

Gamification of Incentive Spirometer

(Technical Paper)

Analyzing the Social Ramifications of Gamification

(STS Paper)

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Prospectus Introduction

An incentive spirometer is a medical device designed to help patients expand their lungs to enable them to take more full and deep breaths. Typically, the incentive spirometer is provided to a patient after surgery or lung-related illnesses to clear out any secretions in the lungs. The device works by having the patient breathe into the mouthpiece and raising a piston. Ideally, the patient would want to raise the piston to an indicator set by the physician. However, the use of incentive spirometers is not usually monitored by the physician or nurses, which leads to patients neglecting or forgetting about the medical device (Martin et al., 2018). The incentive spirometer's current design is rather uninteresting and monotonous to use causing poor patient adherence.

The technical topic primary aim is to improve patient adherence by adding a gamified element to the incentive spirometer. This gives the team the chance to explore the various trials of creating and designing a medical device, but also witness firsthand the impact the device can make on patient care. The STS paper looks to analyze social ramifications that gamification can lead not just limited to medical devices, but to the settings of education and health.

Technical Project

The incentive spirometer carries a considerable impact on respiratory recovery but is severely underutilized. In a study of 27 patients with chronic obstructive pulmonary disease (COPD) 15 of them used an incentive spirometer alongside medical treatment, while the rest were just given medical treatment (Basoglu et al., 2005). This resulted in the COPD patients that used the incentive spirometer to improve arterial blood gasses and better quality of life. Despite the benefits that the incentive spirometer holds it appears that patients don't use it as much as

they should. In another cross-sectional study, respiratory therapists and nurses were conducted across four national professional organizations - the American Association of Critical Care Nurses, the Academy of Medical-Surgical Nurses, the American Association for Respiratory Care, and the American Society of Peri-Anesthesia Nurses measured patient adherence and application of the incentive spirometer via a survey (Eltorai et al., 2018). A total of 1,681 responses were recorded with 84% of respiratory therapists and nurses in agreement that patient adherence with the incentive of a spirometer was poor and 95.4% saying that an improvement should be made (Eltorai et al., 2018).

The main objective of my project is to improve patient adherence by gamifying the incentive spirometer. Gamifying is an attempt to enhance a system or service by applying typical game elements to encourage engagement with users. To gamify the incentive spirometer, our team is planning on redesigning the medical device using CAD adding a Ferris wheel type element making it more interactive for the patients. The Ferris wheel will also be scooping up balls and depositing them in a location giving the patient something to do as they are using the device. Although the major challenge for this project is the fabrication of the actual prototype because it needs to be easily disassembled so that it can be disinfected and used again. However, once the prototype is finished it will be distributed to patients to receive feedback just in case any redesign is needed. Hopefully, the gamified incentive spirometer will spark more engagement and self-motivation to use the medical device so that patients can recover quicker.

STS Topic

In a book called *Homo Ludens* by Johan Huizinga portrays humans as intrinsically playful and this playfulness is a necessary form of social interaction and cultural development (Huizinga & Eco, 2009). This playful nature that humans possess is being utilized using

gamification in the fields of education and health. The goal of the STS topic is to explore how gamification impacts these fields in various ways.

The purpose of gamifying education is to increase student engagement and promote good classroom behavior. There is a program called The Education Arcade created by MIT for teachers to learn how to implement gamification into their curriculum (Schmitz, 2018). These games that teachers create will help students experiment, explore, and build math and science skills. However, there can be downsides to gamifying education like not celebrating failure. Games are usually designed to only reward people when they succeeded in a task but receive nothing when unsuccessful. This is a bad mindset to teach students to only focus on winning and success when there are lessons to be learned through failure. Another potential downside is that sometimes games aren't designed to include different kinds of players/learners and could often favor one over the other.

Gamifying in health is used to encourage and self-motivate users to be more active and improve overall health. This can be seen in video games such as Wii Fit or the now-current model Ring Fit Adventure that motivate players to do physical activity to progress through the game. Another example would be Fitbit creating challenges and competition for its users to promote more activity. Again, there are cons to gamifying health with one being a lack of standardization with no one tried and true model of gamification that is universally effective (Leyton, 2021). It can also cause achievement pressure if goals aren't being met and their progress becomes stagnant creating a bad mental mindset.

Research Question

If the incentive spirometer is such a helpful medical device, why don't physicians proactively encourage patients to use them? Also, could gamifying medical devices have unintended consequences? Lastly could gamifying jeopardize the larger goal of patient recovery in the trade-off of making it more engaging.

STS Methods

The STS method that would be most applicable is the social construction of technology (SCOT) which argues that technology doesn't shape human actions, but human action shapes technology (Klett, 2018). This suits the project well because the incentive spirometer is neglected even though helpful it does not influence whether a patient will use it. Therefore, this lack of human action drives a change that this technical project is hoping to accomplish.

Methods for Data Collection

Once the prototype is complete the plan is to distribute it to patients at the UVA hospital to obtain consumer feedback. If possible, the team would visit the hospital and observe the prototype in use. Afterward, conduct a short interview with the patient to see what they like about gamified incentive spirometer in comparison to the original one. Although if in-person interviews aren't possible then a survey would be sent out instead to gather data such as the number of times used, patient satisfaction, and ease of use.

Key Texts

To give more validity to the impact of gamification especially in education sector multiple studies were conducted. For one study 139 students at an age range of 18-31 years were surveyed in an undergraduate informatics course about how gamification impacted their learning, achievement, and engagement (Davis et al., 2018). This survey was conducted in the beginning,

middle, and end of the course and the results showed that gamification elements had a positive trend. An interesting note in the study showed that nongaming students had shown less motivation than frequent gamers. Another study was also aimed to evaluate the efficacy of gamification for an IT course (Barna & Fodor, 2017). The course had approximately 2500 students and the gamification elements introduced were reward systems and alternative learning pathways. The results had shown an improvement to course quality, but could not solve all problems in the course. Lastly a study with over 100 undergraduate students on an online course was examined to see if gamified learning would increase engagement and enhance learning (Buckley & Doyle, 2014). The results of the study had expressed generally positive impact, but that impact varies between students whether they are motivated intrinsically or extrinsically.

Conclusion

Overall gamification is designed to increase user engagement by implementing game-like elements to ordinary tasks. This is explored in the technical project seeing how design can influence user interaction, but also being cognizant of unforeseen consequences it may hold in the STS research paper. It's important as engineers to help shape society for the better whether it be through gamification or other means.

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