

# Promoting Afforestation for Sustainable Communities through Gamification

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## Abstract

Gamification is the concept of using game features and techniques in a non-game situations. The theory of gamification promotes the fact that users are more likely to accept and actively use an application, when there is a characteristic of game play associated with it. The concept has gained a lot of research interest in recent years. Studies on climate change mitigation strategies can incorporate gamification, with its theoretical aptitude to change people's everyday behaviours. This study aims to raise awareness as well as the capacity of gamification to support sustainable environmental measures with a view to identify possible applications to forest health issues. The study incorporated feedback and ideas with the purpose to encourage the participant to identify possible areas for gamification in the Forestry Commission's projects and propose ideas for potential games. The emphasis was on raising collective awareness to enable behavioural change and inspire people in making sustainable decisions on afforestation. The study looked at two different games, and the challenges meant to influence behaviour in afforestation for sustainable communities. The study established that participants had a positive perception about the concept; and the integration of gamification with afforestation facilitated the creation of a cybernetic environment which brought about a change in how individuals protect the environment for sustainable communities. These are key steps in fighting forest related climate change issues, since it represents a crucial contribution to a more collective and sustainable lifestyle.

## Keywords

Afforestation - Behavior - Climate Change - Gamification - Sustainable Communities

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## 1. Introduction

Methodologies and strategies used to promote sustainability have depended on subjective moral codes. Information and Communication Technologies (ICT) are generally a viable option to influence people's behaviour [1]. Studies

on climate change mitigation strategies can incorporate real promise of Information and Communication Technology[2] such as gamification, with its theoretical aptitude to harness the attention of great number of people in order to change their behaviours[1], [3]–[5]. Research from the education domain shows that proper application and utilization of computer and its technologies such as gamification[6][7] can serve as successful interventions for improving students engagement [8]. Such concept could also be applied in afforestation strategies to influence the general populace. Gamification is a concept of employing game elements and procedure in non-game contexts [9][6]. The theory behind gamification[10] is that users are more likely to be espoused and thereby actively use an application, when there is a characteristic of game play associated with it[11], [12]. The concept has gained a lot of research interest in recent years in its application. Despite widespread commentary on the merits and deficiencies of gamification, few approaches have considered how to foster sustainability through gamification elements and strategies (e.g., points, badges, and leaderboards[13], [14]). Gamification works by harnessing the motivating aspects of gameplay in order to increase user engagement with a task or subject matter [15], to

change behaviour. The question that needs to be answered therefore is how can one engage users in order to change their behaviours to promote afforestation for sustainable communities using gamification as a tool? The aim of this study was to raise awareness and capability of gamification to support environmental concerned issues among Forestry Commission (FC) staff and citizens to identify possible applications of gamification to forest health issues. The study incorporated feedback and ideas with the purpose to encourage the participant to identify possible areas for gamification in the forest sector and propose ideas for potential games. The emphasis was on raising collective awareness on deforestation to enable behavioural change and inspire people in making sustainable decisions on afforestation. The study looked at different games and challenges meant to influence behaviour in afforestation for sustainable communities.

Gamification is all about using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems [12], [14]. It applies characteristics associated with video games, such as game mechanics and game dynamics, to non-game applications [8], [16]–[18]. Therefore, it is important to distinguish it from the well-established use of video games. As a pedagogical concept, gamification does not necessarily involve the use of an actual game but involves the integration of design elements or activity patterns traditionally found in games into educational contexts.

## 2. Application of gamification in natural resource management and agriculture

Acerbis & Riva proposed a gamified application to enhance users' participation and data gathering in a real Water Demand Management (WDM) scenario, by describing the designing principles and the architecture of the envisioned solution[19]. The work suggested that, voluntary submission of data by the users was encouraged through the use of hybrid gamified applications integrated in the platform that make use of both digital and physical games to elicit contributions and refinement of data useful for the definition of behavioural models used in dynamic pricing policies and personalized suggestions on water usage. Another research also considered participatory methods to characterize farmers' needs and preferences in plant breeding to ensure that new varieties fulfil the needs and expectations of end users. Steinke and Etten with regards to these objectives opined that “AgroDuos”, which was an application of gamification, produced valid and useful results while enabling rapid, easy, and engaging data collection [20]. Another research work [21] also described gamification as a method of teaching the concepts of sustainability through the introduction of motivation, design and use of mobile Application as a means of learning about Home Water Management by students

. The ultimate goal was to use the game Application to raise water conservation awareness among the populace and also to save water. Community's sustainability is the possibility of all life flourishing together[4]. Based upon the review of literature, it is important to frame sustainability as a positive vision that leverages autonomy, intrinsic motivation, and self-determination and to leverage the social power of the group rather than the individual. Communities that share values and worldviews can more effectively exchange ideas for sustainable living. Therefore, sustainability can be best accomplished by and within communities.

## 3. Behavioral economics and gamification

A key objective of behavioural economics is to bridge the gap between traditional economics and real global observations of human being's behaviours[22], [23]. This arises due to economics assuming that human beings act rationally [24]. This in turn requires that humans must accurately appreciate a concept for a choice to be made, and subsequently select the first-rate preference.

One particular purpose that behavioural scientists have in helping human beings gain better results is to lay out strategies that get people engaged in events such that the probability of completion is enhanced [25]–[28]. Further, the consequences of nudging can regularly be complemented with interventions which are long lasting in nature – interventions that increase longer-term adherence to a chore at hand[12]. There have been many researchers in this area that have suggested an array of different methods. One of these techniques is the application of gamification. It's far feasible to employ gamification as an effective instrument to subtly disseminate information and try to change behaviours. Games have a robust capacity of offering a sense of agency to the players, making them experience, empowered and given them the impression that their decisions are significant and will have an impact. A sense of urgency refers to the subjective cognizance that is initiating, executing and controlling one's own volitional actions [29].

## 4. Methodology

### 4.1 Reconnaissance Survey, data collection and statistical analysis

The methods of research used in this study were both quantitative where data gathered from the participants were analysed using statistical package for social scientists (SPSS) to produce graphs and qualitative method such as interview, roundtable discussions and review of existing game applications as well as review of conference proceedings such as the European Conference on Game Based Learning 2015, 2016 and 2017 editions and Pacific Asia Conference on Information Systems, 2016 and journal articles from Elsevier, Springer, IEEE and Taylor and

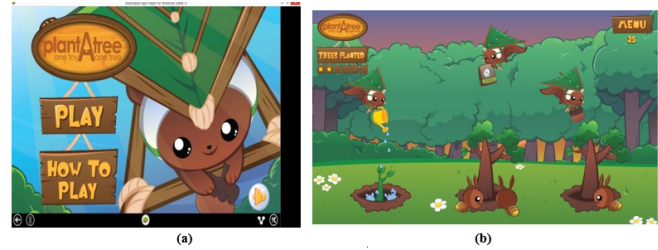
Francis was done. This was done to make sure that the study would be based on enough academic merit and also choose and propose a good model for the study.

Twenty Forestry Commission officers from the Forestry Services Commission in the Brong Ahafo Region and Twenty opinion leaders from five selected communities (Dumasua, Tanoso, Fiapre and Dumase) were purposely selected within the scope of the study for data collection. This selection was done because as Forestry officers it is expected that they would have adequate knowledge in the area of the research and be able to provide the needed information for the study. Since the study was on influencing behaviours towards afforestation, it was prudent for the researchers to contact people who are already in the forestry business. The opinion leaders from the selected communities were also selected because of their influence on their people. The community sees them as role models and hold them in high esteem. The views of these opinion leaders therefore could be regarded as representative enough to be the views of the communities they represent, as they can also advice and teach their members about the various ways of promoting afforestation.

The authors also made sure that participants selected for the study were technologically inclined. These selected participants and their institutions were contacted via personal visit to their various workplaces, towns and villages, email and through phone calls. This was done using an official and standard description to explain the aims and objectives of the research project to the selected participants. A workshop was held to demonstrate and teach the participants on how to use the two game base applications namely; “Plant A Tree” adapted from [30] shown in fig.1 and “Save Trees” also adapted from [31] also shown in fig.2 in order to gather data on causes of deforestation and awareness creation programmes being implemented to reduce deforestation. The collected data was analysed using SPSS 16th edition to rank the causes of deforestation and awareness creation levels based on the responses collected from the 40 respondents for the study, which was later put in percentages. Regression analysis was subsequently performed on these two datasets to evaluate the relationship between the causes of deforestation and level of awareness creation. This regression analysis was to determine the effect that the awareness creation had on the causes of deforestation in the environment.

#### 4.2 Sample Interface the two adapted Games App

This informed the researchers about how to redesign, modify, and validate the application going forward. The modified five steps-processes for applying gamification in education proposed by [12] shown in fig.3 was adapted. The concept of gamification and how one can explore its importance in natural resources management was also explained to the participants. The participants were allowed to comment- on the application, the concept



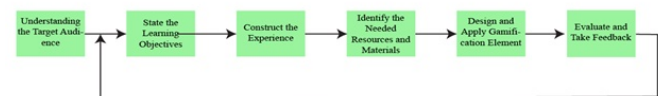
**Figure 1.** Sample screen shots of the game application “Plant A Tree” [30]



**Figure 2.** Sample screenshot of the game application “SAVE TREES”[31]

behind it and make suggestions that were considered to identify possible areas for gamification in the management of our lands and forest and also propose ideas for potential games.

#### 4.3 The Modified Model Used for the Study



**Figure 3.** The Modified five steps-processes for applying gamification in Education proposed by Huang and Soman (2013) [12]

#### 4.4 Components and Application of the Model

The following explains the various components of the modified model used for the study.

- Understand the Target Audience and Context: A key factor that determines the success of any application is to have a good knowledge of your target users. Proper knowledge level of the participants with respect to awareness and causes afforestation helped the researchers to determine factors like age group, learning capacities and current knowledge. The Information Technology literacy level of the participants was also analysed during this step.

- **State the Learning Objectives:** The objectives that the authors want to achieve at the end of the study were also taking into consideration at this stage. This included the main and specific objectives. The main objective was to create awareness of afforestation among FC staff and citizens using gamification.

- **Construct the Experience:** Background and participants previous experience with games was considered at this stage. This serves as the bases for the choice, design, and application of the game Application. Participants experience the causes and how to create afforestation awareness of was noted as well.

- **Identify the needed resources:** After preparing the experience, the authors easily suggested the needed materials and resources needed. This enabled the authors to know the type of game mechanics and elements such as points, badges, leaderboards, level, feedback, challenges, [4], [32] and technologies needed.

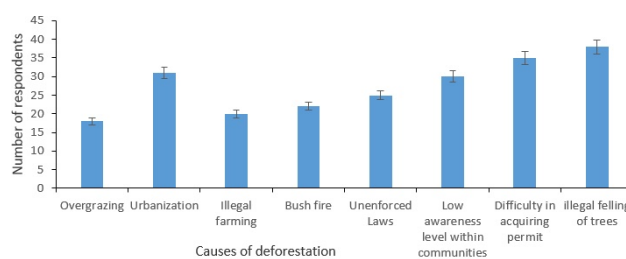
- **Design and Apply Gamification Elements:** The actual gamification process for promoting afforestation for Sustainable Communities was initiated here. This is where the actual adoption and modification of the game App using android studio version 2.2.1.0 on a windows platform with its elements was done. The Application was tested by the participants.

- **Evaluation and Feedback Taking:** Evaluation involves the collection of information about the activities or action, in order to determine its merits or otherwise. The aim was to determine the relevance stated objectives and also test the impact and sustainability of the application of gamification in promoting afforestation. The suggestions and comments from the participants which served as feedback were done to assist the authors in constructing new objectives and content in order to modify the game App going forward. The modified model is now in a loop form which gives room for feedback taking to be used as a new input.

## 5. Results and Discussion

The following captured the remarks concerning the two games used for the study. In the application of the two games, the general consensus was that there would be the need to incorporate different game mechanics and elements to enhance the educational aspect of the game in influencing the behaviours of those who would interact with it. Some general causes of deforestation gleaned from the workshop and interactions were categorized according to their severity and graded as very severe to severe according to the responses obtained from the participants. Results from the grading has been presented in Fig. 4 and were rated as described earlier in descending order of illegal felling of trees, difficulty in acquiring permits, urbanisation, and low level of awareness of the

long-term actions, unenforced laws, rampant bushfires, illegal farming and overgrazing, showing standard errors of the sampled respondents from the population.



**Figure 4.** Causes of deforestation as ranked by respondents

The high level of illegal felling of trees was attributed to unemployment in the communities and difficulty in acquiring permits by chainsaw operators. According to the responses obtained from the participants, procedures involved in acquiring such permits are cumbersome, bureaucratic, expensive, and not decentralized. Such procedures according to Battmann and Klum (1993) [24] could generate discrepancies when dealing with measures to reduce illegalities involved in the felling of trees. Possible illegalities may also arise from a low level of awareness creation among indigenes in communities where such activities are prominent [22].

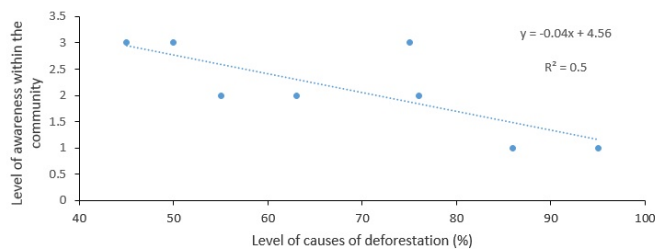
The awareness creation level, according to the respondents, was low and hence deforestation (causes and effect as ranked by respondents and presented in percentages) continues to significantly ( $p < 0.01$ ) increase in the communities (Fig.5 and Table 1) as obtained from the regression analysis to study the cause and effect relationship between awareness creation and rate of deforestation surges. In order to contribute meaningfully to awareness level creation, the concept of gamification is paramount [4]. Thus, the gaming elements of deforestation that would be of importance in the study included those deforestation problems which could more readily be adapted into games. Among these, the issues that could be controlled through modification of human behaviours that were adapted into the game included controlling the grazing habits of cattle, controlled burning of bush to ensure forests safety, and controlled and permitted felling of trees.

According to the results obtained, the most effective means for awareness creation according to the respondents was community education and community involvement (Fig.6). This was closely followed by sanctioning of deviants and implementing the programmes organised under the FC. The Forestry Commission as part of their mandate has introduced certain programmes to increase the forest cover nationwide. Some of these programmes include Ghana forest investment programme (GFIP), natural resources and environmental governance (NREG)

**Table 1.** Correlation between Level of causes of deforestation and awareness creation level in the study area (n = 8)

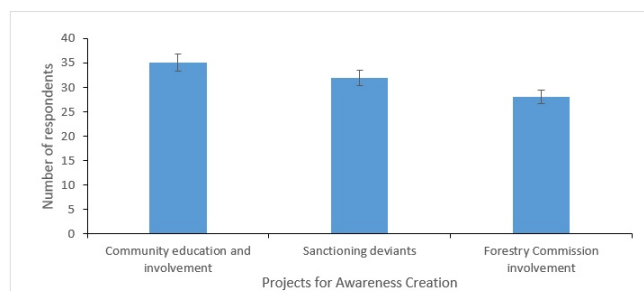
	Variable	Level of causes of deforestation	Level of awareness creation within the community
Level of causes of deforestation	Pearson Correlation	1	-0.920**
	Sig. (2-tailed)		0.001
Level of awareness creation within the community	Pearson Correlation	-0.920**	1
	Sig. (2-tailed)	0.001	

\*\* Correlation is significant at the 0.01 level (2-tailed).



**Figure 5.** Relationship between level of awareness creation and causes of deforestation in the community as ranked by respondents in the study.

and modified taungya system (MTS) as well as trees under cocoa farms. The FC has the power to cause the arrest and arrangement of offending citizens before the courts of the land. The commission lamented that this process is quite counterproductive because of political involvement which weakens the law. The obtained results imply that effective education through gamification plays a major role in changing the way people think and behave in order to achieve a set goal, especially when the people are involved in the core delivery of such education [4]. In this way, they become willing to change any behaviour that might risk their set objectives [12]. Imposing sanctions on deviants may also deter such individuals from felling the trees illegally even though the approach may face setbacks since the interference of top position persons known by such deviants may render the sanctions ineffective. The involvement of FC personnel were rated low since the community involved may think the personnel duties are to green the environment for them (communities) to benefit [32].



**Figure 6.** Grading of projects for awareness creation

To improve upon the concept of gamification for afforestation, the study received a feedback on improving the game to meet intended use for afforestation habits and included weeding, pruning and tending of forests especially when the trees have been initially transplanted. Some other elements that were considered included choosing the right tree species for the available soil types. According to the respondents, some trees do not do well in

some soils and increased investments in those soils would yield little to no benefits. Although the game looked at fertilisation for forests, the respondents advised against that inclusion on the basis that investing in fertilizer for large acres of forests was not economically feasible. In addition, tree species generally planted for afforestation are hardy and do not need fertilizers. According to the participants watering of the plants was required during nursing of the plant seeds at the nursery. Trees are generally planted during the wet seasons to ensure they have adequate moisture to sustain growth. The essential considerations to be made prior to planting the trees are that seedlings would need to be watered, tended, and pruned at the nursery to get the most viable plants for the field, and these measures and suggestions were included the game. All respondents (40) from the FC and the community agreed that gamification could be an effective tool to improve awareness in promoting afforestation.

## 6. Conclusion and Recommendation

Illegal felling of trees is a major cause of deforestation that demands strategic attention to be addressed. Afforestation through awareness creation could be a major breakthrough to arrest deforestation problems. The study revealed that level of awareness creation was highly correlated to the causes of deforestation, thus as awareness level decreases causes of deforestation increase significantly. The concept of gamification could increase awareness creation through education and community involvement thereby decreasing deforestation in communities. The concept was therefore accepted by all participants and was reviewed and validated to meet afforestation needs and standards. The study recommends that future works consider reviewing the number of participants to review and validate the concept of gamification with new models and architecture. The participants should also be given the opportunity to use the Game Application for a set period of time and assess the impacts of the Game Application on their attitude towards afforestation. The components of subsequent games should be updated to reflect conditions pertaining to prevailing deforestation and afforestation issues as well.

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