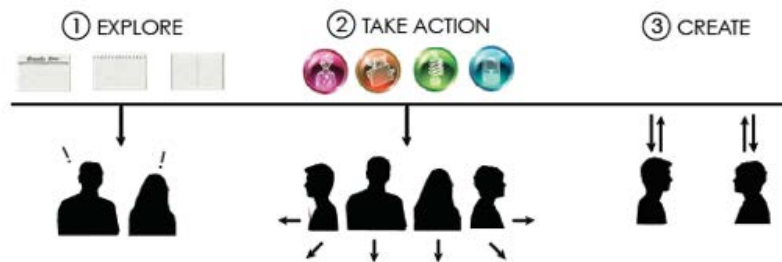


Figure 1: Explore Articles, Take Action (Missions) and Create New Content.

Players can read three kinds of articles within the *Explore* section (Figure 2 below): *News*, *Scientific Concepts*, and *Stories*. *News* articles include a brief summary and links to recent news articles on climate change. *Scientific Concepts* teach players about fundamental climate change concepts such as albedo and the greenhouse effect. Finally, *Stories* include personal accounts of how climate change has impacted one's local environment. The *Explore* section, filled with insightful articles, embedded videos and interactive simulations, serves as a crowdsourced, collective knowledge sharing environment since it makes sharing articles from other resources possible on the *Greenify* website. Players can view highly rated *Explore* articles and boost article ratings by pressing a "+1 Alert" button, thereby boosting the article's *Alert* score. Reading *Explore* articles increases the "intelligence" score of a player's polar bear avatar.



Figure 2: Main page, with Explore Articles and Take Action (Missions) sections.

In the *Take Action* section, players can browse and accept real-world missions in three categories: *Personal*, *Resources*, *Energy*, and *Communication*. Missions are user-generated and vary from practical everyday actions that reduce carbon emissions to missions that involve problem solving or sharing creative ideas to complete. All missions feature step-by-step instructions and a *Why it Helps* section that explains the mission impact. Players earn a number of *Tree* points for completing missions. Missions are rated by all players for their potential impact and the average rating score is displayed; highly rated missions yield a

greater number of *Tree* points when completed. Deeds (players' completed missions) are also viewable and can earn "Thumbs-up" votes.

The *Create* section encourages players to create new missions (practical actions) and *Explore* articles for others. Submitted missions and *Explore* articles are vetted and approved by a team of climate science experts before they are live and playable on the site. Importantly, *Greenify* is designed to inspire players to want to inspire change among their social circle; players earn a number of *Tree* points for creating missions, and earn more points when their missions are rated highly and each time missions are completed by other players. In this way, the game naturally encourages people to take ownership over climate change issues and gets players to want to create high quality, scientifically sound, practical actions for their peers.

The *Recent Activity* section is a news feed that displays recently completed missions and updates. Players can comment on each others' activities, initiate and accept friend requests, etc. The *Wall of Fame* displays badges and superlatives in the form of top scorers and most popular missions. Finally, leaderboards and player scores display the players with daily, weekly, and all-time high scores for *Tree* points. Customizable polar bear avatars, with their happiness scores and intelligence level, are also viewable. Recently completed missions increase the happiness score of the player's pet polar bear.

## Methodology

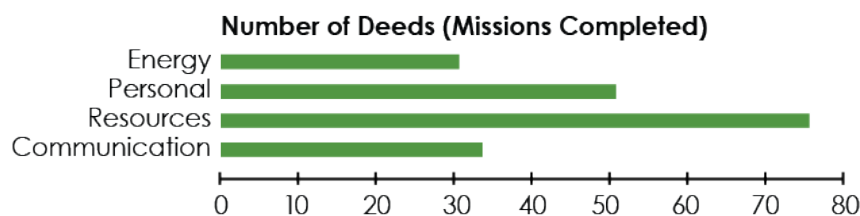
As the first iteration of a *Design Based Research* (DBR) mixed-methods approach (DBRC, 2003), 26 adults from two graduate-level courses at a large private university in New York were selected as part of a convenience sample. 8 men and 18 women participated in the six-week study. Participants were given a pre- and post-implementation survey, each with three types of question items about climate change: 12 questions testing basic knowledge about climate change, 15 Likert-type items exploring attitudes, 7 Likert-type questions looking at participant behaviors, 3 open-response essay questions, and 10 questions about the *Greenify* design and what players perceived as its impacts on their behaviors, attitudes and knowledge. Semi-structured interviews were also administered to six students, focusing on the positive and negative aspects of the experience, the effects of the game on their behavior, what they learned, etc.

## Results

Our findings suggest that players: (1) changed behaviors and learned practical actions to influence climate change; (2) reported an increased awareness of climate change issues and indicated an increased sense of self-efficacy to be able to make a difference; and (3) were encouraged to share knowledge, deeds and ideas with their peers in a form of "positive peer pressure."

### Theme #1: New Behaviors Occurred Because of Gameplay

In-game behavior logs revealed that during six weeks of gameplay, 27 missions were completed a total of 193 times (see Figure 3 for a breakdown of deeds by category). Nine *Resources* missions, including missions that challenged players to reuse bags for shopping purposes and to create homemade eco-friendly cleaning products, were completed (a total of 76 times). Six *Personal* missions, including missions to donate unwanted items or to eat organic and vegetarian meals, were completed 51 times. Three *Energy* missions, including shutting down the computer when not using it, and choosing to take public transportation to work instead of driving, were completed 32 times. Nine *Communication* missions, characterized by peer communication-based tasks such as debating climate change issues and sharing news, information and photos, were done 34 times. Examples of *Communication* missions include "*Debate: Where Can We Trim?*", which asked players to discuss which economic sector and what specific actions could lead America to decrease its carbon footprint the most, and "*Picture the Problem*", which allows players to earn points for uploading photos that highlight the problem of climate change.



**Figure 3: Breakdown of Missions Completed.**

In addition to game logs, survey outcomes demonstrate evidence of *Greenify*'s influence on players' everyday activities and behaviors. Nearly all participants (82.6%) reported that *Greenify* changed their behaviors, with 13.8% reporting a score of *Strongly Agree* on 7-point Likert scale items. When asked what

new behaviors resulted by playing the game, participants gave a wide variety of responses, including: “Started talking about the issue more with friends and family. Did more reading about the topics found on *Greenify* and took a few challenges and incorporated them into my daily routines.”; “Reduced the amount of beef I eat and made changes around the house to conserve energy.”; “More recycling and thinking more about my actions prior to purchasing items that might impact the earth.”; “Didn’t take plastic bags.”; “Used public transportation instead of a car...use more organic products.”; “Donated clothing and other used goods.”; “Complete missions created by others, not just for one time, I tried to continuously follow the missions in everyday life...changed my everyday behavior by saving water, electricity, and disposable goods”; “Use less water and electricity- I put post-it notes around my house reminding everyone to turn the lights off.”

Notably, Likert scale item responses determined that participants at least *somewhat agreed* in the post-survey that they became more careful about the kinds of foods (61.6%) and personal products (65.4%) they buy because of the issue of climate change (an increase compared to 46.1% and 46.2%, respectively, in the pre-survey). Further, the number of players who reported taking practical steps to curb transportation-based emissions rose from 30.8% before playing *Greenify* to 50.0% after. In the end, nearly all participants (92.3%) reported that they changed their behavior as a result of their understanding of climate change (compared to 65.4% on the pre-survey), and half made solid efforts to make changes around the household because of climate change, compared to just over one-third (34.6%) in the pre-survey.

Qualitative data from interviews also supported this finding, as participants reported paying more attention about climate change issues. For example, Laura (female) remarked:

“Actually, I didn’t pay any attention about the global warming and all the environmental issues before. But now by playing *Greenify* I actually I pay more attention about little things and knowledge, like I actually didn’t know the ordinary activities I do can change things.”

*Greenify* players became more aware of how their actions impact the environment. For example, Laura (female) in an interview explained how *Greenify* changed her awareness of personal habits and how she felt more empowered to do simple actions to make a difference:

“I’m a little bit ashamed but actually I would let the water run whenever I’m brushing my teeth everyday and I didn’t feel bad about it. But now immediately after first time I saw the activity I stopped that. I definitely turn off [the water] when I’m brushing my teeth and...I feel good about it, I feel you know I’m really making an impact.”

Similarly, Mary (female) talked about household behavior changes because of *Greenify* missions:

“I actually used to be one of those terrible people that left the computer running all the time with a dimmed screen or even asleep; it has got that residual power draw, you know. I’ve got a big 27” screen iMac at home, so that’s throwing a lot of power. So after reading one of the challenges last week, I started shutting that down every time I leave the house. I’m sure I’ll notice a difference in the power bill so that’ll be nice. But I know that it’ll make an impact for the rest of us, which is more important to me.”

Based upon the evidence found in game logs, survey responses, and interviews, missions in *Greenify* were successful in getting players to change their behaviors in their everyday lives. As getting people to respond to climate change can be a major challenge, this finding demonstrates that an online gamification, social media, crowdsourced approach among a peer group is a promising strategy for prompting behavior change, especially as a part of the gameplay.

## **Theme #2: Changes in attitudes: Increases in environmental awareness and self-efficacy to be able to make a difference as an individual**

When asked if participants “made a special effort to do various actions because of their understanding of climate change” and “know how to take practical actions regarding climate change,” they reported 53.8% and 34.6% agreement with these items in the post-survey (respectively), up from scores of just 23.1% and 15.4% in the pre-survey. Further, participants reported that they were far more aware of how their lifestyle and actions impact the environment – from 23.1% (pre) to 46.2% (post). When asked if they believe their actions contribute to global warming and climate change, 88.5% at least somewhat agreed with this on the post-survey, compared to just over three-quarters of participants (76.9%) on the pre-survey. Most importantly, evidence suggests players began to feel empowered, as they reported a new understanding that individual actions can make a difference:

"I think my opinions about the role of individuals has changed. Whereas before I saw the burden of the instituting change falling to big organizations, now I feel like the collective actions of everyone have to, and can be, mobilized to affect big change." (Kylene, female)

"For me, it just opened my eyes to how much energy I consume and waste at home by leaving my monitor on, never looking into residual power draw for equipment I haven't used in weeks." (Mary, female)

"I did them [missions] not just because of the [Tree] points but also because of my own awareness about the issue of climate change." (Heewon, female)

By combining general knowledge with specific actions that people could take, *Greenify* was able to give players a sense of meaningful accomplishment and reduce the feelings of fatalism common to the issue.

### **Theme #3: *Greenify* provides positive peer pressure that leads players to take action, share knowledge and experiences**

Players expressed that being able to share knowledge, ideas, and deeds within a social network was a very positive and motivating experience. When asked about the strengths of *Greenify*, 61% of the players expressed the benefit of social interactions, e.g., commenting on others' missions and deeds. For instance, players said they are motivated when "seeing others' strategies" and "watching others' activity." They found "positive peer pressure" and crowdsourcing aspects to be positive; in the post-survey, players remarked: "The crowdsourcing aspect is great. It gets so many people involved"; "[I enjoyed] learning in *Greenify* [and] seeing other people are learning too"; "it allows being green to become part of a social network"; and "[The game] lets me see how other people I know are doing [actions] to care about this issue."

In some cases, this kind of "positive peer pressure" went beyond the game itself. In her interview response, Cindy (female) talked about how the experience extended into her apartment and to her roommates—people who were not even participating in the online game:

"I think taking the actions and applying them in your actual life makes the game live beyond the computer. I know for myself I've taken some of these action challenges and posted [them] with friends or roommates—so it almost lives in my apartment or in my everyday life and beyond. You know, which kinda makes it fun and kinda engages roommate conversation. So I think it's good kinda talk at recess or talk outside of the game itself on the computer and kind of go 'oh, how did that go for you?' or talk about the actual actions."

The peer teaching and learning afforded by *Greenify* motivated players to want to teach others about climate change more, from 38.5% agreement (pre-survey) to 65.4% (post-survey). As exhibited in survey responses and interviews, players stated that they discovered the power of collective actions, which changed their opinion about the role and impact of individuals. For instance, Lisa (female) explained:

"I think the real power is just kind of in the interaction. So I've talked to people in the site they have posted links to things or posted articles that I may not have stumbled upon on my own; so I think I've picked up some pretty cool knowledge that I didn't have before."

### **Theme #4: *Greenify* viewed as a unique, effective climate change education strategy**

When asked how *Greenify* compared to other climate change education strategies, students' responses were generally favorable. Lisa (female) remarked: "[*Greenify*] makes it very visual, it makes it very immediate and it makes it very plain. Like you can literally go on to the site, click on an action, click on a mission, and find out what you need to do and what happens in the world as a result of your actions, and I think that's very different than most things you hear. You can watch a video and get told 20,000 different things you should be doing. But this [*Greenify* game] gives you a focus so you can go and focus on one thing that day and make a real change. I think that's pretty powerful."

A frequency-based word cloud based on user responses for "What do you think of *Greenify*?" was produced (Figure 4 below). The most frequently used words were: *informative*, *interactive*, *fun*, and *actions*; followed by *practical*, *social*, and *engaging*. It can be determined that *Greenify* was largely viewed as an informative and interactive experience, consisting of completion of practical everyday actions in a fun and engaging way.

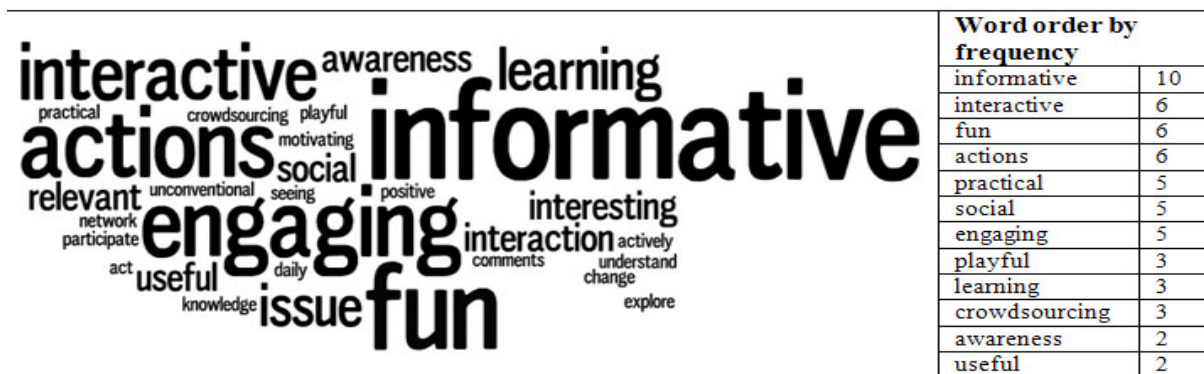


Figure 4: Word cloud for “What do you think of Greenify?”

## Conclusions

Following the recommendations of the literature on climate change education, a social, gamification-based website was designed to form an online community engaged in peer-to-peer and action-oriented learning. Evidence suggests that gameplay helped players realize the importance of their personal actions, with reports of new behaviors and an increased desire to educate others on the website and beyond. These findings suggest that: (1) gamification principles are congruent with needed changes to climate change education efforts; and (2) social media technologies can enable peer-to-peer education and can motivate behavior change effectively. Gamification can be a powerful strategy that converts serious real-world problems into engaging and meaningful game play that promotes peer-to-peer education and behavior change through social interactions.

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