



Critical Reflection Essay

Rising Children's Sustainable Thinking through Educational Game

Author: Zhou Xia

Student ID: s4384656

Team Name: Team Mars

Date: 17th.June.2019

Abstract:

This essay discuss about how the design of educational game can develop children's environmental awareness and sustainable thinking. By considering human activities & its relationship with environment, meaningful & appropriate education model to children and playful interactive game form, it describes the design process of "ENV Manager", including specific design considerations and decision of this game and evaluations of its values and effectiveness from participates.

1. Introduction:	2
2. Background Survey:	4
2.1 The Impact on Environment by Human Activities:	4
2.2 Environment Awareness & Sustainable Thinking through Education:	4
2.3 Environment Protection Games as a Solution:	5
2.4 Inspirations from Other Related Projects & Technologies:	6
3. Reflection on Design Process and Evaluation of Outcomes	7
3.1 Initial Concept:	7
3.2 Observation Analysis:	8
3.3 Project Development	9
3.3.1 Refinement	9
3.3.2 Summative Justification:	10
3.4 Survey Analysis:	11
4. Conclusion:	12
Reference:	13
Appendix:	14

1. Introduction:

Currently, Earth, this beautiful but vulnerable planet we live in, is facing an increasing number of environmental challenges, including global warming, climate change, ecosystem damage, water shortage and etc. There are multiple factors behind this phenomenon, but human activities play one of the most significant roles in environmental degradation. Therefore, the aim of the overall project is to raise the public environmental awareness and sustainable thinking, thereby changing people's behaviors about saving energy and reusing resources.

The essay will discuss the education-oriented game design of sustainable and environment, in relation to the development of the physical computing installation, namely "ENV manager". Conceived around the concept of exploring playful and open-ended interactions in everyday life, "ENV manager" is designed for target audiences who are children aged 9-12, which can be placed in the classroom as a supplementary tool in order to help teachers educate students to raise their environmental awareness. When players are experiencing this game, they need to balance sensible resource use, sustainable business development and environmental protection. While it is true that a growth in human activities, such as manufacturing, would contribute to a general social and technology development, it is equally true that such activities would negatively influence the environment. In this case, it might be inappropriate that simply stopping development is right. Instead, it is advisable to guide them how to develop in an environmental-friendly and sustainable way.

Although I almost participated in all developing tasks and was allocated contributions equally, my main role in the team is a design lead so I took the responsibility on UI/UX, graphic & conceptual design. My key task was to design the interface (GUI) projected on screen and to construct the structure of physical installations including factory, forest, lorry and panel. Therefore, from the perspective as a designer, the essay will focus on describing the reflection on design process for this game-based installation capable of allowing people to comfortably acquire related knowledge and equipped with an understanding of environmental consciousness. By evaluating the feedbacks according to observations, questionnaire and interviews in the studio and at exhibit. I will reflect on the pros and cons of "ENV Manager" in order to change this project better because it was deemed possible to make the product much more appealing to the user.

2. Background Survey:

2.1 The Impact on Environment by Human Activities:

The first step to design a success project about raising environmental awareness is to do background research, and then requiring in-depth understanding on the theme. Sustainability is defined as the ability of satisfying the demands of current human needs, as well as from coming generations at the same time without damaging. (Purvis, et al. 2018) In fact, it is difficult to achieve due to various of factors as mentioned, especially for human activities, such as growing economic and production needs. Taking chemical industry as an example, it is not only extremely important for the world economy, but also represents a substantial income source for developing countries (Zhu, et al., 2017). In order to operating industrial sectors, an energy use and an overconsumption of materials leads are increasing, then leading to an associated rise of greenhouse gases (Potteiger, et al., 2014). Even worse is that some greenhouse gases, like methane, are emitted solely through human activity and occur naturally in the environment (2014). Consequently, a series of serious environmental problems would surface, including the deterioration of surrounding ecosystems and a quality decrease of the atmospheric environment (Zhu, et al., 2017). Although numerous green approaches are utilized in order to solve environmental problems, these risks sometimes are not properly settle through such approaches. M. Çagatay states , a number of eko initiatives in terms of "green" has been launched by some countries, companies and nonprofit organizations, but these necessary precautions are still insufficient (2017). For instance, existing regulations on controlling atmospheric pollutants, along with enforcement often are not enough in developing countries (Zhu, et al., 2017). As stated above, these reasons given me a strong motivation to design a environmental project.

2.2 Environment Awareness & Sustainable Thinking through Education:

After having a deeper understanding on the problem space, I kept researching on potential available approaches designed for rising environmental awareness. Compared with environmental protection at large provided by governments or organizations, small-scaled ones or individuals seems like only can make limited efforts on it. Indeed, when I was seeking practices, I found it is not always true because they achieved satisfied results in many different aspects, including education and technology.

Mohamed et al. claims that "Environmental education has an effective role in creating healthy awareness and preparing suitable environment for the development and maintenance of human minds. (2016)" The ultimate goal of environmental

education is described by Tuncay, et al. as to encourage “responsible environmental behavior (2012)”, such as reductions in energy use. In addition, according to Uzunboylu, et al., mobile learning has increasingly caught the attention of educators, researchers, and companies developing learning systems and publishing instructional materials because this technology offers the potential and learning opportunities and collaborative interaction for geographically dispersed people and groups (2009). Their study notes that observing deteriorated environments and using mobile telephones to exchange information and transmit pictures in real time is helpful on raising students’ environmental awareness, as well as improving their attitudes toward maintaining clean environments and preventing pollution (2009). By considering that my team expected to design a project with playful interactions, rather than to develop something like purifier which directly reduces air pollution. Combined with these 2 major aspects, they provide me a design opportunity which is an education-oriented project.

2.3 Environment Protection Games as a Solution:

Designers have responsibility to create a better world via thinking about environment problems and developing environmental awareness throughout the country (Deniz, 2016). The following question is how to design a project is both playful and meaningful. I investigated some interesting cases for finding a solution. A so-called Chemical Plant Environment Protection Game (CPEP) is introduced by Zhu, et al., which provides the envisioned game-theoretic model for dealing with interactions between the intelligent adversaries, say “attackers” (the chemical plants) and “defenders” (the inspection agency) (2017). They describe that “the latter attempt to discharge excessive atmospheric pollutants to optimize their payoffs after observing the actions taken by the defender. The task of the defender is to optimize the operating schedules of high-accuracy air quality monitoring stations to achieve more compliance from the chemical plants, and at the same time, to reduce its own operational costs.” In their findings, the results show that playing a CPEP game can not only decrease operational costs of high-accuracy air quality monitoring stations, but also make the chemical plants more compliant towards the inspection agencies (2017). To some extent, their game model adapts the development in sustainable way by reducing business costs and reaching environmental regulations. This environment protection games would become a blueprint for our project somehow.

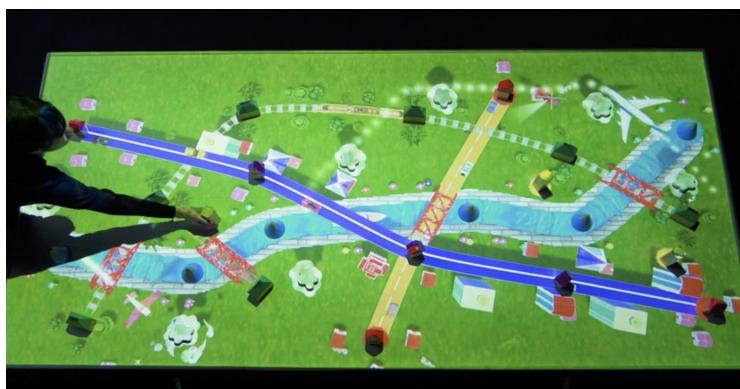
Next, the game background should be discussed. As we all know, manufacturing is highly likely to discharge greenhouse gases. However, because of economic reasons, chemical plants, for example, tend to exhaust excessive atmospheric pollutants without purification treatment in order to maximize their profits (Zhu, et al., 2017). As examined by Potteiger, et al., if greenhouse gases are removed slower than they accumulate, they will accrue in the lower atmosphere and trap energy provided

by the sun, which caused climate variability (2014). These information is set in game background.

2.4 Inspirations from Other Related Projects & Technologies:

After my team decided to develop a game project, I started looking for some existing related game projects and interactive technologies. One interactive artwork called “Connecting ! Block Town” inspired me (see Figure 2.4.1). Participants can move physical wooden blocks to design and connect an evolving system among roads, rivers and railways in order to maintain the ever-increasing traffic flowing smoothly. (SCIENCE FUTURE, 2019), Following this idea, as for our physical interaction paradigm, audience can operate a digital system between factory and forest by controlling corresponding wooden components.

According to the previous statements, I illustrated that pollution is in relation to industry and economic development. The intended experience to players is to promote them to make profits in a environmentally-friendly & sustainable way. Many environmental games are strategic because their gameplay need players to consider multiple elements. For instance, “Play Oil God”, allows players to take on the role of the oil tycoon who wields massive power and intends to teach them the complicated relationship among gas prices, geopolitics, and oil profits. Also, I inspired by other 2 popular Video game, say Overcooked and Plants vs. Zombies. The former requires players to balance the time of preparing ingredients, cooking, serving, and cleaning up. Similarly, the latter requires players to manage costs of sun and plants’ defensive abilities.



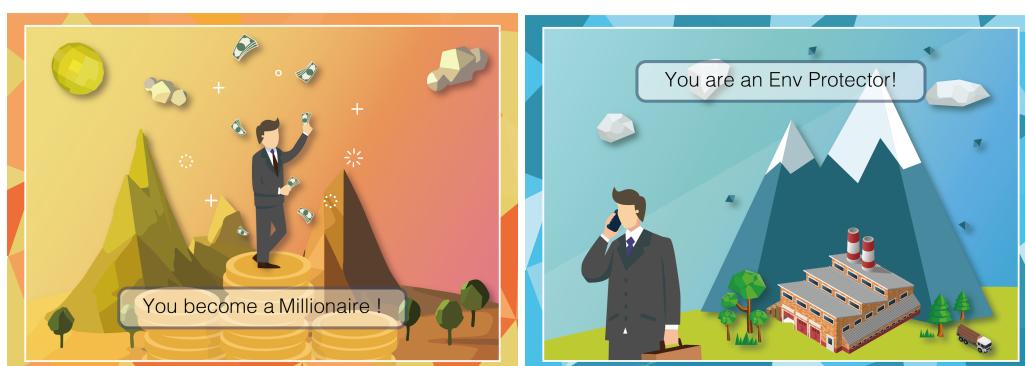
(figure 2.4.1 Connecting ! Block Town)

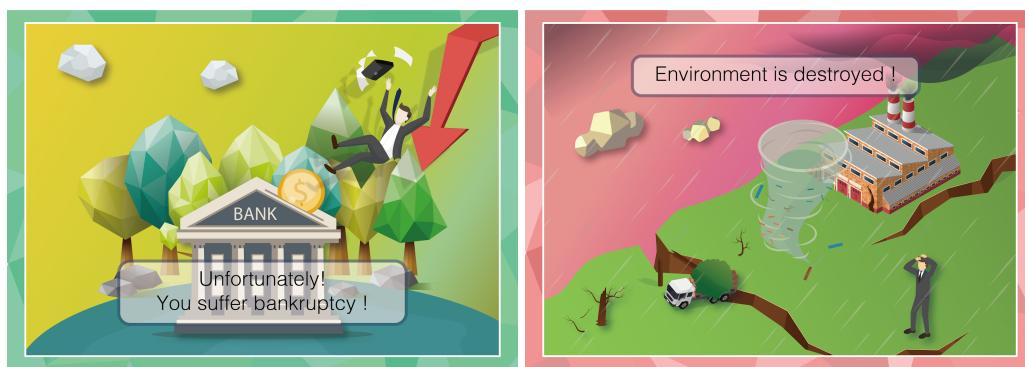
3. Reflection on Design Process and Evaluation of Outcomes

3.1 Initial Concept:

In order to provide intended experience, the design of “ENV manager” should consider factors relevant to the creation of an installation in which people are enjoyable playing an educational game. There are 3 core requirements of this game design. Firstly, players need to create profitable products by increasing efficiency in use resources and minimizing pollution. In other words, they need to balance these 3 factors. Secondly, players should be comfortable and materially educated through their spontaneous decision. Tuncay quotes Allen, who agrees that “if teachers transmit their own values and attitudes to students through environmental education, they will succeed in indoctrination rather than education. (2012)” Hence, the most suitable method help them deal with environmental challenges might is to make their own decisions. That is why the third part is that the game should be open-end. The different endings of the game would alter based on players’ actions and decisions during the game.

Therefore, the initial concept I proposed is to design a single-player game to allow players consume the multi-functional cards for indicating different human activities, including cutting trees & collecting woods, consuming resources, producing goods & making profits and etc. By scanning the card, like QR code at backside, by a machine as physical inputs, and then computing on the game. Once identified, its corresponding effects will apply on game immediately and these effects will be projected on the screen. However, their actions might cause pollutions in the game. For instance, over deforestation will lead to the land desertification. Ideally, Players should control pollutions in order to minimize their impact on the environment. A single card only can be used in each round. When certain rounds end, the game will end. According to the consequence of the card usage, the different endings will be triggered (see Figure 3.1.1).





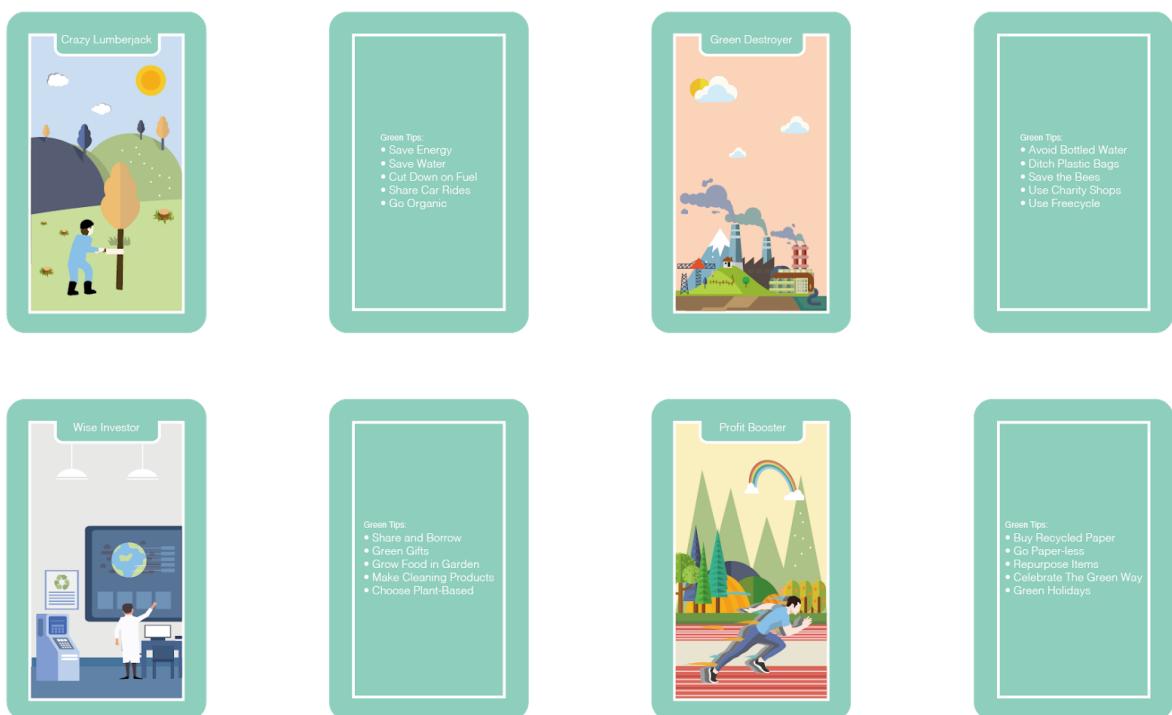
(figure 3.1.1Game endings)

3.2 Observation Analysis:

After my team described the proposal initial on presentation, the feedbacks were received from tutors and audiences. Although most of them believe that using cards is interesting and attractive to children, it is the lack of physical interaction method to control the relationship between human activities and environment. Thus, I should reconsider how to enhance physical interaction with this game meaningfully. Other problem is that single player setting might be inappropriate for this game not only because it is not engage-able, but also it might not represent the real situation. As we all know, the pollutions don't merely come from single individual activities. It also causes by the joint human activities. Therefore, we decided to change the game setting from single player to multiple players.

My team conducted observation and interview to acquire sufficient contextual inquiries. I visited 3 different type of exhibitions in the Brisbane Museum, namely NASA, and Spark Lab and PLAYASAURUS PLACE. The main purposes are understanding children's behavior pattern, examining the initial concept and getting more inspirations from exhibits. The most obvious points is that interactive exhibits which looks cool and fancy (E.g. twinkling lights and lovely music) are highly likely to grab children's attention. As a designer, I need to provide beautiful user interface, vivid animations and sound effect for this game. Also, some decorations (E.g. LED lights) are needed to add on the physical parts. Another finding is that children show a strong ability on understanding relative complicated tasks and willingness on cooperating with their peers. When children interact with these exhibits, it is unnecessary to guide them and provide detailed game rules not only because they usually are capable to figure it out, but also it might deprive them of the pleasure of exploration. Besides, I think that sharing collaborative mission is an useful approach for providing a good experience to such users, so that they feel involved. The reason is that they require to participate in the interaction with exhibits and have communication with their peers. More importantly, collaboration with peers is one of

the interactions that support and promote learning (Johnston, et al., 2018). Moreover, it is more acceptable and straightforward for delivering knowledge to children through experience. 6.32% of the participants report that direct experience with the environmental troubles was important in shaping their moral reasoning (Tuncay, et al., 2012). Thus, I should make the game more immersive and educational. For example, visualization of human activities can be utilized by corresponding animations, thereby experiencing and understanding their impacts on environmental damage. Additionally, if players trigger hidden achievement in the game, cards will be given to them as rewards and some relevant [green tips](#) (2019) written down at the back of cards for embracing environmental protections (see Figure 3.2.1).



(Figure 3.2.1 Cards in double size)

3.3 Project Development:

3.3.1 Refinement:

During the project development process, my team kept improving the concept through iteration of reflection to suit the theme and intended experience.

	Initial Concept	Final Concept
Target Audience	Children aged 6 -12	Children aged 9 - 12

Number of Players	Single Player	Multi-players (2-3 People)
Physical Interaction From	Cards only	Physical Parts, Card Collection
Physical Installation	Wooden sticks	Timber and Dowel
Game Interface Style	Realistic style	Low-poly style
Animations	No	Yes
Sound Effect & BGM	No	Yes
LED Lights	No	Yes

3.3.2 Summative Justification:

- We narrowed down the age group to children 9-12 because two groups behaviour quite differently based on the previous observation analysis. Our project is more suitable for mature and school-aged kids.
- Compared with single player setting, allowing multi-players environment is more active, engageable and collaborative.
- Low-poly style is lovely and more attractive for children (see Figure 3.3.2.1).
- Playing with physical implement is more interactive. Also, in order to encourage players to play until the end and attempt multiple times, cards will be given to participants as rewards.
- Using stronger materials such as timber and dowel rather than wooden sticks can make the physical installation stable and durable (see Figure 3.3.2.2).
- Adding corresponding feedbacks, including animation, sound effect and LED light, can enhance the relationship between digital and physical parts in order to help player understand what will happen in the system after their actions.





(Figure 3.3.2.1 Game interface version, initial & final version comparison)



(Figure 3.3.2.2 Physical installation, initial & final version comparison)

3.4 Survey Analysis:

According to [the survey](#) and final interaction with “ENV Manager”, it is a good opportunity to do user testing. Overall, the public strongly showed an active and appreciating response at exhibit. Most of participants insisted that this game has a good performance on usability, playability and environmental value. As for usability,

most of participants, occupying 67.4%, are able to learn game rules easily and then experiencing with it quickly after we offered a brief instruction and their first attempt (Appendix 3). For playability, 58.8% participants believe that it is a playful and meaningful journey because they are willing to earn profits and prevent pollution (Appendix 6). In addition, participants were delighted to cooperate with their partners and desirable to get reward cards by different endings, say 82.4% and 94.1% respectively (Appendix 11 & 15). In terms of rising environmental awareness, participants claimed that this game conveys such values. When they are playing this game, their main goal is to protect environment and develop in a sustainable way, composed 70.6% (Appendix 18). It seems user experience achieves our expected aims.

After analysing outcomes, there is a main recommendation for future work: This game can be expanded its depth and complexity. Some measures could be taken. Firstly, more types of trees and goods can be added into the game. Each tree or goods has different features. For example, different trees cost different price to plant, but they can solve different degrees or kinds of pollution. Secondly, different terrains can be added, like oceans, to represent more different eco problems, such as water pollution etc. Therefore, users might have a better UX because of balancing more complicate mechanism, and then acquiring more environmental knowledge.

4. Conclusion:

Through the research and reflection on the project development, I have a better understanding on the relationship among resource use, sustainable economic development and environmental protection. Many human activities for social and business growth, such as manufacturing, will negatively affect the environment. Therefore, developing in a sustainable and environmentally way have become more essential today. Education is a helpful approach for rising sustainability and environmental awareness. Learn through play also is an useful method to deliver relevant knowledge to people, particularly to children aged 9-12. To provide a self-exploration platform and avoid drawbacks of indoctrination, "ENV Manager" carefully considered appropriate and acceptable education principles for kids. This game utilize subtle, open-end and interactive form to transmit and facilitate environment values to audiences.

According to feedbacks from audiences, the UI design of "ENV Manager" with low-poly style and graphic design of cards are able to intrigue participants willing to interaction with it. Functionalities are well-integrated between physical and digital parts. Sustainability theme is conveyed effectively by education and engagement is successful by playful and interactive game design. My team achieve the overall purpose, which is rising environment awareness and sustainable thinking.

Reference:

Deniz, Deniz. "Sustainable Thinking And Environmental Awareness Through Design Education". *Procedia Environmental Sciences*, vol 34, 2016, pp. 70-79. Elsevier BV, doi:10.1016/j.proenv.2016.04.008. Accessed 12 June 2019.

"Green Tips For A Cleaner Environment". *World Wildlife Fund*, 2019, Retrieved from <https://www.worldwildlife.org/pages/green-tips-for-a-cleaner-environment>.

Johnston, Kelly, et al. "Supporting Young Children as Digital Citizens: The Importance of Shared Understandings of Technology to Support Integration in Play-Based Learning." *British Journal of Educational Technology*, vol. 49, no. 5, 2018, pp. 896–910.

Potteiger, Kelly, et al. "Sustainability in Athletic Training: A Review of Health Implications Associated with the Environmental Degradation and a Practical Plan for Initiating Green Techniques." *International Journal of Athletic Therapy and Training*, vol. 19, no. 5, 2014, pp. 7–11.

Purvis, B., et al. "Three Pillars of Sustainability: in Search of Conceptual Origins." 2018, pp. Three pillars of sustainability: in search of conceptual origins. Sustainability Science.

SCIENCE FUTURE. "FUTURE WORLD: Where Art Meets Science". *Marinabaysands.Com*, 2019, Retrieved from <https://www.marinabaysands.com/museum/future-world.html>

Tuncay, Busra, et al. "Moral Reasoning Patterns and Influential Factors in the Context of Environmental Problems." *Environmental Education Research*, vol. 18, no. 4, 2012, pp. 485–505.

Uzunboylu, Huseyin, et al. "Using Mobile Learning to Increase Environmental Awareness." *Computers & Education*, vol. 52, no. 2, 2009, pp. 381–389.

M. Çagatay Goktan. "THE ENVIRONMENT AWARENESS IN THE CONTEXT OF ART OF PHOTOGRAPHY." *İdil Sanat Ve Dil Dergisi*, vol. 7, no. 46, 2018, pp. 729–741.

Mohamed, Elagba et al. " Environmental Education and public Awareness." 2016, Retrieved from <https://www.researchgate.net/publication/299389131EnvironmentalEducationandpublicAwareness>

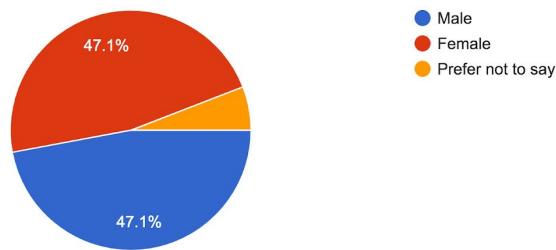
Uzunboylu, Huseyin, et al. "Using Mobile Learning to Increase Environmental Awareness." *Computers & Education*, vol. 52, no. 2, 2009, pp. 381–389.

Zhu, Zhengqiu, et al. "Playing Chemical Plant Environmental Protection Games with Historical Monitoring Data." *International Journal of Environmental Research and Public Health*, vol. 14, no. 10, 2017, pp. International journal of environmental research and public health, September 29, 2017, Vol.14(10).

Appendix:

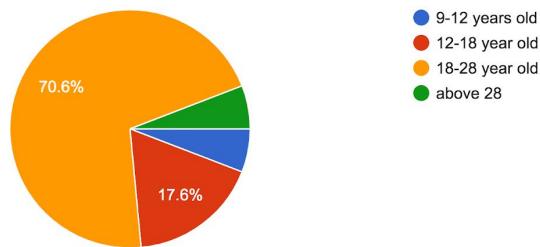
1. What is your gender?

17 responses



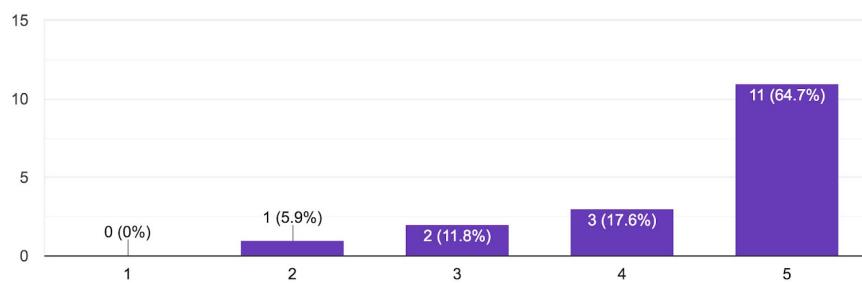
2. How old are you?

17 responses



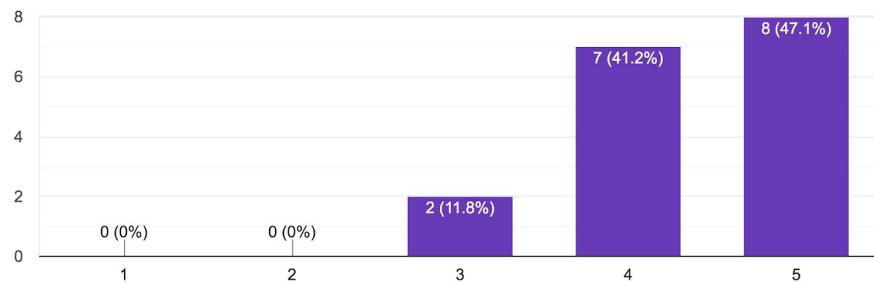
3. I can more easily and quickly playing this game.

17 responses



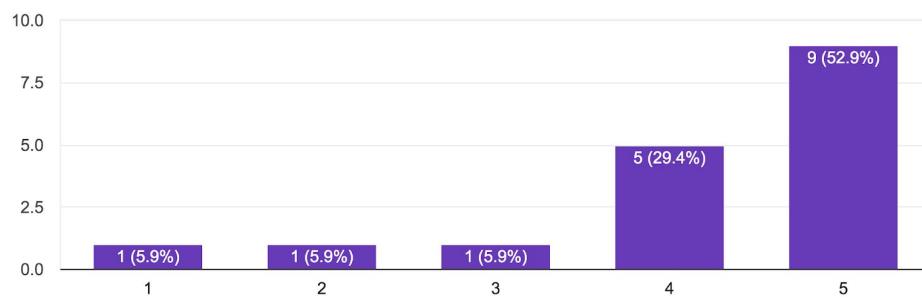
4. This game enables me to make better decisions in managing resources.

17 responses



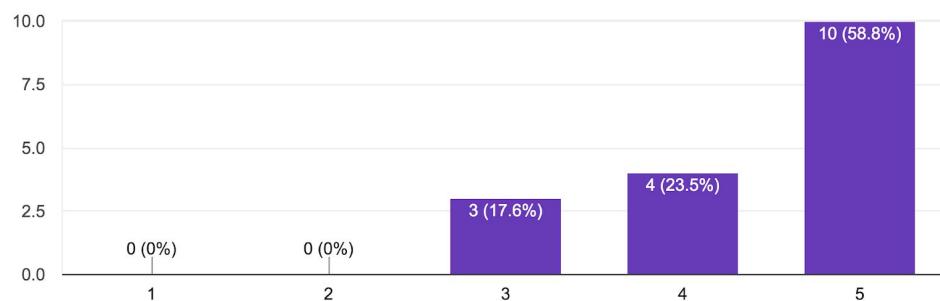
5. Learning to play this game is easy for me.

17 responses



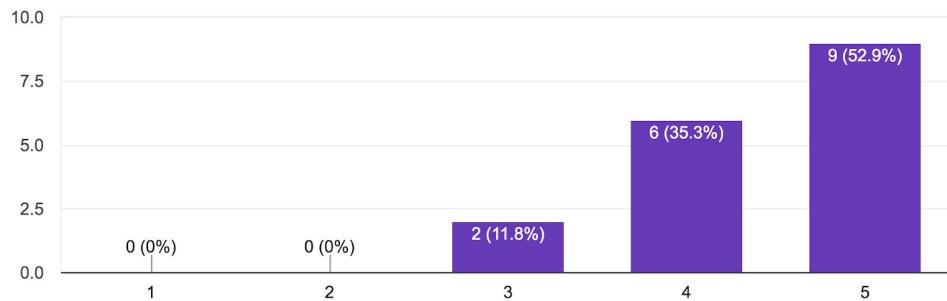
6. In my opinion, it is desirable to play this game.

17 responses



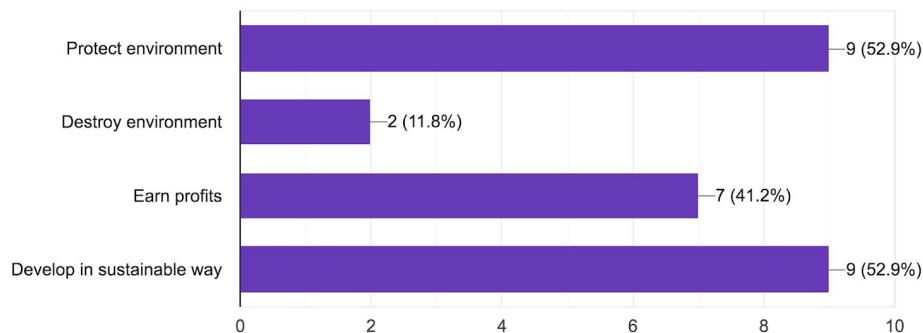
7. I think it is good for me to play this game.

17 responses



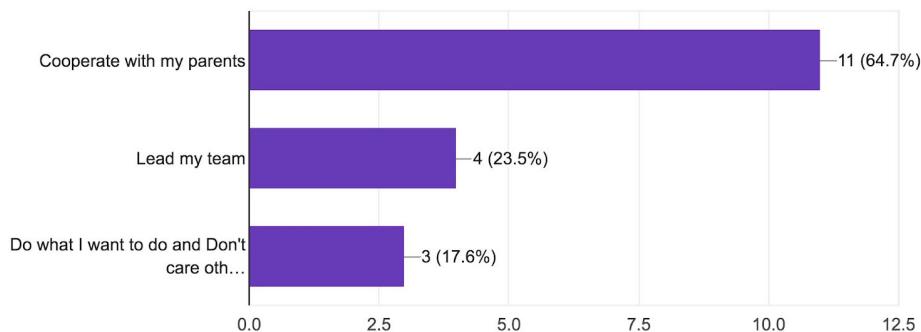
8. What is your goal when you are experiencing the game?

17 responses



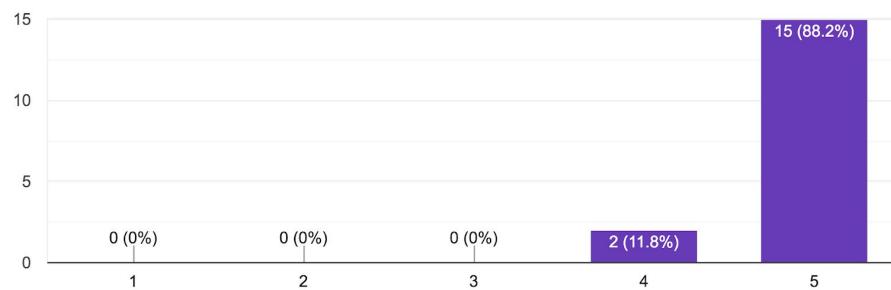
9. Which strategies you used in order to win this game?

17 responses



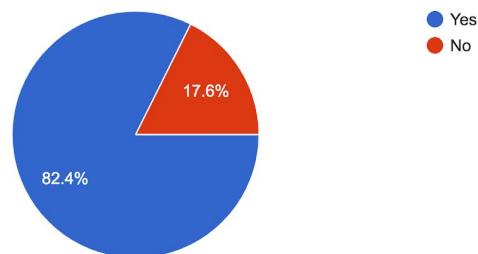
10. Do you satisfied with style & visualization of the game?

17 responses



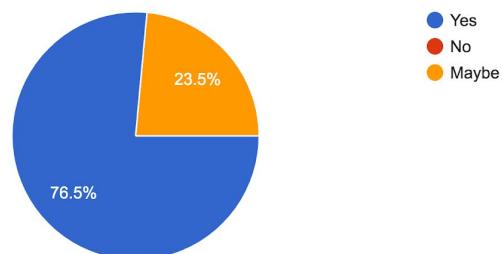
11. Do you enjoy the cooperation with your partners during the game?

17 responses



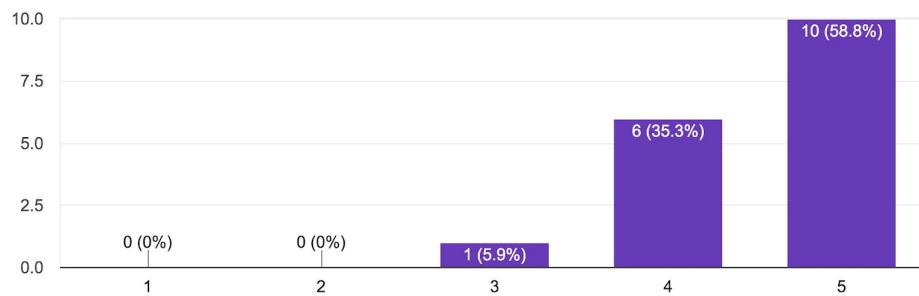
12. Do you think the value changes appropriately represent human behaviors?

17 responses



13. I found each physical input with its corresponding human action were understandable & well integrated?

17 responses



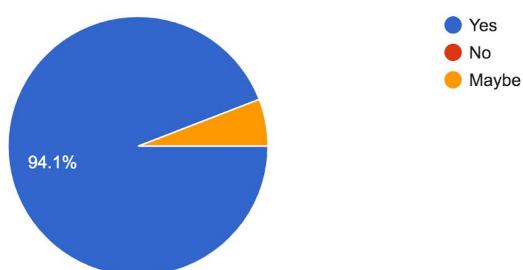
14. Is there anything in the game inconsistent or misdirecting you?

17 responses

no
No
弄
not after the explanation
the button in the factory
position of trees
no, good job!
n/a
the visual aid is perfect
no the your game is great:)
nope, all good

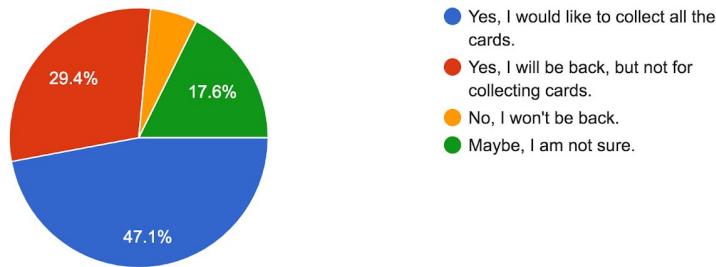
15. Are you satisfied with the reward cards you get?

17 responses



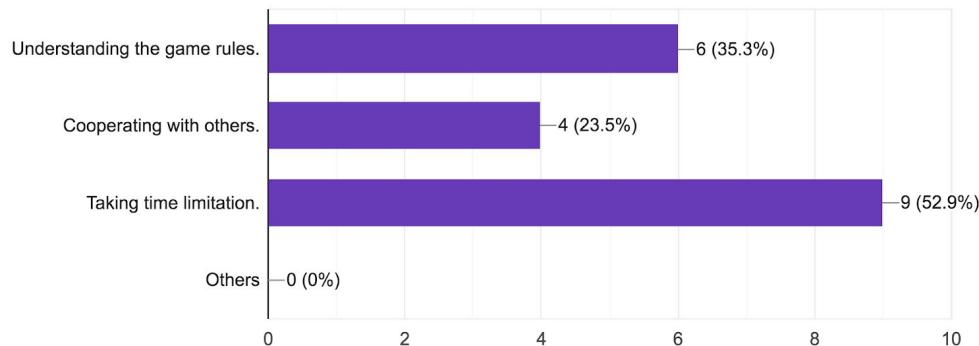
16. After you get cards, will you come back and play the game again for collecting more cards?

17 responses



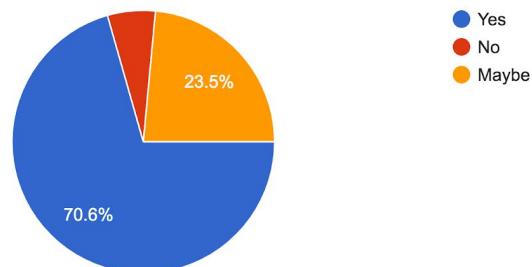
17. Which part(s) do you think it makes the game harder?

17 responses



18. How do you think this game raise your awareness of environment?

17 responses



19. Which functions you expect to add into this game?

6 responses

may be an explanation on what could be the next steps based on what a person wants to achieve

more kinds of trees

more colour

Fires

to be able to farm and not burn tree (growing fruit trees instead of normal trees)

Different terrain

20. More suggestions?

4 responses

nope

no your game was great!! :)

Well done!

providing a thorough and easy game tutorial