SUSTAIN

| Camila Cuesta Arcentales | Caroline “Kiki” Apple | Federico Tondolo |

ABSTRACT

SUSTAIN is a simulation/puzzle game where players focus on caring for a plant by considering the impact of different environmental factors and attempting to strike a balance between them. SUSTAIN explores topics within sustainability, like CO2 emissions and the greenhouse effect, resource waste, the advantages of sustainability, and how one can reduce waste by composting and reuse/recycle techniques. SUSTAIN touches on what it means to have a renewable, balanced ecosystem, and why it is important to care about even the smallest environmental factors to support life. By playing this game, players are familiarized with why renewability is important, sustainable living in general, and how they can make small modifications in their lifestyles/real-life to improve upon their own impact (carbon footprint).

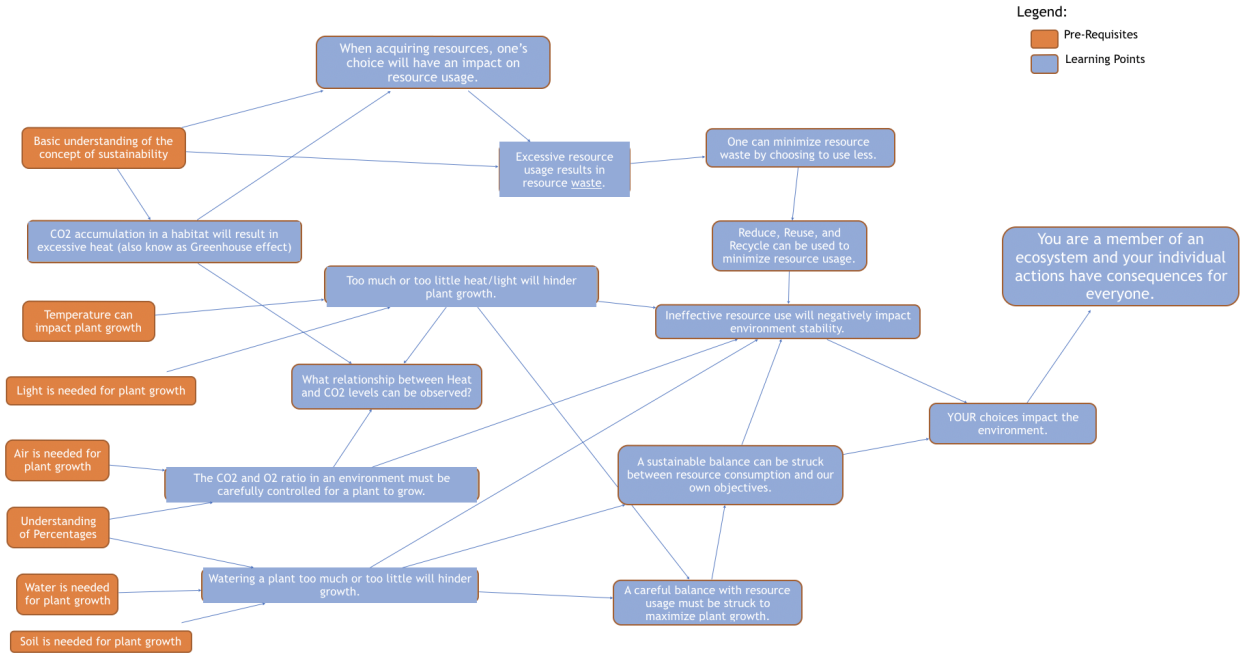
SUSTAIN is designed for a classroom setting, targeting a pre-teen/early teenager age group (ages 11-13), where the game is used by students as a supplement to a course. However, learning objectives can also be reached by an enjoyable independent experience. Caring for plants involves controlling environmental settings like the temperature of the scene, water intake, fertilizer choices, and light sources (natural vs artificial+heated). As a plant grows, the CO2 level in the habitat will also increase or decrease, resulting in fluctuations in environmental temperature, to demonstrate the impact of the greenhouse effect. The CO2 level is susceptible to change depending on the plant species and the interaction between other organisms in the ecosystem.

Game difficulty is increased by gradually introducing more factors into the environment that can affect plant development, directly or indirectly. The game evaluates performance and players’ knowledge by tracking metrics for daily, weekly, and potentially even monthly time-ranges, measuring both the highest overall score and greatest improvement to incentivize progress. The scoring system allows for multiplayer competition, where players try to get the highest scores possible. Furthermore, the scoring system allows for the possibility of easily implementing online multiplayer to allow for synchronous intra-classroom competition. Players ‘build’ their world by personalizing plants with different pots or selecting different backgrounds (wallpaper). The game’s idea of an ecosystem is explicit in including human impact (player’s decisions) as an environmental factor, issues like resource waste can be mitigated by reuse/recycle metrics which award 'spending' points that can be used to improve, expand, or personalize a players’ environment/home location. The multiplayer component allows users to buy or trade items from store or neighbors. However, certain types of activities that might help improve a certain metric can also have a negative impact on another.

SUSTAIN

| Camila Cuesta Arcentales | Caroline “Kiki” Apple | Federico Tondolo |

LEARNING TRAJECTORY



(McDaniel, 2020)

We need to draw a direct correlation between our actions and how they impact the environment. This is not immediately obvious in our everyday lives, so we have created an experience that focuses purely on the cause and effect of our actions within the environment. Our learning trajectory highlights the importance of understanding causality and then proceeding to connect causality to what ways we harm the environment (CO2 emissions and resource wasting). Finally, with an understanding of those causes, we draw a connection to sustainability and the cause + effect of our actions on the environment.

(Olsen-Harbich, 2014)

As students enter middle school it becomes typically the time in their environmental education where the concepts of personal responsibility and impact are first broached. Ideas first explored by experiments tracing one’s carbon footprint and observing the ways in one’s own environment in which greenhouse gases are used are now further explored through simulation. The concept of individual responsibility for one’s actions is highlighted by the self-reflection on one’s resource use, insight on the changing environmental factors’ effects on an organism, and long-term strategic thinking encapsulated in Learning points and needed to succeed at the game

(*Sustainable Schools Project,* 44-50)

Sustainability has the potential to be too abstract for students (and adults), it is important to have anchors in a real world, local context. The Education for Sustainability (EFS) framework has the goal of understanding interconnectedness as “Ecological sustainability.” It is necessary to teach this alongside the goal of “understanding place, the natural and human systems that make up our local communities, both urban or rural,” by this, environmental stewardship is fostered in students. While destruction of the rainforest and toxic waste issues might be too advanced for elementary school because it risks ecophobia (fear and hopelessness in the face of natural disasters), middle school to higher grades are considered appropriate for introducing and exploring these topics.

FIG.1. EFS Framework

When students have an understanding that the world is interconnected, are connected with the natural and human communities that they are part of, and have had opportunities to improve the quality of life in their community here and now, then we are nurturing the development of citizens engaged in creating sustainable communities.

FIG.2. Defining Place: Home to Globe

GAME DESIGN

SUSTAIN is a simulation game where the user is tasked with maintaining a plant’s habitat stability. Ensuring the growth of their organism through the adjustment of a number of environmental variables within the space including fertilizer use, water usage, temperature of the space, and the light (and type of light) the environment is exposed to.

To give an easy to understand medium to understand a player’s relative success at the game’s aim the player is given a sustainability score. This score which is displayed in the game’s primary view is a summation of the many aspects of sustainability which this game

implements including, but not limited to: resource waste, plant growth over time, and relative levels of environmental variables (such as CO2 levels in the habitat).

When SUSTAN is first launched, a player is allowed to create their home-growing environment. They are given a choice of plant pots, wallpapers, plant species, and even minor, and perhaps seasonal, decorations. Moreover, each player is provided with a limited sum of in-game currency (aka ‘Beans’), and while they may be tempted to spend them all on these items, they are forewarned to plan ahead since the Beans will also be of use for resource acquisition later in the game and trading in multiplayer mode.

At this point in the game, the player is also offered a choice in game difficulty by being provided a brief description for each plant species available, discussing the country of origin, fruit/flower production, and preferred climate. More exotic and demanding plants will be harder for the player to nurture and maintain, requiring greater amounts of water, heat, light, and rare fertilizer while also being more intolerant to incorrect dosages of all of the aforementioned. Hence, already at the customization stage the player can begin customizing the game’s challenge to best fit their comfort level.

Difficulty also gradually increases as game play progresses and greater control in the home environment is gradually handed over to the player. At the earliest stages of the game the player merely controls the fertilizer and water available to their plant, all other aspects such as light and temperature being handled automatically. They can spend some of their in-game currency to acquire more water or more/scarcer fertilizer but in doing so they also impact the overall levels of CO2 in the enclosure (to reflect resource waste and the carbon emissions of long-distance shipping). Once the player succeeds in striking a balance in water usage and fertilizer consumption, the game then proceeds to the next ‘level’ and hands the user control over temperature. Having just taught the player about resource waste and usage, by providing them with control over temperature the game then furnishes the user with the tools to break the very balance they just established by causing excessive evaporation with excessively hot conditions or freezing the organism solid. Having the game provide the player with greater control over time results in a process of continuous tweaking of the environmental variables to achieve balance. In this instance, just as water usage is correctly regulated, temperature changes are introduced to alter the equation and break the balance. Now, the player must continually work to strike that balance.

Following this pattern, the last resource which the user is allowed to play with is light. In addition to deciding the luminosity the environment is exposed to, the game also provides artificial light as an alternative to natural light, costing coin and making a plant grow faster in exchange for wasting electricity, raising CO2 levels as per the aforementioned resource-waste metric, while also producing excess heat as artificial lighting tends to do. Indeed, it is this positive feedback loop of increased primary resource usage for increased growth rate which itself results in higher CO2 levels and consequently higher resource usage to maintain stability which makes this final stage of the game the hardest to achieve and maintain.

Once the player has demonstrated mastery of the game’s basic mechanics, maintaining their chosen plant in relative health, the game then allows for a garden to be established. Lifting the one-plant limit of early game the player becomes free to add more organisms to their habitat and create their very own virtual garden filled with whatever plants they choose to put there.

SUSTAIN

| Camila Cuesta Arcentales | Caroline “Kiki” Apple | Federico Tondolo |

This stage in the game is the last ‘structured’ level as from this point onwards difficulty increases in a way directly tied to the player’s own actions as for each plant which is added to the environment difficulty very nearly doubles, the player having to organize the resource partitioning for an entire further organism.

A last thought on difficulty: the non-linear nature of plant growth and environmental relations in general means that as fluctuations in CO2 levels occur during the gameplay inherent to all of the above levels, whether due to excessive use of a rare fertilizer or too rapid growth cascaded by artificial lighting and consequent heating, lulls of relaxed enjoyment in game difficulty are followed by moments of intensely engaging complexity to always keep a player on their toes.

SUSTAIN, however, also possesses Multiplayer functionality. A scoring system exists within the game which, given a time delta, measures relative resource expenditures, growth, and overall instability over said period to extrapolate a ‘sustainability score’ representing their ability to create a stable and thriving environment for life. This score, which can be calculated over a daily, weekly, or even monthly period, and which can be used to track both the overall high score and greatest net improvement (to instill a desire to continue playing), also allows for competition on a both intra and inter-class level, allowing for entire classrooms to play this game as a supplemental educational tool.

To close, SUSTAIN’s online multiplayer functionality allows for players’ plants to co-exist in the same virtual space. By allowing players to visit each other’s gardens and communicate through webchat a virtual sustainable community can be established, communicating the concept that sustainability is a communal endeavour rather than an individual one. In this multiplayer environment, the aforementioned Beans also gain a more prominent role, allowing for the trading, buying, or selling of items or resources between players, teaching environmental cooperation while also engaging users more interested in the mechanics of inventory acquisition and maintenance.

SKILL BUILDING

By playing SUSTAIN, users will learn about photosynthesis and the plant life cycle, sustainability and climate change. As a player advances, they will learn about ways that energy waste, resource waste, CO2 emissions, greenhouse effect, different types of elemental contaminants, and varying soil nutrients affect a whole ecosystem. Environmental factors are introduced sequentially. Observational skills on landscape ecology will enable a player to identify the unknown variables that are affecting their ecosystem. As a player attempts to care for their plant, their knowledge is expanded and challenged by the maintenance of this ever changing ecosystem. In learning to maintain balance within their ecosystem, Players are also challenged to become more self-aware and eco-conscious even as they personalize/customize their ecosystem/home environment because different items are associated with specific industries that have varying degrees of detrimental or beneficial effects. The following few paragraphs will explain the learning trajectory and consequently the skills that the player will develop in greater depth.

SUSTAIN

| Camila Cuesta Arcentales | Caroline “Kiki” Apple | Federico Tondolo |

At the very start of the game, the player begins to learn the basics of how a plant grows and how changing the water intake and fertilizer will affect the sustainability score. The player will constantly be scored on how sustainable their practices are. For example, the more water they give their plant, the higher their resource waste score will be and therefore their sustainability score will lower. After they have mastered this level, they will get control over temperature. Over time, they will get to new levels in which they will have more and more control over their environment. They will then have to rethink their strategies at each level to maximize their sustainability scores. This mimics how we must learn to change our own habits in real life to live the most sustainable life we can live.

As the player continues playing the game and has demonstrated understanding of how a plant grows as well as how their actions impact their sustainability scores, then the game will begin to change the environment settings so that the player must adjust their actions to maintain sustainability. The act of making these small adjustments is a skill that will be developed and repeatedly engrained in the player’s mind as the levels progress. For example, the game may decrease the outside temperature which will then affect the plant’s health. The player can choose whether to let the plant die, increase the heat, provide a heat lamp, etc. Their choice will ultimately impact their sustainability score so the player is challenged to choose the most sustainable option that they can think of. The longer the player plays, the more obstacles they will face in terms of keeping their plant alive while also maintaining a good sustainability score.

In addition, because this game is structured to be played over time, the users will begin to learn how certain habits over time will not be stable ways of living. For example, constantly buying fertilizer will cost them their beans, and if they continue to use this method, they will run out of Beans. However, using homemade compost would be a sustainable and cost-effective method, it just takes longer in the game to produce it (whereas store bought fertilizer is given immediately to the user). This promotes a long-term thinking mindset that explores how sustainable options may not be immediately useful, but over time, they would be the most effective way of life.

In conclusion, one of the main skills we want the user to develop is how to make wise choices in their life to be the most sustainable they can be. They will also learn how to collaborate with others in the Multiplayer mode so that it becomes a group effort to lower resource waste and increase their individual sustainability scores. Lastly, they will be taught to think about long-term solutions to achieving balance in their environment, a mindset and skill that should be encouraged in real life.

BADGE SYSTEM

The badge system which could be implemented in SUSTAIN would allow for badges to be awarded based on the mastery a user achieves over a given element of the game while also providing the advantages of participation and intermediate badges. These badges would be thematically centered around the idea of nature’s elements and would be awarded in response to achievements in areas which reflect the nature of the badge. For example, in very early gameplay the player would be awarded the Earth Badge when they plant and fertilize their first seed. Since this task is accomplished in the game’s own tutorial level, the user having been

guided step-by-step towards its accomplishment, this badge would serve a purpose similar to a participation badge. Specifically, having received this award so early on in the game and independently of the player’s starting skill level, this badge would be giving the user motivation to play on while als rewarding them for having internalized the tutorial’s information at the same time. As the game progresses, unlocking functionality in the habitat by providing control over water usage, light usage, and oversight over CO2 levels, badges would be awarded in their respective order once the user demonstrates control over said variable through its normalization in the habitat. Specifically, when the user would be able to stabilise their water usage within the habitat after being given control of said resource they would receive the Water Badge. When the temperature of the environment is normalized after the introduction of lightbulbs in gameplay the player would receive a Light Badge. Finally, when a stable and low level of CO2 is maintained in the habitat by the player they would receive the Air Badge.

While these ‘elemental’ badges would serve the purpose of achievement badges (and in one case, participation), awards would also be given upon successful maintenance of a plant’s health over a given interval of time. As an example, awards will be distributed for keeping a plant in health for a week or using a personal-record-low level of resources over a given interval. These badges would help to sustain gameplay after the user has achieved mastery over its controls, spurring a competition with the player themselves to keep a plant healthier for longer and with less and less wasted resources.

To complement this badge system a Badge Screen would also be implemented to display all the badges that the player has received in the game thus far and all the badges they have yet to achieve. In this way the player would be better able not only to visualize their achievements in-game as a morale booster but also chart a course towards the badges they have not yet earned creating engagement and motivation.

MOTIVATION

To discuss how our game motivates different kinds of players each with their own unique approach to gameplay, we have broken down this section to focus on a handful of specific player types as discussed by Fullerton (2019), and the ways in which our game was designed for their given motivators.

Competitor

This user type will enjoy the competitive side of the game that is brought about by the leaderboard. The leaderboard will broadcast the top sustainability scores in the class, and the competitive player will always try to be the top on that list. The player will feel more motivated to discover different ways of reducing their resource waste, trading with other players, and developing habits that are more and more sustainable. The leaderboard promotes a deeper engagement with the game that targets the competitive player types. Also, the ability to view other people’s gardens will motivate the competitor to even more to play the game. With the option to see other users’ gardens, the competitor would be inclined to improve their own gardens based on what they see in other people’s gardens. They will want to out-do the other

players and in the act of seeing the progress of their peers and thus they will add more plants or decor to their garden.

Explorer

Would like the world feature that will allow them to explore different cultures and discover new seeds. This kind of player type will feel motivated to use more difficult, exotic plants and will have to learn about the kind of environments in which they grow best. This will offer a challenge to the user because not all plants live in compatible environments. They will be motivated to search for plants that grow in similar climates, soil, etc. and they will curate a garden with interesting and exotic plants. Even if the player does not want to purchase and grow seeds from other parts of the world, they will still want to use the globe feature to read about the relevance of each of the plants to the cultures in which they are grown. While this information is not essential for growing their own sustainable garden, the explorer will want to expand their knowledge about other cultures and will gain a unique appreciation for the environment through their exploration.

Collector

The collector can enjoy this game because as players level up, they have the opportunity to collect more plants and organisms to expand their ecosystems. Since SUSTAIN allows users to make use of (cacao) Beans as currency, the Collector is challenged to improve their ecosystem’s sustainability to generate more and upgrade or personalize their experience. Additionally, since players are able to trade items, a collector has various forms by which to satisfy their interest in gathering objects to improve their experience and performance.

Achiever

SUSTAIN aims to educate players by increasing complexity of the game. An Achiever player type will enjoy the many levels of this game. As the player progresses through the game, their success in maintaining a balanced ecosystem will be measured in a variety of ways: currency, plants, organisms, environmental controls, carbon footprint. An Achiever will appreciate this feedback and aspire to improve their ecosystem. This kind of player will also get motivation from our Badge System and will strive to achieve any of the three different kinds of badges, but in particular the achievement badges.

Joker

The Joker will enjoy the ability to see other players’ gardens because it will allow for some interaction between them and other players. They will find enjoyment from bouncing around from one garden to the next checking out the progress of other players. Additionally, the players will have the ability to chat with the player whose garden they are visiting. The chat box is designed for player types like the Joker who will want to socialize and get to know the other players in their garden.

Director

SUSTAIN

| Camila Cuesta Arcentales | Caroline “Kiki” Apple | Federico Tondolo |

In a manner reminiscent of the Joker player type, Directors will also be engaged by SUSTAIN through its control-oriented game mechanic. Allowing players to shape every aspect of the virtual environment in which the game takes place, from the temperature down to the percentage of carbon dioxide in the simulated ‘atmosphere’. The Director player type loves to be in charge of play which makes them perfect for the simulation genre. Since in this genre a game’s essential mechanic revolves around reacting to the player’s actions in a realistic manner, users have complete control over the speed of gameplay, their actions deciding the rate of the simulation.

Storyteller

Because the Storyteller learns best through stories, SUSTAIN has two different aspects of the game that will intrigue this player. First, the Storyteller will feel motivated to play SUSTAIN due to the world feature through which they will get to learn about other cultures and traditions when they are searching for new seeds. The player can read about each culture and their relationship with a specific plant as well as their overall environment. They will be motivated to learn through other cultures sharing their stories with the game. Second, the process of making their own garden will serve as a way for the player to write their own story in the game. They will have the ability to customize their garden with different plants and decor in a way that makes it feel like their own. This customization aspect of the game allows for the Storyteller to write the story of their very own environment.

DESIGNING FOR USER

In our attempt to design for the user, we have created three different target users of varying skill levels and with radically different backgrounds. We first include a description of the users’ attributes followed by an explanation of how our game has been designed to fit their individual needs in an effort to accommodate as wide a hypothetical user pool as possible.

USER 1

Category: inspired group member(s)
Age: 13
Hobbies: photography, making art, reading sci-fi
Stage of life (e.g. child, teen, single, parent, empty-nester, grandparent): young teen
Personality: extraverted, intellectual, generous/kind
Highest level of mathematical skills: Basic Algebra
Highest level of reading skills: Advanced Elementary
Level of technical skills: Intermediate level
Devices owned: Laptop, Phone
Other relevant skills: coding, debate skills, writing skills
Generations lived in the US: 1st
Cultural background: American upbringing
Gender: Non-Binary

Lack of Skill: This user lacks the general environmental awareness to know how to make a tangible difference on an individual level or why it is important to do so.

This game is designed to be highly compatible with this user and the demographic they represent. Their middle-school level education allows for a foundation of knowledge to be used as a foundation for the game’s learning trajectory. This is multi-faceted, not only has their mathematical education covered the percentages and fractional comparisons needed to understand the mechanics of greenhouse gasses within the game, but also, their limited coding and debate skills provide them with a rudimentary understanding of causality to draw connections between changes in environmental variables and their resultant effects. Furthermore, their American upbringing allows for some assumptions to be made regarding previous knowledge due to the moderate homogeneity of curriculum across public and private educational institutions. For example, while this game is intended to teach many aspects of sustainability, it is not unreasonable to assume given this user’s academic background for them to have at least heard of the ideas of global warming and sustainability, or even just climate change.

Beyond mere compatibility, this game also possesses various elements that are designed to engage this specific audience. An artistic, and generous individual, user 1 will find themselves predisposed to empathize with the concept of nurturing the growth of an organism of their choice. Moreover, their intellectual nature would be occupied by the analysis of cause and effect between destructive human intervention and environmental instability needed to advance in the game. Last but not least, given the lack of any kind of human avatar within the game, the perspective being reminiscent of that of first-person games, while not specifically appealing to a non-binary individual, is a means of removing gender from the equation altogether and thusly not categorizing the player in ways which they might not identify with.

USER 2

Category: not inspired by group member(s)
Age: 15
Hobbies: hanging out with friends, sports (basketball), watching fail videos on youtube, and playing video games
Stage of life (e.g. child, teen, single, parent, empty-nester, grandparent): teen
Personality:Angsty extrovert, confrontational, insecure
Highest level of mathematical skills: Algebra 1
Highest level of reading skills: Analytical reading
Level of technical skills: Intermediate
Devices owned: Laptop, Phone, Tablet
Other relevant skills: Tech savvy, conversationalist
Generations lived in the US: Multiple
Cultural background: Midwestern United States
Gender: Male
Lack of Skills: Due to this user’s lack of familiarity with advanced thematic analysis, some elements of the game should be made more explicit to increase the game’s overall

clarity. Allowing better appreciation of its message. Because of his age and entering high school, this user is probably more self-involved and focused on social and academic pressures so our topic would not immediately interest them.

While it may not seem obvious at first, SUSTAIN appeals to this user’s attributes very well. This player has completed most of (if not all of) elementary school and therefore will have a solid educational background and substantial knowledge of the topics that appear in the game. The prerequisites are satisfied because at this point in their education the user would have been taught basic biology, math, and logic, all of which are necessary for understanding how plants grow, scoring mechanisms, and causality. We are assuming all of these experiences and background points based on their Midwestern American upbringing and through our knowledge of the educational institutions in the Midwest United States. We will also assume that this user has had prior exposure to topics such as sustainability, global warming, and greenhouse gases either through school or through the media. It is a very controversial topic in the current news and around social media, so given the user’s demographics, we are assuming that he has some understanding of environmentalism.

In terms of play within the game, this user would be engaged in multiple different ways based on his personality traits and hobbies. Due to his background in sports and confrontational attitude, we can categorize him as a Competitor player type. As described above, the competitive nature of this user will be satisfied through the leaderboard and scoring system. He will feel motivated to earn the highest score and try his best to consistently be the top name on the leaderboard. He has a social and fun personality which are also traits of the Joker player type. He will most likely engage in the trading/exchange part of the game that connects him with other players and will enjoy having full control over his own environment. The player will easily be able to understand the game, as there is no hidden analytical symbolism to any of the parts of the game, and will find it easy to relate it to his own life. Given that this game is primarily designed for the classroom setting, this player would be participating with his classmates and would engage with the game even though it may not have been his immediate go-to game to play.

USER 3

Category: not inspired by group member(s)
Age: 10
Hobbies: plays mobile games, playing with dolls, musical theater, drawing
Stage of life (e.g. child, teen, single, parent, empty-nester, grandparent): child/pre-teen
Personality: introverted, shy, optimistic, curious, jocose when you get to know her better
Highest level of mathematical skills: Division (long)
Highest level of reading skills: Basic Elementary Level
Level of technical skills: Beginner
Devices owned: none (uses parent’s tablet)
Other relevant skills: imaginative, artistic
Generations lived in the US: 1st (parent’s do not speak English)
Cultural background: English is second language, Phillipino

SUSTAIN

| Camila Cuesta Arcentales | Caroline “Kiki” Apple | Federico Tondolo |

Gender: Female
Lack of Skills Motor skills (along with overall development) are probably more in their infancy so no pinpoint accuracy should be required of the user. This user lacks solid language skills in English, so our game will have to be more visual and intuitive. The user lacks advanced math skills therefore, similarly to language boundaries, we will have to use visual representations rather than complicated numerical values in our game. Also, we are assuming this user does not have a basic understanding of how nature (life, biology, geology, etc) works. Also, most likely lacking experience with video games the user would lack some understanding of the medium as a whole which other users might take for granted, for example, arrow control.

SUSTAIN, as a simulation game, enables players to create their own worlds. The many creative aspects of SUSTAIN, make it a great game for player types like Artist, Director, Performer, Storyteller, and Explorer. Since we know that User 3 enjoys drawing, musical theater, playing with dolls, and is curious, jucose, imaginative, and artistic, it is safe to say that her interests align with the aforementioned player types. The use of graphics and icons with labels make it accessible to somebody who is not familiar with English. SUSTAIN’s emphasis on creating a visual and intuitive experience can allow her parents/family to engage with her performance in the game, and the world that she creates. Her education in math and reading are sufficient for this game as the most complex mathematical tasks require understanding fractions and percentages, but even these concepts have graphics. Given SUSTAIN’s focus on teaching sustainability and ecosystems, that this user lacks an educational background on natural sciences (life, biology, geology, etc), SUSTAIN’s use of levels to increase complexity allows the player to learn as they play. SUSTAIN makes use of simple controls so the technical limitation of this player who does not have a device of her own and instead must use her parent’s tablet, does not greatly affect the experience or ability to interact with the game.

CULTURALLY RELEVANT INSTRUCTION

SUSTAIN seeks to connect the player’s learning experience within the game, with that of their daily and home lives by recognizing that for many, the selection of a plant might be a decision reliant on personal and cultural experiences. Within the game, students have much artististic freedom, they can construct their own aesthetics by picking plants from around the world, and customizing their background with familiar imagery. Backgrounds can be picked from our inventory selection, or uploaded from a personal device. Particularly important to SUSTAIN’s approach to culturally-relevant instruction, is how the game encourages students to ‘Explore the Globe’ and browse through the plants listed as native/common/invasive to different regions around the world, learning about distant plant life alongside that closer to home. In addition to providing students with a wide selection of plants, each of which is accompanied by a short description about the plant, including scientific name, common names, climate, and locations, each also containing a ‘More Information’ section. In ‘More Information’, users are presented with a forum-inspired page where players can share real-life pictures of their plants, care tips, medicinal or artistic applications, and creation/cultural stories, to name a few of its uses next to

external links to scholarly sources. By enabling students to participate in online community-building and discussion, SUSTAIN leverages the unique experiences of its player as contributions of cultural capital to the classroom, and discussion as a vehicle for learning. A section where players can expand and share their knowledge empowers students “intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes” relating to sustainability and environmental stewardship.

UNIVERSAL DESIGN FOR LEARNING

In our game, we will have a Settings page in which the player will be able to alter the game in various ways to be more congruent with their abilities. One option that will be available in the settings page will be to have the colors of the UI inverted, allowing for a different visual of the game. Another option that we will have in our Settings will be to change the size of the game’s fonts. Because it can be difficult to read online, and more specifically small font sizes online, we are adding the option to make the text bigger. This will help not only players with visual impairments but also students who may have a more difficult time reading in general.

In addition to the accessibility features that can be found in the Settings part of our game, we have built in features that are embedded within the design of the game itself that will allow for more players with varying abilities to enjoy the game. First, with every tutorial that we have that includes instructions of any kind, we will have a read aloud button that will read the text to the player when they would like to hear it instead of simply reading it. This helps a multitude of different players that have a more difficult time reading than others, and will allow for those players to get audio assistance while they are learning in the game. The read aloud button will also be available with the feedback that we give to the student to explain their progress in the game as well as in the world feature when students can learn about the different cultures and environment around the globe.

Also, we have many gauges on the primary screen that express how well or poor a player is doing at managing the variables in their environment. For example, the water gauge will provide an indication of whether the player has watered the plant too much or too little. Instead of merely using colors to express these indicators (i.e. red for a bad job and green for a good job), we will be using symbols to indicate meaning. With the water gauge, we will be using a warning sign and not just the color red to show that a plant has not been watered enough or has been watered too much. This sign will be in the form of a triangle with an exclamation point in the middle because that is generally a sign of warning in our daily lives. The game also has a tutorial in the beginning which will walk every player through the icons in the game as well as what they mean and when they appear. This allows for students who may not have the same prior knowledge as others to be able to understand the icons without needing to guess. An example of a player who will benefit from this is one whose first language is not English and who has grown up in a very different cultural home. This player may not have had the same experience with associating an icon with a specific meaning. Therefore, we have added a tutorial to explain these associations to each player.

SUSTAIN

| Camila Cuesta Arcentales | Caroline “Kiki” Apple | Federico Tondolo |

INTELLIGENT SYSTEMS

A very basic way in which our game adjusts to the game’s difficulty to the player’s skill can be observed in the way the game uses the time it takes for the player to achieve certain goals as a way to measure player skill and confidence in-game. If a player has taken a particularly long time to achieve a particular goal, the game will attempt to make itself easier through greater leniency in time-sensitive tasks or less drastic repercussions to environmental adjustments. Contrarily, for a player who breezes through gameplay, the game will adjust itself to be more challenging.

Similar to the intelligent systems we have discussed and seen implemented in class, the basic principle of automatic adjustment based on user skill is present in our game. In a more fleshed out implementation, we would create an algorithm which would keep track in real time of a user’s sustainability score and its fluctuations. By analysing what blunders the user makes to decrease said score, the algorithm could then intuit what concepts of gameplay the player has not fully grasped and what elements the player has mastered. Furthermore, by keeping track of the speed at which a given user attains specific in-game goals, the AI could intuit the player’s relative level in the game and regulate its feedback system accordingly. A comfortable player would not require frequent feedback, indeed it could interrupt the player’s flow and detract from the experience. A less able player would need more frequent feedback to not feel lost or ‘abandoned’ by the game, with the AI adjusting accordingly. With this knowledge, this hypothetical system could then target the player with specific pre-programmed mini-games to help cement these more tenuously learned concepts or smaller on-screen ‘tips’ to highlight minor weaknesses in play. This feedback will be given in the form of blurbs on the screen in the right hand corner so that the player will be able to read (or listen) to it immediately when the intelligent system provides the feedback. Of course, this information would also be automatically relayed back to the player to help them reflect on their own weaknesses.

SUSTAIN

| Camila Cuesta Arcentales | Caroline “Kiki” Apple | Federico Tondolo |

BIBLIOGRAPHY

“The Guide to Education for Sustainability: Sustainable Schools Project.” *The Guide to Education for Sustainability | Sustainable Schools Project*, 2015, sustainableschoolsproject.org/sites/default/files/EFSGuide2015b.pdf.

Mcdaniel, Rhett. “Teaching Sustainability.” *Vanderbilt University*, Vanderbilt University, 30 Mar. 2020, cft.vanderbilt.edu/guides-sub-pages/teaching-sustainability/.

Olsen-Harbich, Emily. “Lesson Plans for Teaching Sustainability.” *Teach For America*, 17 Sept. 2014, www.teachforamerica.org/stories/lesson-plans-for-teaching-sustainability.

Fullerton, Tracy. *Game Design Workshop: a Playcentric Approach to Creating Innovative Games*. CRC Press, 2019.