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Leveraging Gamification for Developing Sustainable Behaviors: Frequently Asked Questions

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Abstract

Gamification is an emerging approach that leverages game design elements to influence user behavior across diverse domains, including health, education, and environmental sustainability. This article addresses fundamental yet thought-provoking questions about the effectiveness of gamification in shaping long-term habits. Through a critical synthesis of existing literature, the article explores how gamification fosters behavioral change—such as increased physical activity, reduced stress, and enhanced self-efficacy—and examines the psychological mechanisms behind these effects. It also considers gamification's adaptability across platforms, its relevance for populations with specific needs (e.g., individuals with ADHD), and its potential for promoting critical thinking rather than superficial engagement. While long-term empirical data remain limited, current applications suggest that gamification holds substantial promise as a tool for cultivating sustainable behaviors. This article offers researchers, educators, and designers a concise, evidence-informed overview of gamification's potential and limitations in advancing sustainable development goals.

Keywords: behavioral change, sustainable development, education technology, user engagement, human-centered design

1. Introduction

The rise in gamification parallels the rise of most modern technology in that it represents a new concept that has most significantly begun to gain momentum in the past decade. Very basic definitions of gamification simplify it to the "use of game design elements in non-game contexts" (Nyström, 2017). Using this definition, gamification has actually been around for much longer. For example, techniques used in gamification, such as persuasion, have been used for about as long as humankind has been around. Persuasion is used to try to change a behavior without coercion or deception (Nyström, 2017). Technology has merely given persuasion a sophisticated vehicle to become more effective in changing behavior.

Gamification's purpose is to change a user's behavior or knowledge in a specific sector. More specifically, gamification engages the user to persuade them to change their habits permanently. In this sense, gamification can be used effectively in various sectors, including health, sustainability, education, and many more. Grendel Games illustrates a successful example of a gamification application on the market currently. Grendel Games is a company based out of the Netherlands that has developed dozens of apps for users to play to gain new knowledge or learn a new skill. These apps include "Wijk & Waterbattle," which teaches the user about sustainable water saving habits, and "Garfield vs. Hot Dog," which teaches children about healthy food habits. These games have proven very effective and engaging within their respective communities of users. Gamification can even help fast-track the UN's widely accepted Sustainable Development Goals, which include SDG 4 - Quality Education, SDG 3 - Good Health and Well-Being, and SDG 12 - Responsible Consumption and Production (Nations, 2022).

This article addresses some fundamental but thought-provoking questions on how effective gamification is on changing users' habits by synthesizing literature on the topic. We argue that although active technological implementation of gamification is a relatively new concept and long-term data is difficult to find, there are enough proven successes on the market to validate an augmentation of the technology. Innovators and entrepreneurs

working on new pedagogies and platforms should use gamification to enhance their processes.

2. What Are the Different Types of Gamification and Game-Based Elements?

It is important to understand different types of gamification and game-based elements to know which aspects are key for the necessary field, specific goal, or desired change. The first major distinction is the use of serious games vs. game-based elements. Serious games are considered more full-fledged designs that are typically intended for a purpose other than entertainment. For example, games designed to teach students keyboarding or math skills represent serious games. They are often found in fields including management, medicine, and policy training, education, and more recently, natural resource and environmental governance. Serious games can also be more complex, therefore limiting the age range of users. Game-based elements, on the other hand, are more general, widely used, and can be applied at any age range. Common elements include avatars, immersive environments, a storyline or narrative, levels, competition and rankings, team play, time limits, and even communication features. For example, points-based reward systems can briefly increase engagement in physical activity despite having little impact on traditional differences in physical activity between boys and girls. However, changing children's eating behavior posed a caveat to that conclusion, noting that rewards could possibly have a negative effect on intrinsic motivation (Ching Yue Chow a, 2020).

When developing any innovations with aspects of gamification, it is important to recognize what elements, strategies, and possible experiences can be the most beneficial for users and the overall goal of the innovation.

3. What Age-Range Does Gamification Work Best for?

There isn't enough research to determine a specific age range that responds best to gamification. Determining which age ranges will participate in gamification represents a more pressing task. Common knowledge and literature inform us that, generally, the younger people will more likely participate in games (Jenny V. Bittner, 2014). Older individuals will likely feel less rewarded by playing a game (Jenny V. Bittner, 2014). Naturally, we would expect gamification to be a popular approach used by schools and businesses to appeal to a younger audience.

Different age groups also feature differing outlooks on life and various motivations. Intrinsic motivations tend to slightly increase with age, while extrinsic ones decrease (Gustavo F. Tondello, 2019). The delineation between intrinsic and extrinsic motivations suggests that an individual's motive to interact with gamified systems will change over their lifetime. For example, students of various ages, when asked to answer a questionnaire that showed their motives behind school grades, showed accomplishment and development were valued among 10th grade students, meanwhile empowerment and social influence were more popular among 7th grade students. In addition, extrinsic motivations will not keep a participant in the game, but it will only draw them to the game initially. More research is required to specify an age-range that works the best with gamification, but younger audiences possess motives that will be towards playing the game. However, if the audiences are too young, they will be mostly motivated extrinsically, and thus, their investment in the app will not last.

4. What Kinds of Behavioral Change Can Gamification Contribute to?

Today, gamification illustrates an increasingly popular medium when designing and developing behavioral change systems in the healthcare domain. Gamification holds the potential to increase physical activity, reduce stress, and improve one's overall self-efficacy (Dominic King, 2013).

Physical activity illustrates a popular area for gamification. This can range from diabetes management apps or persuasive fitness systems. The United States Health and Human Services (HHS) estimates only one in three children are physically active every day, less than 5% of adults participate in physical activity each day, and only 28-34% of adults ages 65-74 are physically active (Council, n.d.), even though the benefits of activity are clear. Physical activity reduces symptoms of depression and anxiety, enhances thinking, learning, and judgment skills, and overall improves well-being (WHO, 2020). The need for humans to become more physically active is clear, with gamification this is more possible than ever. Physical activity competitions can increase physical activity by 23%. Even when it comes to diabetes self-management, gamification has been shown to improve the frequency in blood glucose monitoring (Joseph A Cafazzo, 2012). The persuasive and motivational techniques used in gamified platforms show a clear correlation between their usage and user motivation for better health.

Gamification also shows potential as an effective method towards mental health solutions as well. However, its positive effects are not as straightforward as that of physical activity. One study points out that gamification is indeed being used in a greater range of mental health applications, however it is not being implemented in the behavioral stage, but rather it is only focused on positive reinforcement of behavior. Therefore, more research and games need to be implemented in this sector to draw a complete conclusion on the effects of gamification on

mental health improvements.

As the gamification literature grows and more applications are being developed, it does seem optimistic that gamified technologies will one day improve physical and mental health behaviors equally.

5. Does Gamification Lead to Long-Term Behavioral Change?

Persuasive techniques help gamification lead to long-term behavioral change because it results in users wanting to engage in the action at a deeper level with some intrinsic motivation. For users to develop this intrinsic motivation, they need to truly understand what they are doing and develop their own personalized narrative on why they should do it. In other words, if the gamified environment only emphasizes the points and badges, and users only compete to top the leaderboards, it's not going to be as effective. The challenge then, is to engage users in a way that they don't simply "check off a box," but rather engage with the content and learn. Engaging users with persuasive techniques ensures the users not only complete tasks but enjoy the tasks and understand their importance. The games must be adaptive and punitive, ensuring completion of the task as a successful advancement.

This adaptation of games to users' actions represents a holistic approach to gamification. The game needs to adapt and evolve as the user progresses. If the user stops using the persuasive system, they will revert to their old habits (Nyström, 2017). The program IXL is a program used for various studies including math and language arts. As the user completes games and tasks, they advance in the app, but if they make a mistake they have to go back. This ensures that their learning is thorough and complete. The likelihood of long-term change in habits depends on several factors such as repetition, intrinsic satisfaction, engageability, adaptability, and depth as well as having a holistic view, a metric of success, and proper user participation and design (Nyström, 2017).

ATHWEL is a web-based application that facilitates early intervention for students with learning disabilities and helps them improve their writing, reading, and math skills. It employs points and rewards, and praises students for their performance. It also includes an aptitude test and an adaptive suggestion system. The integration of rewards and tests ensures productive feedback. Levels are personalized to the student, and this personalization represents the very reason why ATHWEL has proven effective in helping students with disabilities learn at a faster rate.

Another mobile game called InSpire PLAY increases users' self-management habits in relation to their asthma. InSpire PLAY helps children (7-14) with self-care through tools such as games with spirometry, quizzes to understand controlling their asthma, geolocation to warn of triggers in an area, charts displaying lung functions, and a credit system with rewards. The tool provides an improved two-way communication system between the patient and the provider, increases the children's motivation, and improves self-efficacy.

Therefore, if the gamified application is built with proper persuasive techniques that grow with the user as they progress, the device can cause sustained habit changes.

6. Gamification and Creativity

The importance of creativity is shown in our society; from authors, artists, entrepreneurs, and even engineers, creativity brings new forms of entertainment, industry, and value-added products that improve human quality of life. Gamification has shown to improve student engagement and motivation in performing complex creative tasks.

Creativity is important not only when it comes to creation but also innovation. When it comes to engineering design projects for electrical and computer engineering students, it may often be difficult to come up with a creative product given such complicated constraints: algorithmic proofs and programming, or mathematical theory (Emily Marasco, 2016). Gamification offers a solution by stirring student creativity and engagement, even for complex theories and algorithms. Game-based projects can be used to develop both technical knowledge and creative problem solving.

While there currently remains a lack of empirical studies supporting the fact that gamification truly leads to an increase in creativity, there is empirical evidence of gamification raising the engagement of the participant and keeping them interested in the process or activity (Nadire Cavus, 2023). Gamification creates a greater sense of engagement to the activity, which increases the likelihood of the person gaining knowledge in that domain. Therefore, it fosters creativity performance which is one of the most important features. Although the direct causation of gamification improving creativity is vague due to the lack of empirical studies, it can be noted that gamification can serve to facilitate levels of creativity.

7. Gamification and Flow

Digital addiction, that is, people spending inordinate amounts of time glued to their smartphones, is detrimental to human health and wellbeing. Digital addiction can lead to neurological complications, psychological disturbances, and social problems (Hilarie Cash, 2012). The gaming community is particularly susceptible to digital addiction

which is believed to lead to bad habits such as poor mental health, reduction in motivation, or escapism. With gamification, however, the concept of addiction can be reframed as "flow," and leveraged to shape positive habits in the longer term. Flow is a behavioral phenomenon where humans lose track of time when they are holistically immersed in the made-up environment of a game. Flow increases focus on the tasks at hand and leads to enhanced lifelong learning habits. There are three components necessary to achieve this state of flow: having a clear goal, unambiguous feedback, and balance of challenges and skills.

Flow does not necessarily lead to negative effects such as poor mental health, reduction in motivation, or escapism usually associated with addiction and as mentioned before. Further, gamification that leverages flow does not lead to antisocial behaviors. In fact, social interactions, irrespective of whether they happen within the made-up world or in the participants' real life, *catalyze* flow. The social connections help participants stay engaged in the task-at-hand and strike a balance between getting bored and feeling overly anxious. Applications that leverage flow often involve competition between users, which leads to positive learning outcomes (Fiona Fui-Hoon Nah, 2014). Team flow, an expansion of this concept, can leverage even stronger group learning outcomes and enhance collaboration. In addition to competition, working collaboratively with a team can enhance interest and efficacy. Flow creates a sense of complete control over one's actions and the outcomes in the game, leading to an all-encompassing concentration on only the game and the objectives. Losing track of time is often a characteristic associated with flow when the attraction to the game is high.

Ultimately, for gamification to be most effective, it must harness flow for positive outcomes while limiting the potential for negative digital addiction. Flow will make the users' habits stick and become more permanent in the long-term (Dongseong Choi, 2004). The gamified application just needs to ensure the habits they are sustaining in their users are beneficial.

8. Does Gamification Work in the Classroom? (Academic Content vs. Life Skills) Is Gamification an Effective Teaching Strategy?

So far, gamification has proved effective in the classroom in various sectors. A literature review done by Hamari and Koivisto shows that gamification yields positive effects in 9 different contexts. The authors wrote specifically about education saying that there was a positive increase in the enjoyment, motivation, and engagement of the participants, but there were negative effects from using gamification in this context, such as increased competition.

In addition, an estimated 50% of startups are incorporating some form of gamification in their products/services, while others (like Codecademy and Duolingo) are solely dedicated to gamifying a skill. Other than education, gamified applications offer users a motive to complete tasks; for example, the app Habitica allows you to set goals and rewards you with upgrades to your character and progress in the game when you complete them. Habitica has 4 million users (Gamify your life, n.d.). Regarding behavioral change, the Fogg Behavior Model states that as long as you converge motivation, ability, and trigger together in a task, you will have long term behavior change (Fogg, 2021). Target demonstrates the application of the Fogg Model because Target installed a system of beeps and green lights as positive reinforcement, which has increased cashier efficiency and employment morale (Patel, 2022). Gamification can be also used to change childrens' habits by rewarding them after completing tasks. Gamifying house chores demonstrates the power of gamification on children, such as when a parent created a 'Game Of Chores' board to inspire everyone in the house to complete chores (Missio, 2016). In addition, using an app like Choremonster makes chores more engaging (Missio, 2016) (Shellenbarger, 2013).

Clear evidence in literature suggests positive outcomes to gamifying learning, whether academically or generally (like playing an instrument or juggling). In terms of behavior change, systems need to be built more carefully to ensure engagement that includes all aspects needed to lead to long-term behavior change. When done correctly, gamification can contribute significantly to positive behavior change.

9. Will Gamification Reduce or Increase Social Interactions/Social Skills in a Learning Setting?

In an age where students rely on short videos for entertainment, it is very hard to keep students attentive and engaged. While gamification may appear to limit progress with social skills, it can contribute to social engagement. Games can encourage collaboration and interaction among students, building teamwork and collective decision-making skills, creating healthier social habits (Ivica Boticki, 2015). Gamification is effective because it gives students rewards (whether intrinsic or extrinsic) to act towards and provides the students the opportunity to interact with each other and work together towards a common goal. During the COVID-19 pandemic, gamification improved participants' engagement, leading to an enhanced overall learning experience.

In looking at how gamification can increase social interactions and/or social skills, it may be helpful to think about the application of this technology in classrooms with autistic children. Through research in the field, it has been

shown that one of the main areas of concern for autistic people is what is called "interaction skill", where non-verbal communication and expressing emotions is difficult (Siti Azreena Mubin, 2019). Gamification can provide motivation to participate in activities that are usually not enjoyable and can lead to progress in areas including social skills.

10. How Does Gamification Transform the Student-Teacher and Peer Relationship?

Gamification not only improves student learning outcomes but also how they learn. As it has been previously established, gamification is a technological tool that can, in an educational context, provide students with another way of learning concepts. In looking at its effect on how students and teachers interact with each other, it is important to think about the role that teachers normally play in the classroom. Teachers instruct students on concepts through lecture-type lessons and oftentimes will employ teaching methods such as ones that appeal to students who may be more perceptive to visual, auditory, verbal and physical learning styles. Gamification, which could be classified as an interactive learning tool, has been, can be utilized as a way to learn and clarify unfamiliar concepts. Teachers can help students when they are using gamified applications just as they would if they were helping students with learning in a more traditional way.

Feeper demonstrates how gamification aids the teachers and students. Feeper is a web-system that aims to help both teachers and their students in classes that pertain to computer programming. Feeper uses gamification elements through the presence of points, badges and rankings. These elements allow for students to have a feel for what their progress in the class is like. Teachers can interact with the platform by assigning exercises to their students. Students can then complete the assignments in the system, and the responses are analyzed through correct outputs that the teachers put into the system. The students are given feedback based on criteria that the teachers created (Rodrigo Smiderle, 2020). Using a system that grades automatically allows for teachers to have more time to address the questions and needs of their students. This focus shift allows for an enhanced teacher-peer relationship by creating easier communication between the two.

11. How Does Gamification Affect Student Motivation?

Motivation represents the impetus of effective learning and sustained behavioral change, especially in younger students, and gamification can create, or induce, that spark. Broadly, gamification and game-based elements in learning and/or changing habits increase student motivation. However, it is important to distinguish between extrinsic and intrinsic motivation. Intrinsic motivation is the drive to do something for the internal satisfaction and gratification of doing said activity (Ching Yue Chow a, 2020). Satisfaction is based on competence, autonomy and relatedness (Ching Yue Chow a, 2020). Extrinsic motivation is the drive to do something for the possible external reward. There is a lack of agreement on whether gamification increases both intrinsic and extrinsic motivation, and on what timescales. Motivation, however, is complex and involves individual, social, and environmental factors (Sun Joo (Grace) Ahn, 2019). With this approach, researchers obtain a more categorical analysis of motivation, which allows teachers, designers, developers, etc. to have a better understanding of how they can implement gamification towards their specific learning goals. When applying gamification to the e-learning process for children with Attention Deficit Hyperactivity Disorder (ADHD), methods can be split into two groups: gamification based on motivation and gamification based on education. In analyzing the "flow" state of an activity, motivation can make players become more involved in a game and lead to increased engagement. Gamification can increase student motivation, but the duration and overall benefit of that increased motivation must continue to be explored, and distinct methods of researching motivation can help that exploration.

12. Potential Long-Term Effects

As noted earlier, current research lacks available data to judge the long-term effects of gamification. Gamification may hold positive long-term effects because of how it incentivizes motivation through the "flow" state of an activity, which can be translated to other educational and occupational goals (Fiona Fui-Hoon Nah, 2014). Potentially negative long-term effects include how not all sectors of life include gamification, so students reliant on gamification at a young age may notice the absence of gamification's ability to create extrinsic motivation based on possible rewards. These long-term effects currently lie in incubation, and this study encourages future research based on longitudinal gamification analyses.

13. Conclusion

Based on the available literature, gamification certainly holds potential in the sustainable learning sector. Currently there exists a lack of literature on the long-term effects and benefits of these types of gamification applications. However, this problem will dissipate in the future as the field and applications become more common in educational and technical fields. However, we have gathered that proper gamification, through educational benefits

and intentions, clear incentives and motivations for the user, and a positive flow, can help students learn better, help people with disabilities, help enhance student-teacher relationships, foster positive competition, and change habits for the better. This field and its research will continue to excitingly involve in the near future.

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Authors contributions

Bishoy Youhana and Allison Duane led the majority of the work on this study under the supervision of Prof. Khanjan Mehta. All authors reviewed and approved the final manuscript.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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