Accessible Digital Game on the UN Sustainable Development Goals in Brazil

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ABSTRACT

The purpose of this work aims to discuss the selection and implementation of accessibility resources for the development of an educational game, on the 17 UN Sustainable Development Goals (SDGs), aimed at the school public, which has the provisional name Planeta ODS. In this study, of an applied nature, was adopted as a technical procedure the ex-post-facto research, because it allows analyzing situations that develop naturally after some event. To think about accessibility resources, it was necessary to investigate concepts such as Universal Design, proposed by Mace et al. (1998), Accessibility Barriers in Games by Thomas Westin, Ian Hamilton and Barrie Ellis (2020) and Accessibility Resources for the Xbox Accessibility Guideline. The general objective of this article is to analyze the criteria that need to be developed for a game to be fully accessible. As hypothesis, it is considered that this analysis enables to perceive strong points that the digital games industry has developed in terms of accessibility resources. In addition, it will still be possible to identify gaps to be explored in this field, in order to reduce the exclusion rate of people with deficiency in digital games. As a methodology, it will be made a cross between the predefinitions found and the principles of accessibility and usability. As results found, we verify that the games industry is investing heavily in resources related to the principles of "Information of Easy Perception" and "Equiparable Use" of Universal Design, while it still lacks resources related to the principle of "Flexible Use". We conclude that this work will contribute to prevent the gaps found about the inclusion, of all people, in digital games.

Keywords: Accessibility, Educational games, Digital game, Universal design

INTRODUCTION

In the pandemic environment experienced since 2020, it was observed that the problems related to education were aggravated. The country, which recently reached the universalization of basic education, is faced with historical difficulties of evasion, gap, and growing differences in the levels of student learning. To measure the consequences of the pandemic on education, the World Bank used the concept of learning poverty, an idea similar to the monetary poverty rate. In the Latin American region, considering the impact on

education until the beginning of 2021 and the School closures for 10 months, the population classified under the concept of learning poverty can increase from 55% to 71%. Faced with this scenario and aiming contribute to issues related to the learning gap, the Laboratório de Inclusão e Ergonomia da Universidade Feevale (Laboratory of Inclusion and Ergonomics of the Feevale University) (LABIE) has the task of developing a digital game about the 17 Sustainable Development Goals (SDGs) of the United Nations (UN) oriented at the school public. Therefore, the paper intends to show how was the accessibility implementation process in this game. Accessibility in digital games is established as a way to remove all barriers that could cause the target audience to be excluded from the game. It has the purpose to maintain a challenging experience and, thus, regardless of whether the player has a disability or not, one will be able to finish the game without outside help. Consequently, when LABIE received the task of developing the game, there were not many elements defined, neither the number of stages, nor the platform or format that it should have. However, from the beginning it was specified that it should be an inclusive game. Not directly focused on people with disabilities, but that could be played by as many people as possible regardless of whether they have a disability. The development of this project took place through the Agile Scrum Methodology, which according to Sutherland (2014), one of its creators, part of the term "Scrum"', originated from the game of Rugby and refers to the way a team works together to advance on the field. In other words, it is a methodology about teams, about using highly organized procedures and events, with different names and specificities. It is a methodology that works through constant monitoring, orderly division of tasks and sharing of problems and doubts. This was very important for the development of the project, as the group did not have a delimited list of accessibility features need to be inserted. To achieve that, investigation, research, analysis of similar, and frequent meetings (where each member of the group shared their advances) was needed. In this way, the Agile Scrum Methodology served to organize the meetings and keep the team aligned, thus avoiding rework.

METHODOLOGY

From the point of view of its nature, it is an applied research because it aims to generate knowledge for practical application oriented to solving specific problems. The research seeks to demonstrate the accessibility features implemented in an educational game developed by a small development team. Its interests are sectored and concern people who also want to develop games or understand how they are made. Stem from its objectives, it is configured as explanatory research, which aims to record, analyze, classify and interpret the phenomena studied, as well as assume the central concern of identifying its determining factors (Prodanov & Freitas, 2009). Ex-post-facto research was also adopted as a technical procedure, as it analyzes situations that developed naturally after some event. It is the type of research that studies a phenomenon that has already occurred, and with its documentation, attempts are made to explain and understand it. According to Prodanov and Freitas (2009), the great differential of this procedure is that it observes something

that happens or has already happened, without the intention of taking any action. Therefore, as the accessibility requirements have been chosen yet and are in the implementation phase, the ex-post-facto technical procedure seemed the most appropriate. Then, to think about accessibility resources, it was necessary to investigate concepts such as Universal Design, proposed by Mace, Mueller and Story (1998), accessibility barriers in games by Thomas Westin, Ian Hamilton and Barrie Ellis (2020) also Accessibility Resources by Xbox Accessibility Guideline.

THEORETICAL FUNDAMENTS

Over the last few years, the digital games industry has focused mainly on the possibilities of accessibility expansion, and in the same way, it is possible to perceive an increase in interest on digital games academic field, since there is a greater number of publications on this subject. The main objective of this article is to analyze the criteria that need to be developed for a game to be fully accessible. Therefore, in order to define which accessibility features would be applied, we are using as theoretical foundation the work on accessibility in games by Westin et al. (2019) and the Xbox Accessibility Guideline. Another important definition for the foundation of this work was Universal Design, which aims to develop projects that can be used by everyone: such as children, tall and short adults, the elderly, pregnant women, obese people, people with disabilities or reduced mobility. It applies to products or environments, whether physical or digital. The main concept of Universal Design says that it is not necessary to develop products for a specific group of individuals, but to develop them in a way that can be used universally by anyone. According to Bassani et al. (2010), the American Ron Mace, a wheelchair-bound architect who needed an artificial respirator, created the terminology Universal Design in 1987. In accordance with Carletto and Cambiaghi (2008, p. 12), "Mace believed that this was the emergence not of a new science or style, but the perception of the need to bring together the things we design and produce, making them usable by all people". In this way, our game, as predicted by Universal Design, is not a specialized game for people with disabilities, but a game that can be used by almost everyone, through a large number of resources. Universal Design proposes seven principles that seek to meet the need to organize accessibility into categories regarding possible uses, analysis and even considerations when designing a product, whether physical or digital, public or private (Table 1).

It is important to point out that according to the seven principles of Universal Design, mentioned in Table 1, creating a product that meets these principles does not necessarily mean developing something that will be used in the same way by everyone. Universal Design recognizes that different types of people create a wide variety of ways to use the same product and that is exactly what the first two principles, Equitable Use and Flexibility in Use, refer to. When one says that a product must have Equitable Use for people with different abilities, the proposing is that the product must allow the same mode of use for all users, identical when possible, equivalent when not.

Table 1. Universal design principles. (Table adapted from Mace, Mueller and Story, 1998).

The 7 Principles of Universal Design, according to Mace, Mueller and Story

1. Equitable Use: The design is useful and marketable to people with diverse abilities;
2. Flexibility in Use: The design accommodates a wide range of individual preferences and abilities;
3. Simple and Intuitive Use: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level;
4. Perceptible Information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities;
5. Tolerance for Error: The design minimizes hazards and the adverse consequences of accidental or unintended actions;
6. Low Physical Effort: The design can be used efficiently and comfortably and with a minimum of fatigue;
7. Size and Space for Approach and Use: Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

According to Mace, Mueller and Story (1998), an example is the door handles that go from the top to the bottom of the door, allowing people of different heights or postures to open it. Flexible Use refers to the ability of a product to offer a wide range of preferences regarding its use. A specific example in digital games would be the possibility of reconfiguring the control functions according to the preferences of each player, enable, for example, that all the functions of the control are on a single side of the control, permitting to be used by people who have reduced mobility in one of their hands, or even who do not have one of them. These specific cases show that the concept of universality of Universal Design is not about making each product a kind of Swiss Army knife, with spare parts and functions that will not make sense to those who do not need it, but through its flexible use and equivalences, it has the potential to become more specific to each niche of individuals. Researchers Thomas Westin, Ian Hamilton and Barrie Ellis (2020) draw attention to barriers (table 2) which can hamper the experience in a digital racing game. Although this type of game is very specific and its requirements are not necessarily common to all types of games, they serve to raise awareness to possible problems that lack of accessibility can cause, even for a more general scenario.

Based on Table 2 it is possible to perceive that the authors Thomas Westin, Ian Hamilton and Barrie Ellis (2020) bring up very important points for the debate about accessibility in digital games in general, although they analyzed a specific case of race games. An example is item 10, which refers to the number of laps, position and speed, even though it refers to specific needs of a race game, it is still possible transport easily these items to other areas, as the needed ease of understanding about the status of the user. As well, these 10 items serve as a gateway to understand the types of problems that need to be addressed.

Table 2. Accessibility resources according to Xbox Accessibility Guideline (Table adapted from Mace, Mueller and Story, 1998).

Main barriers in terms of accessibility in digital games
1. Information presented solely through visual aids.
2. Presentation of text, including how it is affected by the background.
3. Language inconsistency and complexity, including clarity of results.
4. Complexity of menu structure and interaction.
5. Interface elements are difficult to select, due to size, movement, or the need to keep a button pressed for some period of time, or the inability to perform actions using standard game controls.
6. Difficulty in distinguishing the player's car from the track and from other cars (color, shape, etc.).
7. The complexity of controls makes them difficult to learn and use.
8. Need for interactions and decision making at very fast speeds.
9. Information about laps, position, speed, etc., difficult to see or understand.
10. The player has difficulty in restarting the game.

THE RESOURCES OF ACCESSIBILITY IN OUR GAME

Table 3 contains the main contents pointed out by the Xbox Accessibility Guideline as essential to provide an accessible experience selected by the team to integrate the accessibility resources to implement the game. The numbers that are next to each item correspond to the seven principles of Universal Design presented in Table 1 - Universal Design Principles.

In this way, it is possible to perceive that in the implementation of "Planeta ods" game, the items in which the accessibility resources most stand out relate to the universal design precepts, which are: perceptible, in the first place, with 10 related accessibility resources; information, equitable use and flexibility in use, secondly, with 7 accessibility resources each; tolerance for error appears in third place, with 6 accessibility resources. for its part, the accessibility aspects related to the simple and intuitive use principles appear in fourth place, with three items each. in the last place, with 2 accessibility aspects, appears the size and space for approach and us. the item low physical effort does not appear in two resources intended for "Planeta ODS" game.

CONCLUSION

The hypothesis of this work was that a detailed analysis of accessibility resources that were inserted in Planeta ODS game - based on the barriers in digital games proposed by Westin, Hamilton and Ellis (2020) and the accessibility resources for the Xbox Accessibility Guideline - could provide a previous possibility of inserting accessibility proposed by a small studio, with a small development group. Given this context, the seven principles of Universal Design are also important for being able to perceive the strong points that the industry has developed in terms of accessibility resources. It is hoped, through game analysis, to identify gaps to be explored in this field, in order to find alternatives to provide a better user experience for gamers with disabilities. In addition, as well, to identify the rate of exclusion in digital games

Table 3. Accessibility resources according to Xbox Accessibility Guideline (adapted from the Xbox Accessibility Guideline).

Accessibility Resources According to Xbox Accessibility Guideline		
Text display	**UI Navigation**	**Contrast**
1. Minimum text size (7) 2. Minimum icon size (7) 3. (Customizable) Scale text size by 200% (2) 4. Non-serif font (4) 5. Width of text blocks (4) 6. Spacing between lines (4) 7. Spacing between paragraphs (4) 8. Spacing between letters (4) 9. Spacing between words (4) 10. (Customizable) Spaces. (two) 11. Texts in high and low boxes (4) 12. Left alignment (4)	1. Consistent ordering of navigation by UI (HUD and menus) (3) 2. Accessibility menu is the first screen of the game (and it is possible to navigate accessible from the initial point) (1) 3. Fully keyboard navigable and control (2) 4. Standardization of menus (5) 5. Visual element indicating the selected location of the UI (5) 6. Contextualize information, terms or actions of buttons, for example (5)	1. Minimum text contrast (4) 2. Minimum contrast in non-textual elements (4) 3. (Customizable) High contrast in texts (2) 4. (Customizable) High contrast in UI (2) 5. (Customizable) High contrast in interactive objects (2)
Screen narration	**Visual, auditory and tactile feedback (vibration)**	**Description in audio**
1. External software or in-game narration (1) 2. Texts, UI, menus, interactive objects (1)	1. Important actions and interactions passed by more than one sense for the user (1) 2. One can adjust the force of the tactile feedback or turn it off (2)	1. Description in cutscenes (1) 2. Character description (1) 3. Description of the scenario (1)
Ease of identifying Target/Story	**Tutorials/Mechanics**	
1. Current objective in screen (5) 2. Objectives completed in menu (5) 3. Review of history in menu (5)	1. Tutorials in audio and thinking in keyboard navigation (3) 2. Mechanics review by menu (3)	

in order to reduce it. Therefore, in a general way, it is possible to say that the initial hypothesis was confirmed and by filling out the table it was really possible to visualize empty areas and, consequently, lacking attention from the games industry on accessibility for players with disabilities. There are no

accessibility resources implemented thus far that are directly related to the "Low Physical Effort" principle, and this is an important point to be analyzed. Many games have challenges that consist of pressing buttons simultaneously and continuing to press them quickly for a certain period of time, an accessibility resource to remove this barrier would be directly related to this point of Universal Design.

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REFERENCES

Bassani, P. B. S; Behar, P. A.; Heidrich, R. O.; Bittencourt, A.; Ortiz, E. (2010) Usabilidade e acessibilidade no desenvolvimento de interfaces para ambientes de educação à distância. Revista Renote, v. 8, n. 1.

Carletto, Ana Claudia & Cambiaghi, Silvana (2008) Desenho universal: um conceito para todos. São Paulo: Mara Gabrilli. Website: https://www.maragabrilli.com.br/wp-content/uploads/2016/01/universal_web-1.pdf.

Mace, R. L., Mueller, J. L., Story, M. F. (1998) The Universal Design File: Designing for People of All Ages and Abilities. Carolina do Norte: North Carolina State University.

Organização das Nações Unidas (ONU) (n.d.) Objetivos de Desenvolvimento Sustentável no Brasil. Brasília: Casa ONU Brasil. Website: https://brasil.un.org/pt-br/sdgs&gt.

Prodanov, Cleber Cristiano and Freitas, Ernani Cesar de (2009) Metodologia do Trabalho Científico: Métodos e Técnicas da Pesquisa e do Trabalho Acadêmico. Novo Hamburgo, RS: Feevale.

Sutherland, Jeff (2014) Scrum: a arte de fazer o dobro do trabalho na metade do tempo. Tradução de Natalie Gerhardt. São Paulo: LeYa.

Westin, Thomas, Hamilton, Ian, Ellis, Barrie (2020) "Game Accessibility: Getting Started 37". In: Dillon, Roberto. The Digital Gaming Handbook. Flórida: RC Press.