Rodrigo, M. M. T. et al. (Eds.) (2021). Proceedings of the 29th International Conference on Computers in Education. Asia-Pacific Society for Computers in Education

A RECIPE for Teaching the Sustainable Development Goals

Ma. Mercedes T. RODRIGO*, Walfrido David A. DIY, Abigail Marie T. FAVIS, Francesco U. AMANTE, Janina Carla M. CASTRO, Ingrid Yvonne HERRAS, Juan Carlo F. MALLARI, Kevin Arnel MORA, Johanna Marion R. TORRES & Ma. Assunta C. CUYEGKENG
Ateneo de Manila University, Philippines
*mrodrigo@ateneo.edu

Abstract: Every individual is responsible for sustainable development and therefore awareness of sustainability should begin at a young age, when mindsets and habits are formed. One form which sustainability education takes is computer-based games. We describe how we used Nicholson's Meaningful Gamification framework to design *For People and Planet: An SDG Adventure*, a narrative-based adventure game that teaches middle school children about the United Nations Sustainable Development Goals. In this paper, we describe the framework's six elements--play, exposition, choice, information, engagement, and reflection--and show how our design choices align with these elements.

Keywords: Game design, meaningful gamification, narrative game, sustainable development goals

1. Context

As early as 1972, the Club of Rome's *Limits to Growth* (Meadows et al. 1972) already called for a "world system… that is sustainable." Eventually, there were attempts to reconcile economic development with environmental integrity, leading to the concept of sustainable development (Purvis, Mao, & Robinson, 2019). However, convincing individuals to commit to and act for sustainability is not easy because this often challenges them to sacrifice some convenience and comfort. Awareness about sustainability should start at a young age, when mindsets and habits are being developed. It is also important that individuals view sustainability within their own context because ultimately, sustainability solutions begin with the self.

Most of the sustainability aspirations were articulated in the Millennium Development Goals (MDGs) for the period 2000-2015 (UN, 2015). The MDGs became the starting point for the 17 UN Sustainable Development Goals (SDGs) developed in 2015 "to address urgent global challenges over the next 15 years" (UN, 2016). Based on these goals, the 2030 Agenda for Sustainable Development was crafted as a roadmap involving different players and sectors. After four years of implementation, however, there are gaps in the awareness of these goals and how every sector and every individual could actually contribute to the achievement of the SDGs. While governments are responsible for developing national strategies to fulfill this commitment, all sectors of society must recognize that they too have a role to play in ensuring that the SDGs are achieved.

To help bridge the gap between the general public and the SDGs, different groups have created materials such as the SDG Academy, affiliated with the Sustainable Development Solutions Network (SDSN), which has developed publicly accessible learning modules, generally designed for the adult learner. The World's Largest Lesson, in partnership with the United Nations Children's Fund (UNICEF) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), has developed resources that can be integrated in formal education systems - an important conduit since schools play a role not just in educating students about the SDGs but also in guiding their formation towards the practice of sustainability in their everyday lives (Filho et al., 2019, Nousheen et al., 2020).

Because the 17 SDGs can be overwhelming, the non-profit organization Business for Sustainable Development (formerly Philippine Business for the Environment) clustered them into five

thematic areas: natural capital, food systems, social services, livable communities, and ethics and governance.

However, there is a dearth of materials that show the interconnections of systems, which is inherent to the idea of sustainability, and which can be used for Philippine learners. The purpose of this paper is to describe an attempt to fill in the gap for good sustainability learning materials that would connect, not just cognitively, but also emotionally, to a young Philippine audience. We created a narrative, contextualized, computer-based game and accompanying learning materials that illustrate these five themes. In the succeeding sections, we describe existing sustainability games and how they provided inspiration for our own effort, the theoretical basis for the design decisions that we made, and the ways in which we implemented our instructional messages. This paper does not include the game evaluation because, as of the time of its writing, the evaluation was still ongoing.

2. Existing Games for Sustainability Education

Teaching about the SDGs can be daunting because it requires adjustments in existing curricula and teaching methods (Williamo et al, 2018, Hensley, 2020). Thus, innovative approaches are needed since traditional methods have low engagement, especially with young learners (Prensky, 2006). Using games as an educational tool has been shown to be an efficient approach to explain environment and sustainability related concepts (Bevilacqua et al., 2015; Katsakiali & Mustafee, 2012).

Several games for sustainability education have been developed. The *2030 SDGs Game*, developed by Immacocollabo (Japan) in 2016 is a card game that can be played by 5 to 50 people. It is a simulation game for adult learners (practitioners in government, industry, and other institutions), and is an exercise in collaborative engagement for sustainability (Immacocollabo, 2018). In a similar vein, *The World's Future* is a simulation game also for adult learners that shows the realities and complexities of achieving sustainability given the different contexts and situations that exist (Centre for Systems Solutions - CRS, 2019).

Go Goals is an educational board game for children that introduces them to the 17 SDGs and how these affect their lives. Created by the United Nations, the gameplay is similar to *Snakes and Ladders*, and all materials (board game sheet, dice, tokens, information cards) are downloadable for free (UN, 2019).

Once Upon a Tile is a prototype mobile video game the Android, iOS, Windows Phone, PC, Mac, and Linux platforms. Developed by We Are Muesli, Pietro Polsinelli and Daniele Giardini, the objective of the game is to match resource tiles to achieve peace and sustainable development (We are Muesli, n.d.).

World Rescue, developed by Zu Digital, is a mobile video game for the Android and iOS platforms. The game is meant for a younger audience and is set in Kenya, Norway, Brazil, India, and China. In the game, the player assists non-player characters to solve issues related to displacement, health, deforestation, and pollution (Zu Digital, 2020).

Perhaps the most mainstream game for sustainability is the *Oil Springs* expansion to the popular board game "Settlers of Catan" by Klaus Teubers. In this expansion, developed by Erik Assadourian and Ty Hansen, players have to manage the advantages of having a fossil fuel resource against the potential negative impacts of its extraction and use (Catan GmBH, 2020).

The games we reviewed have several recurring themes. They contextualize the SDGs in the day-to-day and they challenge players to solve problems through proper allocation and management of available resources. The games are not tutorials disguised as games. Rather, they are activity-oriented and they persuade the players the fulfillment of the SDGs is not simply the work of individuals, not just of large institutions. To develop the game described in this paper, we borrow from the game patterns and themes used in prior games, specifically those of contextualization in the day-to-day, problem solving, and empowerment.

3. For People and Planet: An SDG Adventure

For People and Planet: An SDG Adventure is a narrative-based adventure game for the mobile phone or tablet that helps learners see the SDGs in their day-to-day lives. The adventure game genre was chosen because of its emphasis on story and exploration. Players assume the role of a middle school student in a rural community in the Philippines.

The game itself is divided into five (5) stories that can be played in any order. In each story, the player is tasked with performing errands and other everyday activities while also being shown how the community encourages sustainability and maintains their environment. Each story covers an aspect of life and ties it to one or more SDGs. In *What's For Lunch?*, the player is asked to buy food for the family's lunch. Afterwards, the player's grandmother asks for assistance with meal preparation and food waste disposal. In *Flood Fighters*, the player accompanies the grandmother and learns about disaster risk reduction and disaster risk management, both at the community and at the household levels. In *A Walk in the Park*, the player goes to a neighboring town with friends to learn about clean energy and wastewater treatment. On their way to visit the town park's bird sanctuary, the group also makes friends with another visitor who was bullied for her physical disability. In *Work, Work*, the player visits the community enterprise that the grandmother works in. Various employees of the enterprise tell the player about their work, which includes ecotourism in the nearby coastal area. In *Learning is for Everyone*, after attending a theater workshop in school, the player befriends a student with low vision. Together, they search the school for the whereabouts of their grandparents and engage in a variety of activities pertaining to the education system. Gameplay involves exploring areas and playing mini-games to fulfill quests.

Information is presented mostly through small chunks of text accompanied by colorful background images in a format similar to a visual or kinetic novel. Mini-games are designed to be a simple and fun way to break the monotony of reading character dialogue and educational text. Some mini-games also provide an alternative way to present certain lessons. For example, a simplified "hidden object" mini-game is used to present a list of items found in an emergency Go-Bag. As the player progresses, pieces of badges are awarded. Each of the 17 badges represents an SDG.

To assist teachers with the integration of the game in their classes, we also provide a teacher guide. The guide contains a mapping of the various stories with the learning goals stipulated by the Philippines Department of Education. It contains recommended debriefing questions and personal projects that students can undertake to deepen learning.

4. Implementation of Nicholson's RECIPE

Gamification refers to the embedding of game elements such as points, badges, achievements, and leaderboards in non-game, day-to-day activities in order to motivate behavioral change. However, the use of extrinsic rewards, also known as rewards-based gamification, is often unable to produce lasting change. To encourage behaviors, therefore, Nicholson (2015) recommends the use of game design elements that increase intrinsic motivation or meaningful gamification. Meaningful gamification refers to the use of game elements that will enable users to connect a game experience with their own beliefs and allow the transformation of these beliefs, leading to lasting change.

Since the experience we are creating is a game in itself, it may therefore be said that a gamification framework is inappropriate because we are not in fact layering game elements, whether intrinsic or extrinsic, on an existing real-world system. Game-based learning, referring to the creation or use of a game to drive home a specific instructional message (Ingwersen, 2017), would be more appropriate. However, we found that Nicholson's (2015) six elements apply to games in general and not just gamification specifically. These elements are: Play, Exposition, Choice, Information, Engagement, and Reflection. When reordered, they spell the acronym RECIPE.

4.1 Play

Play refers to voluntary activities that occur within a defined space, e.g. a stadium or a field. Play has rules but also allows for exploration. Play has constraints but allows players to modify those constraints as they progress. Most critically, play is intrinsically rewarding and does not rely on external rewards to drive the activity.

For People and Planet is intended to be a supplement to classroom instruction. It is up to teachers and students whether to use the game or not. Once in the game, players can play stories in any order. They can save their games and continue where they left off. In order to complete each quest and obtain the badge pieces, players must play the mini-games at least once. However, the badge piece is awarded regardless of score. In the Waste Segregation mini-game, for example, the player has to put as much trash as possible in the correct bin within a 30-second time limit. Putting the trash in the correct bin increases the player's score but putting the trash in the wrong bin results in penalties. The player can play the game earnestly or can simply let the time run out. In either case, the player earns the plot item needed to complete the quest and the plot item stays in the player's inventory even if the player replays the story. This was a design choice made for players who would like to replay the story but not the mini-games. Players can choose to replay mini-games to achieve higher scores but these scores are not shared publicly, so this choice is wholly for their own personal satisfaction.

4.2 Exposition

The narrative layer of the game is the *Exposition*. Aside from serving as a backdrop for the game elements, the narrative, if reflective of reality, provides the player with a means of connecting to and understanding the real world. Brand and Knight (2005) identify four dimensions of narrative elements in games: the evoked narrative, the enacted narrative, the embedded narrative, and the emergent narrative. The evoked narrative refers to a pre-existing mythology or franchise in which the game is rooted. The enacted narrative is the delivery of the narrative through game elements and cut scenes. Embedded narratives are the backstories that the player discovers in the course of interacting with the game. Finally, the emergent narrative is the story that the player constructs by making meaningful choices while playing.

For People and Planet is an original work with no roots in prior mythology. However, the game scenarios are drawn in day-to-day life experiences, so we may argue that the embedded narrative is day-to-day life in the Philippines. The enacted narratives occur when each of the quests is completed. For example, once the player has helped the farmer Ate Chay, the player receives a basket of fruits and vegetables in a cutscene. The non-player character backstories provide the embedded narrative. In "A Walk in the Park", the player meets Tanya, a young girl with a disability. The player learns that Tanya was the victim of bullying and was wounded because of the incident. The player's decision to take Tanya to a clinic for first aid is an example of an emergent narrative.

4.3 Choice

This leads us to the next element: *Choice*. The player needs to have some control or autonomy over how he/she interacts with the system. In games for learning specifically, learners should ideally have a choice of activities from which they can learn the same concept. Regardless of their goals, learners have to be given guides so as to empower them to reach their goals.

As mentioned earlier, *For People and Planet* does not enforce a sequence of stories. The player is free to move around the game. Furthermore, the game provides multiple opportunities to learn about an SDG and the different paths to achieving it. As shown in Table 1, SDG #3 Good Health and Well-Being is covered in stories four of the five stories while SDG #14 Life Below Water is covered in "What's for Lunch" and "Work, Work".

Narratives and interactions with non-player characters provide the player with support about what to do next. When Ate Chay tells the player, "You see, it's those pests again. I usually get rid of them myself but my back hurts today. How am I supposed to get any work done now?" this cues a mini-game in which the player helps Ate Chay remove the pests from her crop. When the fisherman Manong Max says, "You're here for some fish, aren't you? If you help me with my fishing and ocean cleanup duties, then I'll give you some of today's catch." this leads to two mini-games: one to collect trash from the ocean and another to catch adult (as opposed to juvenile) fish.

4.4 Information

Information refers to game feedback that enables learning about the real-world context as well as the real-world consequences of their choices. Players can receive information through the visual displays

that represent player or world statistics, through dialogs with non-player characters, through the narratives, or even through game mechanics.

For People and Planet integrates information about sustainability throughout the gameplay. The information can precede mini-games or be part of the game mechanics. Before Waste Segregation, for example, the player is told about the importance of segregating household waste. In Pest Control, the player uses a spray bottle with pesticide but the preceding narrative explains that pesticides are one of several ways in which farmers can control pests. In the Go Bag mini-game, the player is prompted to find items that should go into the bag. The items should indeed be part of a go bag such as flashlight, water, and some ready-to-eat food.

4.5 Engagement

Engagement in this context has two definitions: Social engagement which refers to cooperative, collaborative, or competitive interactions with other players that enable discovery and learning, and an engaging game experience in which game difficulty and player skill are well-matched.

For People and Planet is not a multiplayer game nor does it have a social media presence. However, it is intended to be played in a classroom setting or as part of the class. While the game is playable in itself, the intention was for it to be part of a teacher's lesson. This opens the possibility of social engagement with and through the game. Within the game itself, social interaction is simulated through interactions with non-player characters. The player cooperates with friends and relatives in order to achieve the game's goals.

4.6 Reflection

Finally, *Reflection* refers to activities that deepen engagement and learning by assisting participants to find other interests and past experiences that connect with the game. These opportunities usually occur in the form of debriefings that challenge learners to step back and think about the experience.

The game implements this by referring to actual incidents or social realities. In "Flood Fighters", the player's grandmother talks about the disaster wrought by Typhoon Yolanda in 2013 (See Figure 1). In "A Walk in the Park", the narrative shares that people with disabilities are sometimes targets for harassment. Reflection is further encouraged through the recommended activities. Out-of-game reflection is encouraged with debriefing questions and personal projects. One such personal project for "A Walk in the Park" is to try to assess how disabled-friendly a place is. Students are asked, "Are there facilities such as easy-to-use ramps, elevators so that wheelchairs can access upper floors, or passable sidewalks and walkways? If there aren't enough, where do you think these can be added?"

5. Summary and Future Work

In this paper, we described the design and development of a game that teaches about the SDGs that is contextualized in the Philippines. We were motivated by the need for sustainability awareness that is rooted in Filipino scenarios. Nicholson's (2015) RECIPE framework guided our design choices. In this paper, we give examples of how we implemented the principles of Play, Exposition, Choice, Information, Engagement, and Reflection in *For People and Planet*. The research team is currently completing the last few mini-games. In parallel, we are performing a user experience review and completing the teacher resource materials. Once the game and all ancillary materials are completed, we will we will conduct teacher training in the use of the game for classes and will perform a field test with our target learners.

Acknowledgements

We thank our support team composed of Ma. Rosario Madjos, Jose Isidro Beraquit, Rommel Ian De La Cruz, Fr. Johnny Go, SJ, Tomas Falgui, Hakeem Jimenes, Dan Mark Restoles, Toby Rubio, and Jaclyn

Ting Ting Vidal. This work was made possible through the grant entitled, “For People and Planet: Gamified Tutorials for Middle School on Sustainable Development” from the University Research Council of the Ateneo de Manila University.

References

Bevilacqua, M., Ciarapica, F. E., Mazzuto, G., & Paciarotti, C. (2015). “Cook &Teach”: learning by playing. *Journal of Cleaner Production, 106*, 259-271.

Catan GmBH. (1996). *Settlers of Catan* [Board game]. Germany: Catan.

Centre for Systems Solutions. (2019). *The World’s Future*. Retrieved from https://worldsfuture.socialsimulations.org/

Filho, W. L., Shiel, C., Paço, A., Mifsud, M., Ávila, L. V., Brandli, L.L., Molthan-Hill, P., Pace, P., Azeiteiro, U.M., Vargas, V. R., Caeiro, S. (2019). Sustainable Development Goals and sustainability teaching at universities: Falling behind or getting ahead of the pack? *Journal of Cleaner Production. 232*, 285-294.

Hensley, N. (2020). Educating for sustainable development: Cultivating creativity through mindfulness. *Journal of Cleaner Production, 243*, 118542.

Immacocollabo. (2018). 2030 SDG Game. Retrieved from https://2030sdgsgame.com/2030-sdgs-game/

Ingwersen, H. (2017). Gamification vs. game-based learning: What’s the difference? Retrieved from https://blog.capterra.com/gamification-vs-games-based-learning/

Katsaliaki, K., & Mustafee, N. (2012, December). A survey of serious games on sustainable development. In *Proceedings of the 2012 Winter Simulation Conference* (WSC) (pp. 1-13). IEEE.

Meadows, D.H., Meadows, D.L., & Behrens III., J. (1972). *The Limits to Growth*. Washington DC: Universe Books.

Nicholson, S. (2015). A recipe for meaningful gamification. *Gamification in education and business*, 1-20, Springer, Cham.

Nousheen, A., Zai, S. A. Y., Waseem, M., & Khan, S. A. (2020). Education for sustainable development (ESD): Effects of sustainability education on pre-service teachers’ attitude towards sustainable development (SD). *Journal of Cleaner Production, 250*, 119537.

Philippine Business for the Environment (PBE). (2018). SDGs Our Biz. Report on PBE-UNDP project.

Prensky, M. (2006). Don't bother me, Mom, I'm learning! How computer and video games are preparing your kids for 21st century success and how you can help. *St. Paul: Paragon House.*

Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: in search of conceptual origins. *Sustainability science, 14*(3), 681-695.

UN. (2015). The Millenium Development Goals Report. NY: United Nations. Retrieved from https://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf

UN. (2016). The Sustainable Development Goals Report. NY: United Nations. Retrieved from https://unstats.un.org/sdgs/report/2016/The%20Sustainable%20Development%20Goals%20Report%202016.pdf

UN. (2019). *Frieda Makes a Difference: The Sustainable Development Goals and How You Too Can Change the World*. NY: United Nations.

UN. (2019). *Go Goals! Welcome to the SDG Board Game for Children* [Board game]. Retrieved from https://go-goals.org/

We are Muesli (n.d.). Once upon a tile: A (not so) casual puzzle life-sim. Retrieved from https://www.wearemuesli.it/out/

Willamo, R., Helenius, L., Holmström, C., Haapanen, L., Sandström, V., Huotari, E., Kaarre, E., Värre, U., Nuotiomäki, A., Happonen, J., Kolehmainen, L. (2018). Learning how to understand complexity and deal with sustainability challenges – A framework for a comprehensive approach and its application in university education. *Ecological Modelling. 370*, 1-13.

Zu Digital. (2020). *World Rescue*. Retrieved from http://worldrescuegame.com/