

## Article 1

# Applying Green Gamification to Support Green Campus Initiatives in Reducing Carbon Emissions

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### **Abstract**

*Green gamification is a technique with the purpose of using game elements in non-game context to encourage positive environmental behaviours. It is believed to be able to support behaviour change with the help of persuasive technology which is the Go Green Campus web application. The objective of this project is to create awareness on environment sustainability by applying green gamification technique to encourage behaviour change in reducing carbon emissions which is believed to be more fun and enjoyable. This research focuses on the college students in UiTM Perlis as an initiative to Green Campus concept. The research significance is to motivate people to change their behaviour in order to reduce carbon emission. Evaluation of the web application has been conducted using heuristic evaluation which consists of three elements: perceived, structural and perceptual elements. Questionnaires were distributed among ten college students where they had been closely monitored by researchers for two weeks. The results show that besides feeling motivated to realize that each activity can contribute to reducing carbon emission, almost all participants enjoyed the green gamification elements since they are enjoyable and fun.*

**Keywords:** *Green gamification, carbon emission, Green Campus Initiatives*

### **Introduction**

Nowadays, carbon emission issues have become a highly concerned topic. The atmosphere's concentration of carbon dioxide (CO<sub>2</sub>) has increased by more than 30 percent over the last 250 years, mainly due to human activities and most of it has occurred for past 50 years (Socolow, R., et al, 2004). There are many initiatives that have been made in order to overcome the carbon emission issues. One of them is the "Green Campus" initiative. Green campus is a place where environmentally responsible practice and education go hand in hand and where environmentally responsible views are borne out by example (Emmanuelle M., et al, 2010). This concept offers higher institutions a chance to take the lead in rethinking its environmental culture and developing new paradigms for solving problems regarding nature. By applying the same green campus concept, this research will enable the students to see the amount of carbon emission that they have contributed to the environment if solid waste is not managed by them in the right way. The technique that will be used is called green gamification. Gamification itself refers to the use of game design components in a non-game context (Deterding et al., 2011). Meanwhile, green gamification is the technology-incorporated game mechanics in the context of "green" behaviours (Froehlich et al. 2012, 2009).

It is a type of persuasive approach whereby a computing system is interactively designed to change people's behaviours (Fogg 2003, 6). There are many factors that lead to behaviour change. Many researchers before this had implemented persuasive technology. Most of them are to create people who are conscious about a healthy lifestyle. This project will incorporate green gamification which is an extension of persuasive technology itself, primarily to keep people conscious towards the environment that as illustrated in Figure 1.

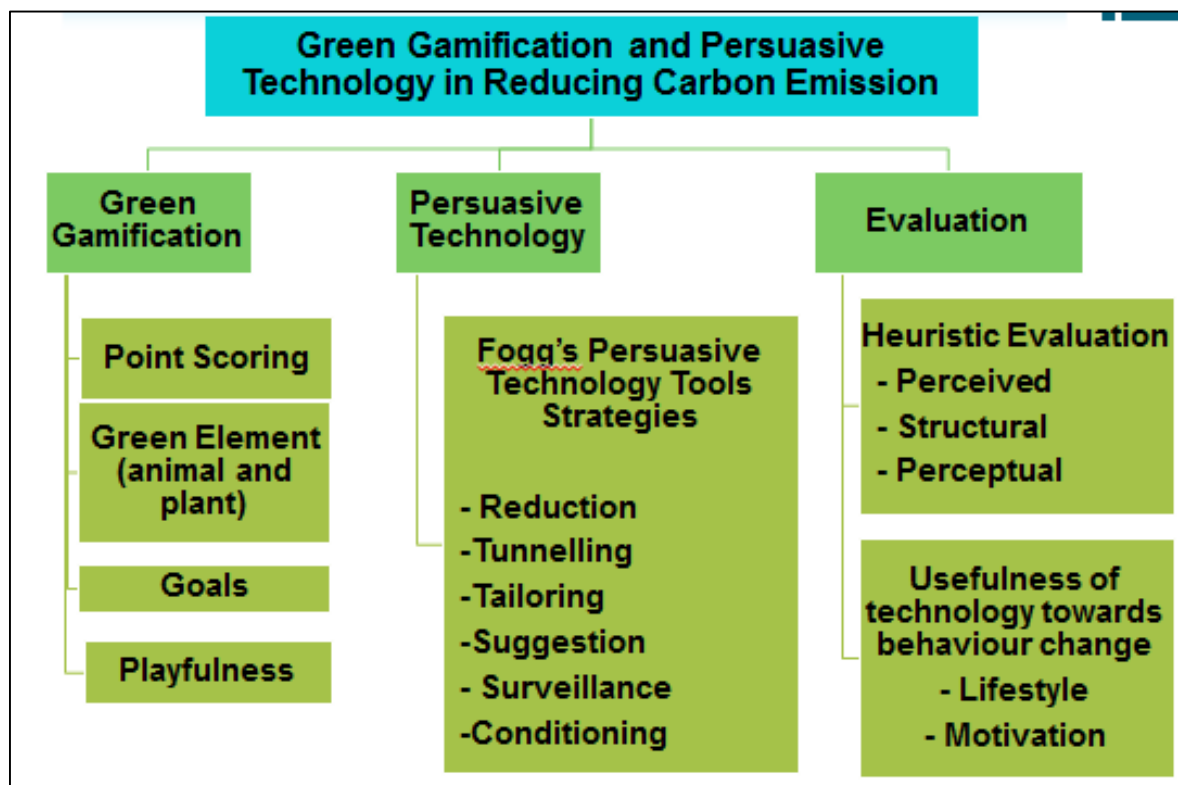


Figure 1: Research model

## Related Works

### *i. Green Gamification*

Green Gamification is the use of game elements to make sustainability fun and rewarding. This technique has been used widely these days as an initiative to make the world “greener”. The use of game elements like collecting points, goals to achieve, leaderboard, feedback, customization and playfulness has made the gamification of the environment much more enjoyable. Froenlich has enumerated green gamification and eco-feedback examples in the context of three environmentally significant domains namely, home resource consumption, personal transportation, and waste disposal behaviours (e.g., littering and recycling) (Froenlich J., 2015). With the growth of ubiquitous Internet connectivity, mobile and in-home displays, and smart meters, there is an increase of promotion and support towards pro-environmental behaviours at home using this technology. In the last few years, there are inventions for almost everything we use in our daily life, ranging from cars, buses and even motorcycles that rank and reward fuel-efficient driving performance. For example, in Figure 2, the Nissan Leaf Carwings system gives virtual rewards to efficient driver and to services that monitor and reward home recycling behaviours as shown in Figure 3.

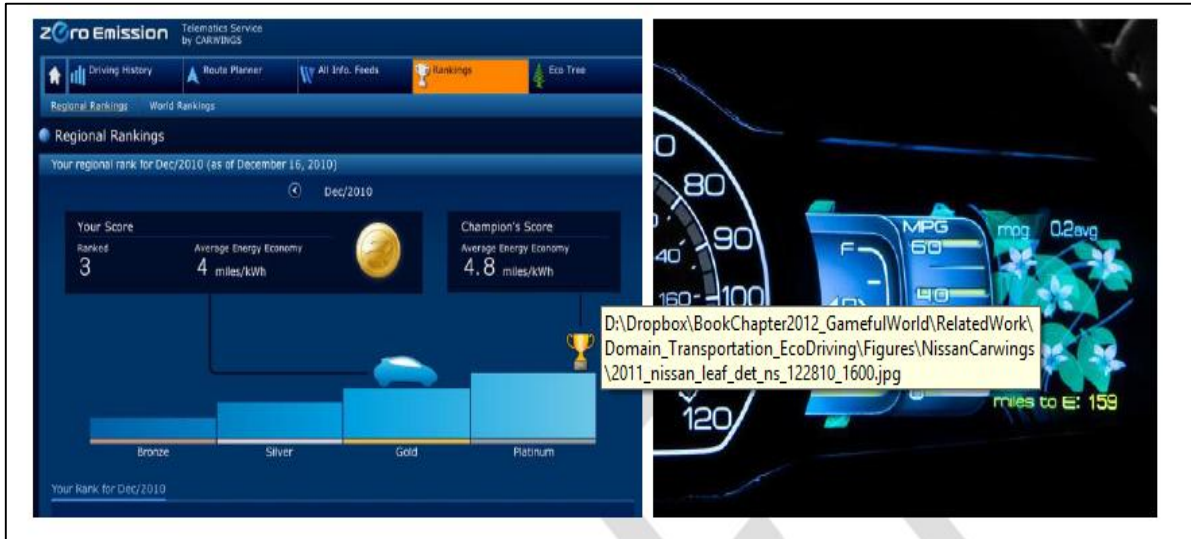


Figure 2: Nissan Leaf Gamification Interface (O'Dell, 2009)

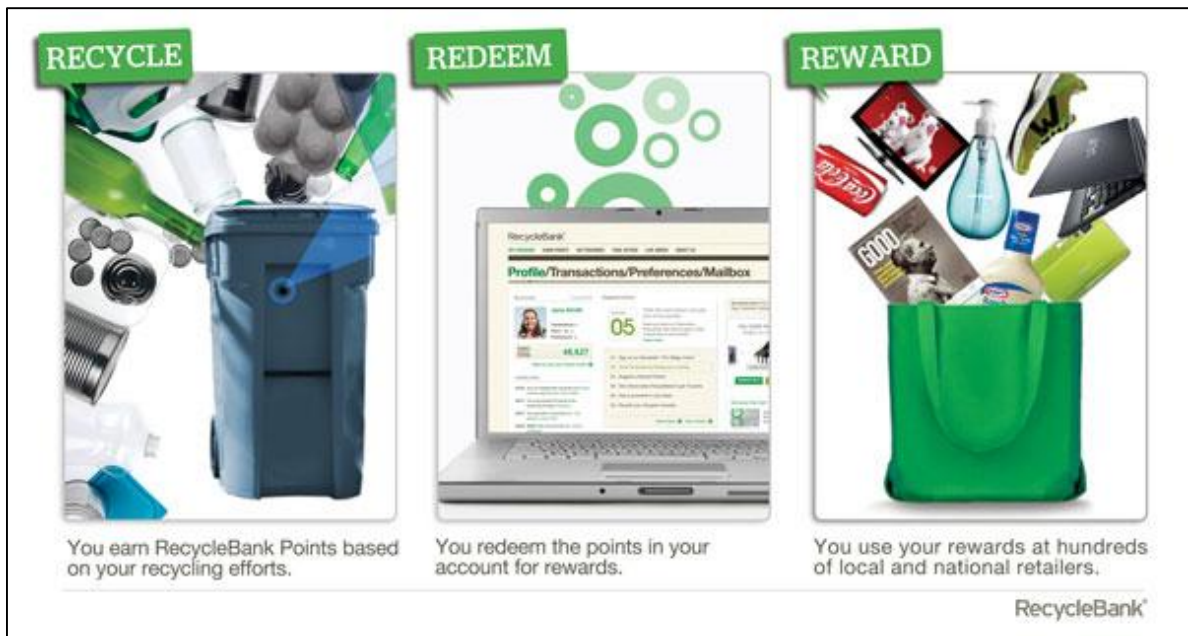


Figure 3: How RecycleBank works. (RecycleBank, 2011)

This concept of gamification which is uses game design elements in traditionally non-game contexts (Deterding et al. 2011) technique is related to persuasive technology, mainly to sustain and encourage a better behaviour towards the environment.

## ii. Carbon Emission

Carbon emission is the release of carbon into the atmosphere. To talk about carbon emissions is simply to talk about greenhouse gas emissions which are the main contributor to climate change. Since greenhouse gas emissions are often calculated as carbon dioxide equivalents, they are often referred to as “carbon emissions” when discussing global warming or the greenhouse effect (Ecolife, 2013). Since industrial revolution has increased, it directly correlates to the increase of carbon dioxide levels in our atmosphere and thus causing the rapid increase of global warming. It can also be caused by an organization, event, products or individual. The amount of carbon emissions calculated is called carbon footprint. Nowadays, the carbon emission issues is a topic of great concern. Although many actions have been taken

to raise awareness, there is no sign of real solution to these problems. Thus, by developing this application, the amount of carbon emission can be reduced if the community knows how much they have contributed to carbon emission to the atmosphere.

### ***iii. Effect of Behaviour Change in Reducing Carbon Emission***

Behaviour change has been an important starting point for people to overcome many issues. Previous researches had used persuasive technology to promote behaviour change in order to solve problems. Gasser (2006) has proposed a mobile lifestyle coaching application, which was intended to improve the users' healthy behaviour as well as their health. It also highlighted the importance of behaviour change in humans' lives. Other than that, UbiFit Garden (Consolvo et al., 2009) is another application that also applies persuasive technique to inspire users to maintain the desired level of their physical activities in everyday life. Both applications demonstrate attractive elements as a display when the user reaches a certain goal. The use of attractive elements motivates users to use the application frequently since it is fun and in a way it encourages users to do more physical activities voluntarily. This will then promote behaviour change among users to be more fit and concerned about their physical well-being. Hence, this shows how changing of people's behaviour will help in achieving something. Thus, behaviour change will be promoted in this project in order to reduce carbon emission.

### ***iv. Green Campus Initiative***

A green campus initiative carries out functions according to a system-wide culture of environmental sustainability, balancing function and design with existing and foreseen resources (Allen, A. S., 1999). This initiative is being made in order to sustain pro-environmental behaviours in a student's daily life. Colleges and universities develop green campus' best practices through research, implementation and the willingness to revise and adapt. These best practices should be shared with colleagues to ensure that effective strategies and successful initiatives can be easily adapted and replicated (Emmanuelle M. & Humblet, R. O., 2010) (Allen, 1999). In this project, green campus initiative is implemented through web application by using both green gamification and persuasive technology in order to change behaviours into the ones that will help in reducing carbon emission.

## **Conclusion**

This project enhances the use of web application in reducing carbon emission through changing people's behaviours using a proposed technique, green gamification. Rewards are given to students that contributed to more reducing carbon emission activities and through this Go Green College web application, they can view the rewards collected by students of each floor in Block A, Dahlia 3 and hence making them feel motivated to do better in collecting points.

The web application user interface is designed based on persuasive technology tools strategies and green gamification elements such as reduction, tunneling, points, scoring and leaderboard. In the testing phase, two types of questionnaires were distributed, pre-questionnaire and post-questionnaire. The pre-questionnaire set was distributed to look into users' familiarity towards Go Green College initiatives via web application. Meanwhile, for post-questionnaire phase, ten questionnaires were distributed. The students had been closely monitored by researchers for two weeks to update their activities via the web application. This is important it is to find out the impact of the design and content of the developed web application which adopts the green gamification techniques, on the college students' behaviour change. Thus, the post-questionnaires were evaluated using heuristic evaluation which consists of perceived, structural and perceptual elements and is suitable for green gamification techniques.

From this result, it can be concluded that the perceived elements which convey the enjoyable and attractive elements have been well received by the participants. It is because by viewing the web application, there are various green gamification elements that can be found which are point scoring, star rating, leaderboard and many others (Figure 4). Other than that, the animated virtual aquarium that represents the reward also attracted users' attention. For structural evaluation that focuses on interactivity, each of the structure of the website has to be interactive and easy to be used. The web application is an easily navigated web application with various interactive animations to attract and motivate students at the same time. Lastly, perceptual elements which are about the narrative persuasion or reward-related elements are well received by the participants. It is because the reward-related elements are fun and enjoyable. Other than that, it may motivate them indirectly.

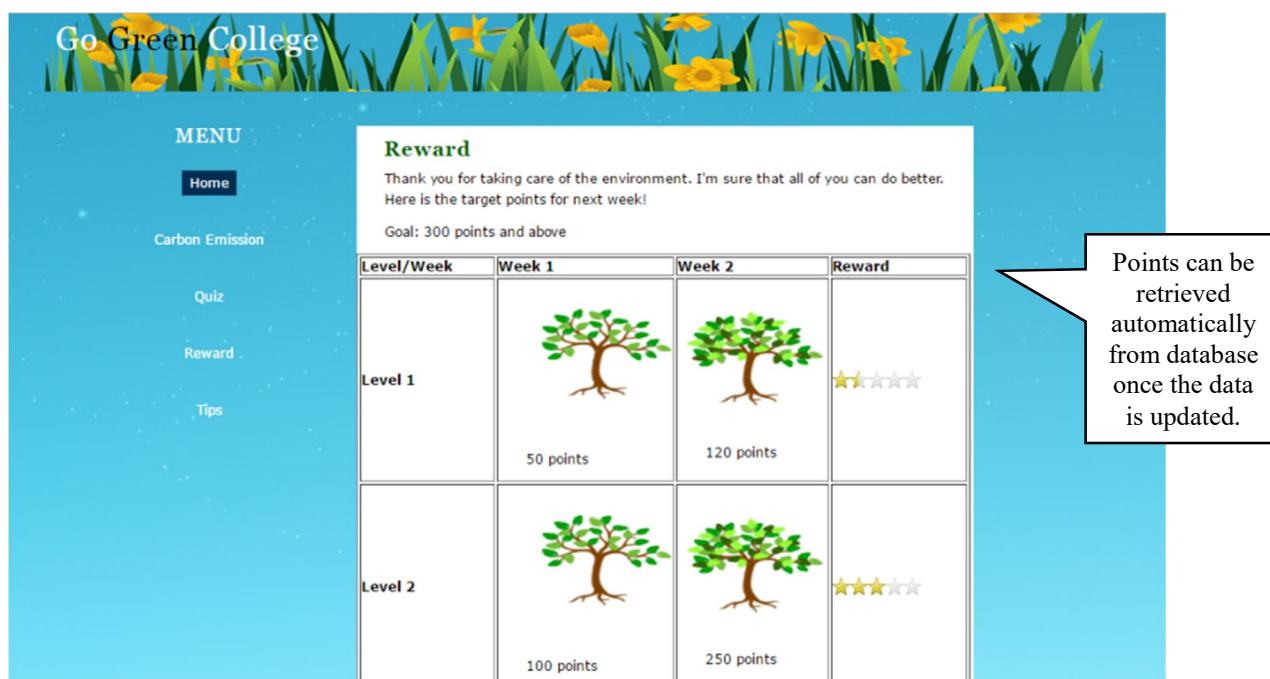


Figure 4: Rewards page

Therefore, the initiative taken towards achieving the “Green Campus” concept by starting at the place where students spend time the most which is the college, is only the beginning. Many more intervention techniques could be introduced in order to achieve the concept. The development of Go Green College web application is to request students to take the complex issues such as environment seriously. Thus, by using this web application, students will understand better that each activity in their daily-life can contribute to carbon emission. Other than that, the separate-your-waste initiative allowed users to obey the new law that has been enforced, which requires each and every household to separate their solid wastes accordingly. Students also will get rewards and points if they participate in an activity that reduces carbon emission which motivates them to do more activities that could help the environment to get higher points. Other than that, the use of green gamification elements like points scoring, star rating, quiz and leaderboard makes the web application fun and enjoyable; hence, persuaded students to use it often.

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