



Article

The Pedagogical Value of Creating Accessible Games: A Case Study with Higher Education Students

Carla Sousa ^{*} , José Carlos Neves and Manuel José Damásio

Centre for Research in Applied Communication, Culture, and New Technologies (CICANT), Lusófona University, 1749-024 Lisbon, Portugal; josecsn@ulusofona.pt (J.C.N.); mjdamasio@ulusofona.pt (M.J.D.)

* Correspondence: carla.patricia.sousa@ulusofona.pt

Abstract: The potential of games in empowering underrepresented groups is a central theme in the field of media studies. However, to ensure that everyone can benefit from them, it is necessary to ensure that they are inclusive and accessible. In the present work, we have implemented a Participatory Action Research (PAR) approach to target this problem, right at the stage of training new game designers and game developers. Thus, through a game-design-based or experimental game design pedagogical approach, we intended to promote inclusive and accessibility-driven game design and development skills in students, while decreasing their negative attitudes towards people with Intellectual Disability (pwID). A protocol with a Non-Governmental Organization in the field was established and, during two semesters, students were challenged to develop 10 accessible games and physical interfaces for pwID and motor disabilities, through participatory processes. Pre and post assessment was conducted, through a mixed-method approach. After participating in this process, students reported satisfaction and increased knowledge of cognitive and motor accessibility, and inclusive game design in general. Moreover, the attitudinal assessment showed significantly lower levels of prejudiced beliefs towards pwID ($p < 0.05$).

Keywords: games; accessibility; intellectual disability; game-based learning; higher education; game creation; game design; game development; inclusion



Citation: Sousa, C.; Neves, J.C.; Damásio, M.J. The Pedagogical Value of Creating Accessible Games: A Case Study with Higher Education Students. *Multimodal Technol. Interact.* **2022**, *6*, 10. <https://doi.org/10.3390/mti6020010>

Academic Editors: Edward Melcer and Dominic Kao

Received: 20 December 2021

Accepted: 22 January 2022

Published: 25 January 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Currently, games are increasingly seen as having the potential to provide empowering interactive experiences, enabling the promotion of social inclusion, through adaptable, motivating, and engaging strategies [1]. Nevertheless, as a cultural product, games can also reproduce the socially constructed forms of producing and maintaining power, expanding them for the virtual environment. Therefore, it becomes relevant to critically analyze how games can also be vehicles of exclusion, by expanding social exclusion to the gaming world [2] and responding with more inclusion-driven alternatives.

Intellectual Disability (ID) is a neurodevelopmental disorder that affects both intellectual and adaptive functioning, with transversal impacts in individuals' daily lives, including the conceptual, social, and practical domains. These aspects can include: deficits in intellectual functioning, impacting cognitive abilities, such as reasoning, problem-solving, planning, or abstract thinking; and deficits in adaptive functioning, impacting autonomy, social participation, communication, and daily life in general [3]. Nevertheless, the current models of disability shifted the paradigm, from a medical perspective to the so-called social model of disability. In general terms, the second (and current model) emphasizes how disability is produced, not by an individual impairment, but by society's inability to accommodate and include such an impairment, through accessibility, which produces a devalued life experience [4].

Therefore, it is important to emphasize that, given the cognitive functioning usually associated with ID, not all existing games are effectively playable by this population, which

again highlights the importance of accessibility [5], mainly considered the above-explored social model of disability. Additionally, people with Intellectual Disability (pwID) often have other associated conditions, such as motor disabilities, further driving questions regarding the accessibility of the available digital games [6]. Moreover, if accessibility is not considered a priority in the development process, games can contradict their potential role in social inclusion, by reinforcing the production and dissemination of narratives that are exclusive to dominant groups [7]. In this context, the need to target accessibility at the earlier possible stage, through transformative practices emerges as a key problem.

Considering media accessibility in general, Greco [8] highlighted the need to create a new critical pedagogical approach to the development of accessibility-driven skills in future media creators. This model, described as diversity-based, user-led, proactive-oriented, creativity-driven, and quality-centered, should be based on the avoidance of labels and stereotypes, valuing human variations and including them in the creative process through the voices of their representatives, instead of creators' assumptions based on their functionality. The involvement of the target audience in the production processes is also considered as a strategy for the promotion of accessibility and human dignity through this model [8]. To this extent, previous experiences, in other fields of media development (e.g., filmmaking), have shown the value of accessibility-driven pedagogical practices, both in the developed artifacts [9] and in the development of more inclusion-driven beliefs by students [10]. Moreover, this type of learning outcome is considered to emerge better if the university is framed as the center of knowledge, which works at the service of the civic society as a whole, providing students opportunities to adapt to different environments and challenges, through a value-driven education [11].

1.1. Game-Based Learning and Game Creation

Nowadays, with the adoption of a more student-centered pedagogical paradigm in higher education, games are already documented as feasible and effective learning spaces, supporting the development of transversal knowledge, conceptual understanding, and action-directed learning in a supportive environment [12]. For teaching game design and development specifically, it is difficult to operationally define the frontiers between the subject area of the courses and games as a methodology per se, but practical examples are easily found. For instance, games like *User Inyerface* [13], to trigger reflections about user interface development, or *SweetXheart* [14], to foster reflections on emotion induction through gameplay, and empathy promotion.

Besides learning through games, another relevant contemporary perspective would be the possibility of learning through the design and development of games. According to Kafai and Burke [15], the boundaries between playing games and "making" games are artificial and centered around academic purposes. This division is related to both activities being studied by different scientific fields. From these authors' perspectives, the "tangible side" of game creation also assumes relevance in the present work, considering how it is seen as promoting the emergence of more nuanced views about technology and more spaces for computational participation [15]. Even if their perspective is mainly applied to children, it seems essential to frame both pwID's experience as more accessible and students' experience as more technically integrated due to the development of physical interfaces.

Even though the promotion of accessibility-driven skills through game creation processes is not extensively documented as viable, it is possible to emphasize that it presents some relevant characteristics to this extent. This includes providing a "real world" learning environment based on tangible problems while emphasizing user diversity. Furthermore, such an aspect might be even more relevant if we have, as in the present study, interaction with the target audience that enables the meaningfulness of learning, based on the mutual exchanges between the process of "building something" and "evaluating something" [10]. Therefore, it is possible to approximate the steps of creating a game to the process of critically understanding how to design for accessibility. Moreover, since game creation is known as requiring a transversal comprehension of game features and contents, from

programming to art [16], learning through this path matches the centrality that accessibility must have from an early stage, as previously explored.

Additionally, Project-Based Learning (PBL) premises can also be seen as relevant for the present work since it configures an active student-centered pedagogical proposal. Therefore, students are challenged to build their investigation towards the fulfillment of a goal, while reflecting on real-world problems and practices [17]. Here, empathy is also seen as crucial, since it is both central to learning about accessibility [10] and feasible to be promoted through game design and development processes [18,19].

Participatory Action-Research (PAR), as we will explore below, is seen as having the potential to better frame this process, since it is classically defined as a methodological approach to empower the oppressed. Furthermore, it emphasizes process outcomes as a part of social change instead of focusing only on final outcomes [20]. This is seen as favoring an iterative process such as game creation. The mixed methods approach of the present study is also based on these premises by integrating baseline and endline measurements with systematic observations of the development process.

1.2. Methodological Framing

According to Waern and Back [21], although experimental game design can be seen as a regular part of any game design process in an intrinsic manner, it can also be considered a method for academic inquiry. Furthermore, this method does not necessarily aim to produce “good games”, but instead explores design aspects of communication factors that can be considered challenging, such as accessibility. Therefore, it is focused on the process and its exploration and not centered on approaching game design as a controlled scientific experiment.

Aligned with the premises explored by Kafai and Burke [15], this method seems to be increasingly used, even it can appear in the literature through several different designations, including experimental game design [21]; game development-based learning [22]; or game design-based learning [23]. However, despite the designation, these processes seem to have in common the use of game creation-driven processes to explore new development solutions through game design and, very frequently, learn about the process and acquire skills that also transcend it.

Combining the frequent marginalization of people with disabilities in gaming [24,25] and the need to explore the process as research established here, the adoption of PAR principles presented itself as very relevant. PAR can be considered as a specific form of action research defined by the systematic collection of data to implement action, empower change, and generate empirical and scientific evidence [26]. Furthermore, PAR that involves youth has been documented as providing participants with opportunities to learn and broadly contribute to knowledge-producing processes, raising awareness through critical thinking that fosters concrete actions and change [27]. Moreover, it also seems relevant to emphasize the voice of people with disabilities while shaping research to meet their needs, with Quality of Life (QoL) as an ultimate goal [28].

Mixed methods were adopted, considering the increasing relevance attributed to methodological integration in media studies and educational research. This intends to improve the potential perspective of the study’s aims through a triangulation that sets two well-known observation points to enhance the exploration of this third and less-observable object. Mixed method approaches are seen as crucial in games research, especially if the different methods are integrated systematically, by establishing a dialogical perspective between different information tracks [29].

Considering the defined framework, the present study aims to explore the pedagogical value of game design and development in the promotion of inclusive and accessibility-driven skills and attitudes by videogames students, through PAR. Most specifically, it will be based on the following research questions:

- RQ1: Can a collaborative project involving pwID be effective to promote inclusive and accessibility-driven game design and development skills?

- RQ2: How can game design and development foster attitudes for a more inclusive view of society?
- RQ3: What are the students' perceptions on the value of this experience to their professional development?

2. Materials and Methods

2.1. Participants

The presented study adopted a non-probabilistic sampling approach, with a convenience sample composed of higher education students enrolled in two complementary subjects of a Bachelor's degree in Videogames. Although all students participated in the process, only the ones that successfully provided answers to all the data gathering tools were included in the final sample. Therefore, thirty university students participated in the process, but only 17 provided valid answers to both questionnaires. The questionnaire administered before the game development process gathered a total of 17 answers, while the post-game development questionnaire gathered a total of 25 answers. The overview of this process is illustrated in Figure 1.

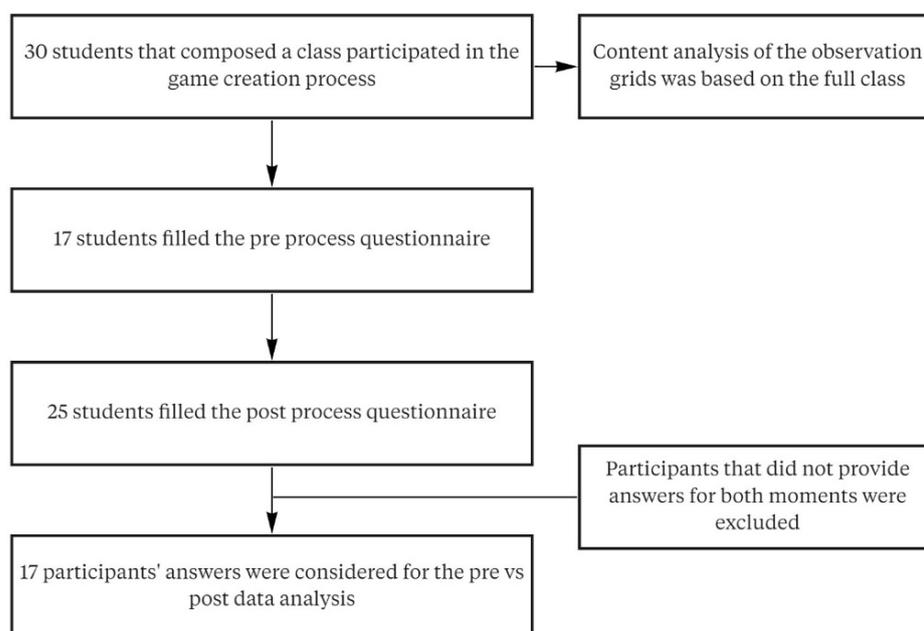


Figure 1. Flow-chart for participants and data inclusion.

From the 17 that fully complied with the requirements of the final sample (filling both questionnaires), 12 identified as males (70.60%), two identified as females (11.80%), and three (17.60%) preferred not to answer. The students were aged between 19 and 25 years old ($M = 21.12$; $SD = 1.62$). Most of the students had no regular contact with pwID ($n = 14$; 82.40%). The three other students (17.60%) stated that they have pwID in their families, with whom they contacted sporadically ($n = 2$; 11.80%) or monthly ($n = 1$; 5.90%). Full results can be found in Table 1.

Besides the presented sample of students, a group of pwID also cooperated in this experience through collaborative processes, as the target audience for the games. Fourteen individuals with ID participated in the development process and were recruited through a collaboration protocol with a Non-Governmental Organization (NGO) in the field. Considering the assessment details provided by the organization, all the participants were characterized as having severe ID, with relative autonomy, but a constant need for support in activities of daily living. Eight participants (57.14%) also had motor disabilities, ranging from the inability to autonomously use one of the hands to spastic tetraplegia. Seven participants (50.00%) used a wheelchair.

Table 1. Sample demographic data ($n = 17$).

Category	Subcategories	n (%)
Gender	Male	12 (70.60)
	Female	2 (11.80)
	Prefer not to say	3 (17.60)
Regular contact with pwID	Yes	3 (17.60)
	No	14 (82.40)
Nature of the contact	Family	3 (17.60)
	Professional	0 (0.00)
	Other	0 (0.00)
Frequency of the contact	Daily	0 (0.00)
	Weekly	0 (0.00)
	Monthly	1 (5.90)
	Sporadically ¹	2 (11.80)

¹ Sporadically = less than monthly.

The selection of this user sample was also based on a non-probabilistic process, obtained through a pre-selection made by the NGO technical staff, followed by a decision from the pwID. This process was the most feasible considering the institutional dynamics and, mainly, answered to the self-determination and empowerment pillars of the Convention on the Rights of Persons with Disabilities (CRPD).

2.2. Instruments

2.2.1. Community Living Attitudes Scale-Intellectual Disability

To assess the students' beliefs and attitudes regarding ID, the short version of the *Community Living Attitudes Scale-Intellectual Disability* (CLAS-ID) was used. This scale was developed by Henry, Keys, Jopp, and Balcazar [30], and was originally named *Community Living Attitudes Scale-Mental Retardation* (CLAS-MR). In more recent studies, like the ones developed by Su, Cuskelly, Gilmore, and Sullivan [31] and by Wilson and Scior [32], the designation CLAS-MR was replaced by CLAS-ID, and the concept of "mental retardation" disappeared also in the scales items, accordingly. Such a change coincides with the paradigm shifts in the field of ID, which include both the adopted words and the societal positioning of these subjects, to human rights and inclusion-driven framings [33].

In its short form, CLAS-ID is a self-report scale, composed of 17 items, grouped in four subscales: empowerment, exclusion, sheltering, and similarity. The empowerment subscale assesses the perception of the ability of individuals with ID to make decisions. The exclusion subscale approaches the desire to exclude pwID from community living. The sheltering subscale intends to assess the attitudes regarding the need to protect and supervise pwID. The similarity subscale assesses the way the respondents perceive pwID as equals. The answers to this instrument are given through a six-point Likert scale, ranging from one (totally disagree) to six (totally agree). When scoring the answer, items are recoded to allow that higher scores always represent more positive attitudes. Considered as a measuring scale that reflects the premises of empowerment and community inclusion of pwID, CLAS-ID shows good internal consistency and validity, with a Chronbach's Alpha higher than 0.70 in the four subscales, as well as the coefficient of test-retest reliability [31]. The short form subscales present strong and positive correlations with the full form of the scale, composed of 40 items [34].

2.2.2. Questionnaire for Students

The questionnaire for students was administered through an online form, which comprised demographic information, CLAS-ID items, and open-ended qualitative questions aimed to evaluate their knowledge about accessibility, perceptions of inclusion, and insight about the implemented pedagogical process. Two versions of the questionnaire were developed, one to be implemented before the starting of the game design and development

process, and the other after the end of this process. Both versions included CLAS-ID and a set of questions about inclusion and games accessibility-related skills and attitudes. Demographic data were collected only in the pre-process version. The post-process version also included open-ended questions about the perceived value of the experience for the professional future of the students as game developers/designers. The questionnaires started with an informed consent form, developed under the Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and that was mandatory before the filling of the rest of the form. A private keyword process ensured the correspondence between the pre and post questionnaire from each participant.

Besides age and gender, the gathered demographic data included questions about the familiarity of each student with the reality of pwID, asking them about their close contacts with these individuals and, if this contact existed, the nature and the frequency of it. All demographic data was answered through multiple-choice questions, except for age, answered through a two digits' numerical format, and gender, answered in an open-ended manner to ensure the collection of all the multiplicity of possible answers.

After CLAS-ID, the third section of the questionnaire was composed of four questions, aimed to understand students' knowledge and beliefs about cognitive accessibility, motor accessibility (since the target audience were also composed of a majority of people with multiple disabilities), and inclusion, as following:

- What measures can be implemented in a game to make it more accessible for pwID or other cognitive impairments?
- What measures can be implemented in a game to make it more accessible for people with Motor Disabilities?
- How can games contribute to the inclusion of pwID?

The three open-ended questions included in the post process version intended to assess students' perceptions about their participation in this game design and development process, as follows:

- How do you describe the process of developing your game?
- Do you think that participating in this project can influence your professional future? In what way?
- If you had the opportunity to develop a game for pwID again would you do something differently? What would you do?

2.2.3. Systematic Observation Grids

To operationalize the methodological premises discussed above, namely regarding media ethnography and PAR, a systematic observation grid was developed to be filled in all the creation sessions. The developed grid was adapted from a previous contribution in the field, centered around game creation-based learning with children [35], considering these specific subjects, and research aims.

The grid was also developed to address two types of observation categories: descriptive categories and orthogonal categories, with the second one having a specific emphasis on capturing the different aspects of the design activity [36]. The descriptive categories included: date of the session; number of participants (students); place; and title of the concept/game under development. The orthogonal categories included: accessibility, separated into three subsections (cognitive, motor, and sensory accessibility); concerns about game experience; beliefs about ID; main comments of the students; and other aspects of the observation. These categories' conceptual correspondence with CLAS-ID and the developed questionnaire intended to support data triangulation.

2.3. Procedure

To better operationalize PAR, the entire creative process with the students was documented, as well as the subsequent playtesting and gaming sessions with pwID, in a

logic of participant observation and through an ethnographic approach, which allows the study of this form of media as a complex process of meaning construction, socially and contextually situated [37]. For this, a systematic observation grid was filled in each development, co-creation, playtesting, and gaming session.

At the beginning of a two-semester subject of the Bachelor's degree in Videogames, students were challenged to design and develop a game and a specific physical interface that could be accessible to the above-mentioned sample of pwID. Emerging from the key problem of the lack of accessible games for this population—most specifically games that primarily target entertainment, developed considering their specific interests and priorities [24]—students were challenged to move away from a vision more closely related to serious games or games with specific goals, typically external to the game world. During game creation, more than developing for a specific target, students were also challenged to develop games that can be interesting for everyone, even if containing specific accessibility options and features. User requirements emerged from information provided by the NGO, video observation of the audience, and an initial focus group about their interest and needs. Generally, the pwID that composed the audience had a complex set of support needs, characterized by limitations in social, conceptual, and practical domains, aligned with severe ID [3]. Therefore, the sample presented complex cognitive accessibility needs that justified the creation of games that could represent a low burden on memory, attention, executive functioning, among others. The sample also presented motor accessibility needs. Here, the most common condition was the inability to use both hands simultaneously and autonomously.

The games were developed over two semesters, with the first semester being dedicated to the concept and production of the test prototype. In the second semester, the prototype was tested with the audience, the game was finalized, and the physical interface was produced. All sessions, excepting the ones aimed at assembling the interface, were conducted through Zoom, due to the pandemic restrictions. Nevertheless, one of the researchers was physically present in all the sessions with pwID, in the venue of the NGO, to better explore their interaction with the games underdevelopment, as well as other contextual factors.

The concept phase began with a session on the interests, cognitive, and motor characteristics of the target audience, led by the researcher that was in constant and direct contact with the audience. The game concept and gameplay principles, developed with the assistance of the subject professors, were discussed and validated in two sessions interspersed in time, also with the researcher and considering the feedback provided by pwID. The first semester ended with the finalization of the game prototype and the second semester started with the respective playtesting, recorded on video, by pwID. This video registration was essential for the students to meet the interests and accessibility needs of the audience.

Through this procedure, one focus group about interests and media habits, nine co-creation sessions with feedback gathered from the target audience, and three playtesting rounds were conducted, between March 2020 and January 2021.

Since pwID were considered a high-risk population for COVID-19 transmission, direct contact with students was not possible as initially planned. Nevertheless, one focus group about support needs, interests, and media habits, nine co-creation sessions with feedback gathered from the target audience, and three playtesting rounds were conducted, between March 2020 and January 2021. Although pandemic restrictions did not allow for direct contact, it was clear that the various moments of feedback and video documentation brought a participatory nature to the game development process.

Games were developed in UnityEngine. Physical interfaces were designed on Onshape and produced in 3D printing with the integration of Arduino boards and switches.

Data were gathered during the participant observation of the research, with the filling of observation grids. The questionnaires, including demographic data, CLAS-ID, and open-ended questions, were filled in the initial session and after the end of the process, through an online form. All subjects gave their informed consent for inclusion before any data gathering moment.

2.4. Data Analysis

Data emerging from open-ended questions were analyzed through a content analysis procedure, characterized as bottom-up, due to the innovative nature of the present study. Therefore, an inductive coding procedure was adopted, to capture the complexity and richness of the phenomena associated with this creative process. This process was based on the postulates from Boyatzis [38] about coding and the thematic organization of observations. After documenting the manifest content, organizing it in conceptually similar groups, the codebook was developed, and all the material was coded. The sentence was adopted as the unit of analysis for this purpose. Frequencies of each coding were noted and the respective percentages were later calculated. Means and standard deviations were also calculated, when applicable, to analyze the number of units of analysis coded by each participant. Inter Coder Reliability was calculated with the support of an independent researcher, based on 11.76% of the material coded by the two team members (answers from two randomly assigned students). Divergences in coding were solved through group discussions. The agreement rate was 80.63%, which is considered acceptable [39].

Demographic data were analyzed using descriptive statistics and CLAS-ID data was analyzed using Wilcoxon signed rank test, version 26. This option was adopted considering the small sample size of this exploratory approach, as well as the inability to confirm all the paired sample *t* test assumptions, such as normal distribution.

Data from the participant observation notes were used to frame the overall results, as a strategy to capture the environmental influences and contextualized beliefs that produce both inclusion-driven and disabling outcomes in a creative process. This methodological option was based on the approach to the production of insights adopted by McGrath and Rudman [40].

3. Results

3.1. Developed Games

Ten games were developed through this process, nine digital games and one hybrid game (analogical with an electronic interface). The games presented great diversity in terms of genres, including one party game (*Adivinhas?*), one first-person shooter (*Chicken Shooter*), two simulations (*Canoe* and *FlyYouBirds*), two arcades (*Orbiter* and *Space Conqueror*), one endless runner (*Endless Runner*), one casual game (*Virtual Companion*), and two puzzles (*Futebolástico!* and *SoundQuest*). Overall, games mainly adopted an approach with a small number of inputs, around two or three, to support accessibility. Students progressively realized that the possibility to customize in-game options, such as speed or number of opponents was crucial to the success of their work. Observing the process makes it possible to mention that these features mainly resulted from playtesting conclusions and pwID insights. Generally, students seemed to increasingly favor accessibility solutions that favor user diversity, such as customization, considering their participatory experiences.

As mentioned above, every game had a physical interface specifically developed for it, serving a double purpose: enhancing games' motor and cognitive accessibility, considering the characteristics of the audience, and enhancing engagement through the creation of a tangible interactive product that is aligned with each game's aesthetic. An example can be seen in Figure 2.

The digital games' art frequently adopted classic games aesthetic trends, like pixel art. Another interesting trend observed in some games was the desire to provide pwID with sensory experiences that are not frequent in their daily lives (e.g., walking on the raining in *EndlessRunner*) or that can provide a certain notion of freedom (e.g., driving a boat in *Canoe* or flying in *FlyYouBirds*).



Figure 2. Images from the game Futebolástico! (a) Screenshot of the gameplay; (b) Physical interface of the game.

3.2. Inclusive Design and Accessibility Driven Skills

Regarding the question “What measures can be implemented in a game to make it more accessible for pwID or other cognitive impairments?”, students mentioned a set of information that resulted in 11 themes, with 31 subthemes. In the pre-development process questionnaire, students made a total of 54 mentions to accessibility measures, ranging between one and five measures per student ($M = 3.18$; $SD = 1.33$). The most mentioned theme was the possibility to allow customization within the game ($n = 12$; 12.22%), mainly the customization of the level of difficulty ($n = 8$; 14.81%). This was followed by: visual information-related measures ($n = 8$; 14.81%), most specifically the replacement of written words by pictograph representations ($n = 6$; 11.11%), and the need to accommodate players’ support needs ($n = 8$; 14.81%), materialized by the inclusion of subtitles ($n = 3$; 5.56%). The aspects that were not mentioned in the pre-development questionnaire included the need to: improve visual information clarity; to simplify the game design; to allow user interface customization; to remap controls; to increase difficulty progressively; and to include more explanatory elements in the tutorials.

In the post-development process questionnaire, students made a total of 63 mentions to accessibility measures, ranging between one and six measures per student ($M = 3.70$; $SD = 1.40$). As in the previous questionnaire, the possibility to allow customization within the game ($n = 19$; 30.16%), specifically the customization of the level of difficulty ($n = 14$; 22.22%) was the most mentioned. Also, the adoption of pictograph representations ($n = 10$; 15.87%), and the whole visual information-related measures ($n = 15$; 23.81%), were again the second most mentioned. Simplification-driven measures ($n = 9$; 14.29%), namely game design simplification ($n = 4$; 6.35%) appeared as the most mentioned theme and respective subtheme. Accessibility measures related to inputs lost representation in the post-development process questionnaire, alongside window of opportunity customization, the adoption of mechanics that are not based on speed or reaction time, the possibility to, in general, allow repetition of game moments/elements, the assist mode, the subtitles, and the need for non-passive tutorials. None of these was, therefore, mentioned.

Full results for both pre- and post-development process questionnaires can be found in Table 2. The frequencies and percentages totals were calculated based on main themes only (codings 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11). Adding up all the lines would lead to an erroneous result, where the subthemes would be considered in duplicate.

Table 2. Proposed cognitive accessibility measures, before and after the process ($n = 17$).

Codings for Cognitive Accessibility Measures	Pre <i>n</i> (%)	Post <i>n</i> (%)	Total <i>n</i> (%)
1. Accessibility	5 (9.25)	2 (3.17)	7 (5.98)
1.1. User interface accessibility	5 (9.25)	2 (3.17)	7 (5.98)
2. Simplification	5 (9.25)	9 (14.29)	14 (11.97)
2.1. Mechanics simplification	2 (3.70)	2 (3.17)	4 (3.42)
2.2. Gameplay simplification	3 (5.56)	3 (4.76)	6 (5.13)
2.3. Game design simplification	0 (0.00)	4 (6.35)	4 (3.42)
3. Inputs	3 (5.56)	0 (0.00)	3 (2.56)
3.1. Input number reduction	2 (3.70)	0 (0.00)	2 (1.71)
3.2. Variety of input modalities	1 (1.85)	0 (0.00)	1 (0.85)
4. Allow customization	12 (22.22)	19 (30.16)	31 (26.50)
4.1. Difficulty customization	8 (14.81)	14 (22.22)	22 (18.80)
4.2. Color/contrast customization	1 (1.85)	1 (1.59)	2 (1.71)
4.3. Speed customization	2 (3.70)	1 (1.59)	3 (2.56)
4.4. Window of opportunity customization	1 (1.85)	0 (0.00)	1 (0.85)
4.5. User interface customization	0 (0.00)	3 (4.76)	3 (2.56)
5. Mechanics	5 (9.25)	1 (1.59)	6 (5.13)
5.1. Mechanics not based on dexterity	1 (1.85)	1 (1.59)	2 (1.71)
5.2. Mechanics not based on speed	1 (1.85)	0 (0.00)	1 (0.85)
5.3. Mechanics not based on reaction time	3 (5.56)	0 (0.00)	3 (2.56)
6. Visual information	8 (14.81)	15 (23.81)	23 (16.66)
6.1. Pictograph representations	6 (11.11)	10 (15.87)	16 (13.68)
6.2. Simplification of visual information	2 (3.70)	1 (1.59)	3 (2.56)
6.3. Clarity of visual information	0 (0.00)	4 (6.35)	4 (3.42)
7. Allow repetition	2 (3.70)	0 (0.00)	2 (1.71)
7.1. Allow repetition of narrative elements	1 (1.85)	0 (0.00)	1 (0.85)
7.2. Allow repetition of tutorials	1 (1.85)	0 (0.00)	1 (0.85)
8. Accommodation of support needs	8 (14.81)	8 (12.70)	16 (13.68)
8.1. Assist mode	2 (3.70)	0 (0.00)	2 (1.71)
8.2. Mechanics' automation	1 (1.85)	1 (1.59)	2 (1.71)
8.3. Voice over	2 (3.70)	2 (3.17)	4 (3.42)
8.4. Subtitles	3 (5.56)	0 (0.00)	3 (2.56)
8.5. Control remapping	0 (0.00)	4 (6.35)	4 (3.42)
8.6. Gradually progressive difficulty	0 (0.00)	1 (1.59)	1 (0.85)
9. Feedback	2 (3.70)	6 (9.52)	8 (6.84)
9.1. Feedback clarity	1 (1.85)	3 (4.76)	4 (3.42)
9.2. Convey feedback through multiple sensory channels	1 (1.85)	3 (4.76)	4 (3.42)
10. Tutorials	1 (1.85)	1 (1.59)	2 (1.71)
10.1. Non passive tutorials	1 (1.85)	0 (0.00)	1 (0.85)
10.2. Tutorials with more explanatory visual elements	0 (0.00)	1 (1.59)	1 (0.85)
11. Gameplay	3 (5.56)	2 (3.17)	5 (4.27)
11.1. Decrease the punishment associated with errors	2 (3.70)	1 (1.59)	3 (2.56)
11.2. Allow freedom/decision-making	1 (1.85)	1 (1.59)	2 (1.71)
Total accessibility measures	54 (100.00)	63 (100.00)	117 (100)

Overall, more cognitive accessibility measures were mentioned in the post-development process questionnaire, and even if this is somehow residual, different distribution aspects can be highlighted, considering Table 2 data. The number and variety of inputs lost its emphasis in terms of cognitive accessibility, from three mentions (5.56%) in the pre questionnaire, to not being mentioned at all in the post questionnaire. Game mechanics-related measures also lost representation, from five mentions (9.25%) to one mention (1.59%). The possibility to customize different game aspects maintained its centrality from

pre ($n = 12$; 12.22%) to post ($n = 19$; 30.16%), but user interface customization appeared only in the post-development process ($n = 3$; 4.76%). The need to accommodate players' support needs also kept its centrality from pre ($n = 8$; 14.81%) to post ($n = 8$; 12.70%), but control remapping appeared only in the post questionnaire ($n = 4$; 6.35%). Simplification-related measures gained relevance, from five mentions (9.25%) to nine mentions (14.29%), with the emergence of game design overall simplification in the post-results ($n = 4$; 6.35%). Similarly, accessibility measures related to feedback gained relevance from pre ($n = 2$; 3.70%) to post ($n = 6$; 9.52%), both regarding its clarity and the need to convey feedback through multiple sensory channels. These subthemes went from one mention in the pre questionnaire (1.85%) to three mentions in the post questionnaire (4.76%).

Regarding the question "What measures can be implemented in a game to make it more accessible for people with Motor Disabilities?", students mentioned a set of information that resulted in nine themes, with 24 subthemes. The theme and subtheme structure were kept as uniform as possible from cognitive to motor accessibility, with slight adaptations to fit the coded content. In the pre-development process questionnaire, students made a total of 45 mentions to motor accessibility measures, ranging between one and four measures per student ($M = 2.65$; $SD = 1.70$). The most mentioned themes and subthemes were: inputs related measures ($n = 10$; 22.22%), specifically regarding the decrease of the number of inputs and sensitivity, with three mentions each ($n = 3$; 6.67%); measures related to game mechanics ($n = 10$; 22.22%), namely the avoidance of dexterity-based mechanics ($n = 6$; 13.33%); and measures driven to the accommodation of players' support needs ($n = 10$; 22.22%), most specifically control remapping ($n = 8$; 17.78%). User interface accessibility, game design simplification, user interface customization, visual information-related measures, and assist mode were not mentioned as motor accessibility measures in the pre questionnaire.

In the post-development process questionnaire, students made a total of 63 mentions to motor accessibility measures, ranging between one and five measures per student ($M = 3.71$; $SD = 1.40$). The possibility to customize different game aspects was the most mentioned theme ($n = 14$; 22.22%), most specifically to customize difficulty ($n = 6$; 9.52%). It was followed by inputs-related measures ($n = 11$; 17.46%), emphasizing the decrease of the number of inputs ($n = 6$; 9.52%), and by the need to accommodate players' support needs ($n = 10$; 15.87%), most specifically control remapping ($n = 6$; 9.52%). The need to decrease the variety of input types, their frequency, the attribution to several functions to the same input, voice over, and the decrease of the punishment after errors were not mentioned in the post questionnaire.

Full motor accessibility results for both pre- and post-development process questionnaires can be found in Table 3. The frequencies and percentages totals were calculated based on main themes only (codings 1, 2, 3, 4, 5, 6, 7, 8, and 9).

Overall, more motor accessibility measures were mentioned in the post-development process questionnaire ($n = 63$), when compared to the pre-development questionnaire ($n = 45$), justifying a higher average of measures mentioned by students, from 2.65 ($SD = 1.70$) on the pre questionnaire, to 3.71 ($SD = 1.40$) on the post questionnaire. Considering Table 3 data, some differences in distribution can also be highlighted. Motor accessibility measures related with inputs roughly maintained their relevance (Pre $n = 10$; 22.22%; Post $n = 11$; 17.46%), as well as game mechanics-related (Pre $n = 10$; 22.22%; Post $n = 9$; 14.29%), the adaptability of the game to different physical interfaces (Pre $n = 6$; 13.33%; Post $n = 8$; 12.70%), and the need to accommodate players' support needs (Pre $n = 10$; 22.22%; Post $n = 10$; 15.87%). The simplification of different game aspects increased its relevance (Pre $n = 2$; 4.44%; Post $n = 7$; 11.11%), with a specific emphasis on gameplay overall simplification (Pre $n = 2$; 4.44%; Post $n = 6$; 9.52%). The possibility to customize the game also increased its relevance (Pre $n = 6$; 13.33%; Post $n = 14$; 22.22%), most specifically the customization of difficulty (Pre $n = 3$; 6.67%; Post $n = 6$; 9.52%), and the emergence of user interface customization in the post questionnaire ($n = 2$; 3.17%). User interface accessibility,

that was not mentioned in the pre questionnaire, was mentioned three times in the post questionnaire (4.76%).

Table 3. Proposed motor accessibility measures, before and after the process ($n = 17$).

Codings for Motor Accessibility Measures	Pre <i>n</i> (%)	Post <i>n</i> (%)	Total <i>n</i> (%)
1. Accessibility	0 (0.00)	3 (4.76)	3 (2.78)
1.1. User interface accessibility	0 (0.00)	3 (4.76)	3 (2.78)
2. Simplification	2 (4.44)	7 (11.11)	9 (8.33)
2.1. Gameplay simplification	2 (4.44)	6 (9.52)	8 (7.41)
2.2. Game design simplification	0 (0.00)	1 (1.59)	1 (0.93)
3. Inputs	10 (22.22)	11 (17.46)	21 (19.44)
3.1. Decrease the number of inputs	3 (6.67)	6 (9.52)	9 (8.33)
3.2. Decrease the variety of inputs	1 (2.22)	0 (0.00)	1 (0.93)
3.3. Decrease input sensitivity	3 (6.67)	4 (6.35)	7 (6.48)
3.4. Increase input cooldown	1 (2.22)	1 (1.59)	2 (1.85)
3.5. Decrease input frequency	1 (2.22)	0 (0.00)	1 (0.93)
3.6. Several functions for one input	1 (2.22)	0 (0.00)	1 (0.93)
4. Allow customization	6 (13.33)	14 (22.22)	20 (18.52)
4.1. Difficulty customization	3 (6.67)	6 (9.52)	9 (8.33)
4.2. Color/contrast customization	1 (2.22)	1 (1.59)	2 (1.85)
4.3. Speed customization	1 (2.22)	2 (3.17)	3 (2.78)
4.4. User interface customization	0 (0.00)	2 (3.17)	2 (1.85)
4.5. Number of mechanics customization	1 (2.22)	3 (4.76)	4 (3.70)
5. Mechanics	10 (22.22)	9 (14.29)	19 (17.59)
5.1. Mechanics not based on dexterity	6 (13.33)	4 (6.35)	10 (9.26)
5.2. Mechanics not based on speed	1 (2.22)	1 (1.59)	2 (1.85)
5.3. Mechanics not based on reaction time	3 (6.67)	4 (6.35)	7 (6.48)
6. Visual information	0 (0.00)	1 (1.59)	1 (0.93)
6.1. Clarity of visual information	0 (0.00)	1 (1.59)	1 (0.93)
7. Accommodation of support needs	10 (22.22)	10 (15.87)	20 (18.52)
7.1. Assist mode	0 (0.00)	2 (3.17)	2 (1.85)
7.2. Mechanics' automation	1 (2.22)	2 (3.17)	3 (2.78)
7.3. Voice over	1 (2.22)	0 (0.00)	1 (0.93)
7.4. Control remapping	8 (17.78)	6 (9.52)	14 (12.96)
8. Gameplay	1 (2.22)	0 (0.00)	1 (0.93)
8.1. Decrease the punishment associated with errors	1 (2.22)	0 (0.00)	1 (0.93)
9. Physical Interface	6 (13.33)	8 (12.70)	14 (12.96)
9.1. Adaptability to different physical interfaces	6 (13.33)	8 (12.70)	14 (12.96)
Total accessibility measures	45 (100.00)	63 (100.00)	108 (100.00)

3.3. Attitudes towards Intellectual Disability and Inclusion

Through the analysis of CLAS-ID, filled by all the participants ($n = 17$), it is possible to highlight that statistically significant differences were found between pre- and post-game development processes in three out of four of the scale's dimensions. Students' attitudes regarding the empowerment of pwID significantly improved from before the game development process ($Mdn = 4.40$), to after this process ($Mdn = 4.60$); $T = 97$, $Z = 2.82$, $p = 0.005$. The beliefs towards the need to protect and supervise pwID, expressed in the sheltering dimension, also improved significantly from pre ($Mdn = 4.00$) to post assessment ($Mdn = 4.75$); $T = 120$, $Z = 3.42$, $p = 0.001$. The beliefs regarding pwID as equals, expressed in the similarity dimension, also registered statistically significant improvements from the first assessment point ($Mdn = 5.25$) to the assessment made after the game design and development process ($Mdn = 5.75$); $T = 120$, $Z = 3.48$, $p = 0.001$. Results obtained for the

exclusion dimensions did not show significant differences between the pre ($Mdn = 4.75$) and the post process assessments ($Mdn = 4.75$); $T = 30$, $Z = -0.78$, $p = 0.439$.

By critically analyzing CLAS-ID results and integrating them with the one's obtained through the content analysis of the question "How can games contribute to the inclusion of pwID?", it is possible to sustain the increasing beliefs of students related to the role of games in the inclusion of this population. The attitudinal content expressed by students in this question was organized into two main dimensions and 15 sub-attitudinal dimensions. The full results of this question's content analysis are expressed in Table 4.

Table 4. Students' attitudes regarding games and inclusion, before and after the process ($n = 17$).

Codings for Attitudinal Dimensions	Pre <i>n</i> (%)	Post <i>n</i> (%)	Total <i>n</i> (%)
Inclusion, similarity, and empowerment driven attitudes	23 (67.65)	55 (100.00)	78 (87.64)
Democratize games as cultural form	3 (8.82)	6 (10.91)	9 (10.11)
Games for awareness raising	4 (11.76)	1 (1.82)	5 (5.62)
Online games as fostering sense of community and belonging	2 (5.88)	4 (7.27)	6 (6.74)
Games as spaces for social interaction	7 (20.59)	7 (12.73)	14 (15.73)
Games for entertainment	2 (5.88)	8 (14.55)	10 (11.24)
Create standardized information measures for games' accessibility	2 (5.88)	6 (10.91)	8 (8.99)
Games as decreasing environmental barriers	1 (2.94)	4 (7.27)	5 (5.62)
Accessibility as a right	0 (0.00)	8 (14.55)	8 (8.99)
Inclusive design improves games for everyone	0 (0.00)	7 (12.73)	7 (7.87)
Games as a source of challenge	0 (0.00)	2 (3.64)	2 (2.25)
Games as spaces for the development of skills	2 (5.88)	2 (3.64)	4 (4.49)
Exclusion driven attitudes	11 (32.35)	0 (0.00)	11 (12.36)
Offer pwID the possibility to interact with neurotypical individuals	8 (23.53)	0 (0.00)	8 (8.99)
Games as a way for pwID do useful things for society	1 (2.94)	0 (0.00)	1 (1.12)
Games are necessarily a vehicle of exclusion	1 (2.94)	0 (0.00)	1 (1.12)
Accessibility measures as a barrier to designers and developers	1 (2.94)	0 (0.00)	1 (1.12)
Total accessibility measures	34 (100.00)	55 (100.00)	89 (100.00)

In the pre-development process questionnaire, a total of 34 attitudes and beliefs were coded, ranging between two and five per respondent ($M = 2.00$; $SD = 0.79$). Twenty-three units of analysis (67.65%) were coded in the first dimension, developed to aggregate positive attitudes and beliefs, considered as inclusion, similarity, and empowerment driven. Here, the potential of games to foster social interaction ($n = 7$; 20.59%), and to raise the awareness of neurotypical individuals for the reality of pwID ($n = 4$; 11.76%) were the most mentioned aspects. In the second dimension, 11 (32.35%) exclusion-driven attitudes were coded. Games as offering the possibility for pwID to interact with neurotypical individuals was the most prevalent ($n = 8$; 23.53%). Such an attitude was considered exclusion-driven, since students' views were mainly framed in an ableist notion that for pwID to interact with people without disability would, without a doubt, be an asset in their daily lives. These answers were also very frequently linked with a strong cleavage between people with and without disabilities, not perceived as similar.

Besides this, one student, in particular, expressed how they were against this type of accessibility-driven process. For them, games were necessarily a vehicle of exclusion, and "creating games to include these people greatly limits the game design". They proceeded to answer that "if the creators' idea does not make it possible to include these people, then you should not change the game just to include them".

In the post-development process questionnaire, a total of 55 attitudes and beliefs were coded, ranging between two and five per respondent ($M = 3.24$; $SD = 0.97$). All the attitudes were coded as inclusion, similarity, and empowerment-driven, with a stronger notion that games for pwID can be above all a form of entertainment ($n = 8$; 14.55%) and that accessibility is a matter of rights ($n = 8$; 14.55%). Moreover, the idea that games could be a space for social interaction gained even more relevance ($n = 7$; 12.73%), and the notion that accessibility driven inclusive design practices could improve games, not only for pwID but for everyone ($n = 7$; 12.73%) emerged. One student went further by suggesting that, as is already done with the Pan European Game Information (PEGI) age labels, games should have a system “to certify whether they are accessible and for whom”.

3.4. Student's Perception of the Process

When asked to describe the game development process, students' answers were very diverse, but generally structured in a similar way. Frequently, students mentioned something more challenging or frustrating about the process, followed by an aspect that they found positive or enriching. Examples would be “time-consuming but very rewarding” or “challenging, but fun, and above all rewarding”. Considering the content analysis results, 32 units of analysis were coded from this question, expressed through 17 different characteristics and beliefs groups. Most students considered the process both challenging ($n = 4$; 12.50%), reinforcing how it had to be done in a person-centered manner ($n = 4$; 12.50%). Aligned with this, students highlighted the struggles they experienced with the implementation and adaptation of games' difficulty levels ($n = 3$; 9.38%). Nevertheless, the development process was characterized as rewarding ($n = 3$; 9.38%), with answers such as

It is a very satisfying process when you know that the game will really help someone and make people enjoy themselves without having that fear of not being able to play because the game is too hard for them.

Considering students' perspectives, the development process was interesting ($n = 2$; 6.25%) and enriching ($n = 2$; 6.25%). Nevertheless, some diverse views were registered regarding its complexity, from being considered easy ($n = 2$; 6.25%), to being considered complex ($n = 2$; 6.25%), but feasible ($n = 2$; 6.25%). Other beliefs about the game development process included: the inherent frustration associated with the constant adjustment of the gameplay ($n = 1$; 3.13%); the notion that the process was very long ($n = 1$); the feeling that this project was more interesting than the other projects developed in the Videogames Bachelor's degree ($n = 1$; 3.13%); the perception of the process as necessary for being a competent professional in the future ($n = 1$); the process of being evidence-based and demanding of a profound research work ($n = 1$; 3.13%); and the notion that this process was similar to other game development processes ($n = 1$; 3.13%), requiring only more planning ($n = 1$; 3.13%).

The students unanimously agreed ($n = 17$; 100.00%) on the potential influence of participating in this project on their future as game designers and/or game developers. Forty-one reasons for this were mentioned by them, afterward grouped into nine themes. The acquired knowledge on how to develop with accessibility in mind was the most mentioned one, either for skills specifically aimed at cognitive ($n = 8$; 19.51%) or motor accessibility ($n = 8$; 19.51%). The project, seen as a trigger for being more aware of the potential mismatch between the capabilities and individual characteristics of the designer/developer and the target audience, was also very relevant in students' answers ($n = 7$; 17.07%). Moreover, students also mentioned frequently how the inclusive design practices they implemented could help them in the development of better games for everyone, regardless of whether they have a disability or not ($n = 5$; 12.20%). To this extent, a participant noted: “(...) I gained experience in how to develop games for specific audiences, with different limitations, which in my opinion is an asset not only for developing games for this population but for game development in general”. Aligned with this view, a participant also noted how this project would be a very valuable asset for their portfolio. Through this project, students felt they gained more awareness of games as also a potential vehicle of exclusion

($n = 3$; 7.32%), and how developing accessible media is a form of citizenship ($n = 3$; 7.32%). Their positive experiences related to the project were also expressed by their willingness to develop similar work in the future ($n = 3$; 7.32%), with one of them expressing how this makes them even more motivated to work as a game developer, considering this now as a form of helping society as a whole ($n = 1$; 2.44%).

When asked to reflect on what they would do differently if they had to repeat the process, three students noted that they would not do anything differently (17.65%), while the remaining 14 (82.35%) have demonstrated this willingness. From this 14, the main change would be increasing the direct contact between them and the pwID involved in the process, and hindered by the pandemic, mentioned eight times (42.11%) in the answers, such as

(...) but what I would do differently is to actually go there in person and play games, talk, spend a few afternoons with these people to understand and learn more about what they like, what their daily life is like and what they do for fun, the types of group activities, etc...

Increasing the effort in the implementation of customization features in the games and increasing the initial research about the target audience were both mentioned three times (15.79%) by the sample. Other mentioned aspects included: not basing the game features in the designers/developers abilities ($n = 2$; 10.53%); giving more relevance to User Experience (UX) from an early stage ($n = 2$; 10.53%); and increasing the effort in the implementation of more visual and pictographic information ($n = 1$; 5.26%). Overall, 19 aspects were mentioned, grouped in the previously presented six sets of reasons.

3.5. Participatory Observation

The nine development sessions with students, where the feedback and insight from the target audience were presented and discussed, were held on Zoom, with the participation of all the students ($n = 27$), including the ones that did not fill the questionnaire pre and/or post questionnaires. From the notes registered in the above-explored grid, it is possible to highlight that there was a certain avoidance in the students of lowering the difficulty level of the games, even after this was one of the main indications from the first playtesting. Although it seems to be based on the huge gap between the ability and gaming literacies of the students and the target audience, the situation has progressively improved, circumvented by customization options and by the decrease of the lower threshold in such options. This aspect was registered as concerning both cognitive accessibility and game experience, considering the barriers it initially imposed in the interaction, and the overall players' engagement.

Regarding motor accessibility, one of the main difficulties expressed by students was the need to avoid the usage of two simultaneous inputs. Also, this was progressively overcome, through the isolation of mechanics as an inherent part of level design.

Sensory accessibility was not as central as the previous ones and was mainly centered around strategies to provide visual information in clearer manners, both through different hierarchies and through pictographs. Here the biggest challenge seemed to be on how to align these concerns with the aesthetical proposals students developed for each game. It is important to highlight that this issue can also be considered as central for cognitive accessibility.

Regarding the game experience, it is possible to emphasize that the promotion of engagement was planned by students through the framing of the interests expressed by pwID, namely by providing them interactive experiences as an alternative to their limited daily lives. These limitations, imposed by institutionalization and exponentiated by the COVID-19 full lockdown for at-risk populations, such as pwID, were addressed by students through gaming experiences such as flying (*FlyYouBirds*), riding a canoe (*Canoe*), or running in the rain (*Endless Runner*).

Other aspects from the observation included a moment where a student, after the first session, proactively asked very specific and profound clarifications about the target

audience. These clarifications motivated an extra session about the target audience's interests and needs, where students proactively clarified what emerged when they started ideating about the game design.

4. Discussion

The present exploratory study aimed to explore the pedagogical value of game design and development in the promotion of inclusive and accessibility-driven skills and attitudes by videogames students, through PAR and a partnership between an academic institution and an NGO in the field.

Considering RQ1, it was possible to document that students not only developed more knowledge on how to create accessible games for pwID, but also showed a better understanding of accessibility measures that are in line with an inclusive design perspective. The centrality assumed by customization seems to be aligned with the development of a more person-centered approach to game design and development by students. Moreover, the results obtained regarding the implementation of customization within the development games were also obtained through the integration of students' creative vision and the narrative of having ID, provided by these individuals through playtesting. This empirically validates the premises approached by Harrell [41] on customization options needed to result from a co-construction perspective, that allow them to be implemented and situated critically. Gameplay adaptation to accommodate players' needs, also showed how students started reflecting on accessibility more as part of the game essence, instead of being accessory, consequential, or only *a posteriori*.

The development of physical interfaces as part of the process was also a relevant step towards the development of more accessible experiences, considering cognitive and motor support needs. Moreover, through this process, students were able to acquire a set of concrete skills, including the systematization of affordances and constraints, 3D modulation, ergonomics definition, and physical computing. The transmission of these skills seemed also to facilitate the processes of students' engagement and focus. It is recurrent for students to get to this point without ever having soldered or stripped a cable and end up helping less competent peers in the process, which adds a, so often rare, stimulus of physical interaction. For many of them, who spend the vast majority of their daily hours developing digital content, the development of a functional object was a novelty. These are people whose training and experience have kept them away from tangible creation, where a simple pair of pliers seem to have unveiled functions. We believe that, as Poissant [42] argues, the tangible dimension is still indispensable, and was an asset in the development of inclusive and accessibility-driven game design and development skills.

The development of skills by students, through the proposal of this specific challenge, also supports the feasibility of PBL in higher education, particularly to train more inclusion-driven media creators. It also stresses the importance of connecting their pedagogical development with institutions outside of the "academic circle", as a strategy to effectively tackle real-world problems and practices [19], in this case, the digital divide, or the exclusion of pwID from the gaming industry. Therefore, students' answers and feedback can be also seen as a hands-on, participatory model for both cognitive and motor accessibility that was co-constructed, even if requiring further discussion and validation.

It is also possible to emphasize that, while these results provide insights on the effectiveness of a combination between game design-based learning, PAR, and collaboration, they do not base conclusions about each one of these components *per se*. Although this was a methodological decision based on previous contributions regarding the pedagogies of accessibility, such as the one made by Putnam et al. [12], it still opens space for further research with non-combined methods.

This exploratory approach also provided some data regarding game design and development as strategies to foster more inclusive views of society, such as questioned in RQ2. Students' results, obtained from CLAS-ID and their attitudes regarding games for the inclusion of pwID showed the relevance of the proposed approach to the development of

more positive beliefs in these fields. The relevance of these results can be better explained by the premise of Gilbert [43], establishing that prejudice and stereotypes are an enormous barrier to the adoption of an attitude the author calls “designing with accessibility in mind”. This is supported by the less stigmatizing attitudes towards the empowerment, sheltering, or similarity with pwID, but also by the critical posture students acquired of accessibility as a human right, with the potential for improving game experience for everyone.

Moreover, students showed the effort to provide pwID with experiences that positively enrich their daily lives, while democratizing the classic aesthetic of videogames, even though none of this was in the briefing they were given. This highlights how more, besides accessibility, also inclusivity was approached in the developed media objects, presenting narratives that result from the integration of students’ creative intents, and the experience of being an institutionalized adult with ID during a pandemic.

Overall, students showed positive perceptions of the value of their involvement in the proposed practice to the future they will have as game designers or game developers. While acknowledging how demanding the process was, students were also able to link it with the valuable knowledge outcome they developed. Also, a proactive, autonomous research attitude was shown by students during it, with clarifications and support materials being frequently delivered on demand. These results provide data on the perceived value of this collaborative experiences for students, even if needs further development in the future, considering the sample size and the contextual homogeneity of the participants.

The restrictions imposed by the COVID-19 pandemic were also central in students’ debates about the experience. These were seen, both by researchers and subjects, as decreasing the collaboration between the three main stakeholders, namely pwID, students, and researchers, while increasing the mediation and needed intermediaries to keep the voice of the target audience included in the process. As discussed above, it also affected the narratives presented in the developed games, which seemed to be very centered around the experience of isolation. This aspect is very interesting since, while we centrally associate this with the pandemic context, Bartlett [44] also considered isolation a frequent, or even continuous, experience for people with disabilities. Such a premise, aligned with our conclusions, could support further investigation on the association between accessibility practices and how gaming worlds can provide alternative spaces and situational refuge for this population, aligned with work by Wästerfors and Hansson [25].

Still, regarding the pandemic context in which the study took place, it is essential to emphasize its influence on the results obtained through the students’ perception of the need to increase interpersonal and “live” relationships with the target audience. Although unintentionally, this is one of the main future directions that emerged from this approach, the need to increase spontaneous and personal contact between the two groups, students and pwID.

While the present study offers relevant insights into the importance of engaging students and pwID, through participatory approaches, in the accessibility and inclusion-driven training of game designers and game developers, it is important to emphasize its exploratory nature. Factors such as the sample size, the sampling strategy, the inclusion of the study in a broader process of formal education, and consequently evaluation, condition how the results obtained can be generalized. Thus, it is relevant to consider this study as a set of preliminary findings, to be further explored in other contexts and through broader methodological approaches.

Besides more extensive studies with similar objectives, exploring and comparing the beliefs of both parties’ views would be crucial to understand the extent of the obtained results. Therefore, future studies should compare students’ perceptions with pwID perceptions about the development process. Through this process, it would be possible to understand if the produced games represent the narrative of pwID, and the cohesion between game designers and the target audience’s beliefs, which would represent an added value.

5. Conclusions

The results obtained in the present study provide empirical bases to game design and development-based learning processes, as a novel approach in the field of game-based learning, which includes accessibility as a pillar while fostering the representation of underrepresented groups, multimodality, and tangibility. Its conclusions, regarding the skills related to games accessibility that were promoted in the students, stress the importance of tightening the bond between academia and civil society organizations, such as NGOs of pwID, to foster social change through participatory media creation, and inclusive learning processes.

Regarding the pedagogical value of the current approach to the game developers/students, it was relevant on two different levels: the development of accessibility-driven skills and decreasing discriminatory beliefs towards individuals with ID. Moreover, students showed lower levels of discriminatory beliefs toward pwID, adopting attitudes more in line with the principles of empowerment and community inclusion. Both results can be seen as relevant for the development of better professionals in the future that can genuinely incorporate accessibility-driven practices into their work while fostering inclusion and representation in the games industry.

The participatory process was heavily conditioned by the restrictions imposed by the COVID-19 pandemic, and characterized by its exploratory nature. Although several efforts were developed to ensure that the voice of the pwID was listened to by the game developers/students, this process was mainly mediated, which can cause different biases. This highlights the relevance of validating the present conclusions in a different context and larger samples. Testing other approaches to sampling, besides convenience, could also be relevant to improve the potential for results' generalization. The lack of subjects fully completing the questionnaires is also a limitation of the present study, which shortened the included sample, while reinforcing higher education students' survey fatigue.

Future studies should also address how these processes result in media representing the narrative of having a disability, as a strategy to increase underrepresented groups' voices while keeping the underpinned methodological concerns. Besides expanding the sample, this must be done by critically analyzing the players' perceptions, framed with the results obtained in the game designers/developers' inquiry.

Author Contributions: Conceptualization: C.S., J.C.N. and M.J.D.; Data curation: C.S.; Formal analysis: C.S. and J.C.N.; Funding acquisition: no funding was acquired for the specific scope of this article; Investigation: C.S.; Methodology: C.S., J.C.N. and M.J.D.; Project administration: J.C.N. and C.S.; Resources: J.C.N. and C.S.; Software: J.C.N. and C.S.; Supervision: M.J.D. and J.C.N.; Validation: C.S., J.C.N. and M.J.D.; Visualization: C.S. and J.C.N.; Writing—original draft: C.S. and J.C.N.; Writing—review and editing: J.C.N. and M.J.D. All authors have read and agreed to the published version of the manuscript.

Funding: The present work was funded on the scope of a scholarship attributed by the Centre for Research in Applied Communication, Culture, and New Technologies (CICANT) to the first author. CICANT is co-funded by the Portuguese Foundation for Science and Technology (*Fundação para a Ciência e a Tecnologia*; FCT).

Institutional Review Board Statement: The study was conducted in accordance with the European Federation of Academies of Sciences and Humanities (ALLEA) Code of Conduct for Research Integrity, and approved by the Lusophone Research and Development Institute (*Instituto Lusófono de Investigação e Desenvolvimento*; ILIND) Ethics Committee (statement no. 6 from 27th of September 2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are openly available in FigShare at <https://doi.org/10.6084/m9.figshare.17187020> and at <https://doi.org/10.6084/m9.figshare.17187731>. All names and other data that made participants potentially identifiable was replaced by numerical IDs.

Acknowledgments: The research team acknowledges the support of *Associação de Pais e Amigos de Deficientes Profundos* (APADP) in the game development processes. The team also thanks Hernâni Pawlick David for providing students with advice and coordination regarding the games' programming.

Conflicts of Interest: The authors declare no conflict of interest regarding the present study.

References

1. Stewart, J.; Bleumers, L.; Van Looy, J.; Mariën, I.; All, A.; Schurmans, D.; Willaert, K.; De Grove, F.; Jacobs, A.; Misuraca, G. *The Potential of Digital Games for Empowerment and Social Inclusion of Groups at Risk of Social and Economic Exclusion: Evidence and Opportunity for Policy*; Publications Office of the European Union: Luxembourg, 2013.
2. Lukacs, A.; Embrick, D.G.; Wright, J.T. *Social Exclusion, Power, and Video Game Play—New Research in Digital Media and Technology*; Lexington Books: Lanham, MD, USA, 2012.
3. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition (DSM-5)*; American Psychiatric Publishing: Arlington, VA, USA, 2013.
4. Berger, R.J.; Lorenz, L. Disability and Qualitative Research. In *Disability and Qualitative Inquiry—Methods for Rethinking an Ableist World*; Berger, R.J., Lorenz, L., Eds.; Routledge: New York, NY, USA, 2015; pp. 1–12.
5. Jiménez, M.R.; Pulina, F.; Lanfranchi, S. Video games and Intellectual Disabilities: A literature review. *Life Span Disabil.* **2015**, *18*, 147–165.
6. Flink, A.R.; Boström, P.; Gillberg, C.; Lichtenstein, P.; Lundström, S.; Åsberg Johnels, J. Exploring Co-Occurrence of Sensory, Motor and Neurodevelopmental Problems and Epilepsy in Children with Severe-Profound Intellectual Disability. *Res. Dev. Disabil.* **2021**, *119*, 104114. [[CrossRef](#)] [[PubMed](#)]
7. Gray, K.; Leonard, D. Not a Post-Racism and Post-Misogyny Promised Land: Video Games as Instruments of (In)Justice. In *Woke Gaming: Digital Challenges to Oppression and Social Justice*; Gray, K.L., Leonard, D.J., Eds.; University of Washington Press: Seattle, WA, USA, 2018; pp. 3–23.
8. Greco, G.M. Towards a pedagogy of accessibility: The need for critical learning spaces in media accessibility education and training. *Linguist. Antwerp. New Ser. Themes Transl. Stud.* **2020**, *18*, 23–46. [[CrossRef](#)]
9. Romero-Fresco, P. Accessible filmmaking: Joining the dots between audiovisual translation, accessibility and filmmaking. *J. Spec. Transl.* **2013**, *20*, 201–223.
10. Putnam, C.; Dahman, M.; Rose, E.; Cheng, J.; Bradford, G. Teaching Accessibility, Learning Empathy. *ASSETS* **2015**, *15*, 333–334. [[CrossRef](#)]
11. Franganillo, J.; Sánchez, L.; Asensio, M.; Ángeles, G.; Marquès, A. Aprendizaje emocional y de valores en la formación universitaria, aplicado al grado de Comunicación Audiovisual de la Universidad de Barcelona. *Rev. Lat.* **2021**, *79*, 151–173. [[CrossRef](#)]
12. Vlachopoulos, D.; Makri, A. The effect of games and simulations on higher education: A systematic literature review. *Int. J. Educ. Technol. High. Educ.* **2017**, *14*, 22. [[CrossRef](#)]
13. BAGAAR. User Interface (Digital Game). 2018. Available online: <https://userinterface.com/> (accessed on 22 November 2021).
14. Small, C. SweetXheart (Digital Game). 2019. Available online: <https://cattsmall.itich.io/sweetxheart> (accessed on 22 November 2021).
15. Kafai, Y.B.; Burke, Q. *Connected Gaming—What Making Video Games Can Teach Us about Learning and Literacy*; The MIT Press: Cambridge, MA, USA, 2016.
16. Fowler, A. Informal STEM Learning in Game Jams, Hackathons and Game Creation Events. *GJHGC* **2016**, *16*, 38–41. [[CrossRef](#)]
17. Kokotsaki, D.; Menzies, V.; Wiggins, A. Project-based learning: A review of the literature. *Improv. Sch.* **2016**, *19*, 267–277. [[CrossRef](#)]
18. McDonald, H. iThrive Games Empathy Jam at DigiPen. In Proceedings of the International Conference on Game Jams, Hackathons, and Game Creation Events, San Francisco, CA, USA, 18 March 2018; pp. 28–33.
19. Schrier, K.; Ohu, E.; Bodunde, I.; Alugo, M.; Emami, C.; Babatunde, A. Piloting a Game Jam in Nigeria to Support Empathy and Compassion. In Proceedings of the Sixth Annual International Conference on Game Jams, Hackathons, and Game Creation Events, Online, 2 August 2021; pp. 60–63.
20. Selener, D. *Participatory Action Research and Social Change*; The Cornell Participatory Action Research Network: New York, NY, USA, 1997.
21. Waern, A.; Back, J. Experimental Game Design. In *Game Research Methods*; Lankoski, P., Björk, S., Eds.; ETC Press: Pittsburgh, PA, USA, 2015; pp. 341–353.
22. Dlab, M.H.; Hoic-Bozic, N. Effectiveness of game development-based learning for acquiring programming skills in lower secondary education in Croatia. *Educ. Inf. Technol.* **2021**, *26*, 1–24. [[CrossRef](#)]
23. Rugelj, J.; Lapina, M. Game Design Based Learning of Programming. In Proceedings of the SLET—2019 International Scientific Conference Innovative Approaches to the Application of Digital Technologies in Education and Research, Stavropol-Dombay, Russia, 20–23 May 2019.
24. Sousa, C. Empowerment and ownership in intellectual disability gaming. *Int. J. FILM Media ARTS* **2020**, *5*, 14–23. [[CrossRef](#)]
25. Wästerfors, D.; Hansson, K. Taking ownership of gaming and disability. *J. Youth Stud.* **2017**, *17*, 1–18. [[CrossRef](#)]

26. MacDonald, C. Understanding Participatory Action Research: A Qualitative Research Methodology Option. *Can. J. Act. Res.* **2012**, *13*, 34–50.
27. Gaventa, J.; Cornwall, A. Power and knowledge. In *The SAGE Handbook of Action Research: Participative Inquiry and Practice*; Reason, P., Bradbury, H., Eds.; SAGE: London, UK, 2008; pp. 172–189.
28. Balcazar, F.E.; Keys, C.B.; Kaplan, D.L.; Suarez-Balcazar, Y. Suarez-Balcazar. Participatory action research and people with disabilities: Principles and challenges. *Can. J. Rehabil.* **1998**, *12*, 105–112.
29. Lieberoth, A.; Roepstorff, A. Mixed methods in game research—Playing on strengths and countering weaknesses. In *Game Research Methods*; Lankoski, P., Björk, S., Eds.; ETC Press: Pittsburgh, PA, USA, 2015; pp. 271–289.
30. Henry, D.; Keys, C.; Jopp, D.; Balcazar, F. The Community Living Attitudes Scale, Mental Retardation Form: Development and psychometric properties. *Ment. Retard.* **1996**, *34*, 149–158. [[PubMed](#)]
31. Su, H.; Cuskelly, M.; Gilmore, L.; Sullivan, K. Examination of a Scale Assessing Attitudes towards Individuals with Intellectual Disability in China. *Int. J. Disabil. Dev. Educ.* **2015**, *62*, 660–675. [[CrossRef](#)]
32. Wilson, M.C.; Scior, K. Implicit Attitudes towards People with Intellectual Disabilities: Their Relationship with Explicit Attitudes, Social Distance, Emotions and Contact. *PLoS ONE* **2015**, *10*, e0137902. [[CrossRef](#)]
33. Fyson, R.; Cromby, J. Human rights and intellectual disabilities in an era of ‘choice’. *J. Intellect. Disabil. Res.* **2012**, *57*, 1164–1172. [[CrossRef](#)] [[PubMed](#)]
34. Scior, K.; Addai-Davis, J.; Kenyon, M.; Sheridan, J.C. Stigma, public awareness about intellectual disability and attitudes to inclusion among different ethnic groups. *J. Intellect. Disabil. Res.* **2012**, *57*, 1014–1026. [[CrossRef](#)]
35. Sousa, C.; Cardoso, D.; Costa, C.; Tyner, K. Making Games, Making Literacy: A Case-Study in Formal Educational Contexts. In Proceedings of the 12th European Conference on Games Based Learning (ECGBL), Sophia Antipolis, France, 4–5 October 2018; pp. 608–615.
36. Ball, L.J.; Ormerod, T. Putting ethnography to work: The case for a cognitive ethnography of design. *Int. J. Hum. Comput. Stud.* **2000**, *53*, 147–168. [[CrossRef](#)]
37. Schröder, K.; Drotner, K.; Kline, S.; Murray, C. *Researching Audiences*; Hodder Arnold: London, UK, 2003.
38. Boyatzis, R. *Transforming Qualitative Information: Thematic Analysis and Code Development*; Sage: Thousand Oaks, CA, USA, 1998.
39. Lombard, M.; Snyder-Duch, J.; Bracken, C.C. Content Analysis in Mass Communication: Assessment and Reporting of Intercoder Reliability. *Hum. Commun. Res.* **2002**, *28*, 587–604. [[CrossRef](#)]
40. McGrath, C.; Rudman, D.L. Using Participant Observation to Enable Critical Understandings of Disability in Later Life: An Illustration Conducted With Older Adults With Low Vision. *Int. J. Qual. Methods* **2019**, *18*, 1–11. [[CrossRef](#)]
41. Harrell, D.F. Designing empowering and critical identities in social computing and gaming. *CoDesign* **2010**, *6*, 187–206. [[CrossRef](#)]
42. Poissant, L. *Esthétique des Arts Médiatiques: Interfaces et Sensorialité*; Publications de l’Université de Saint-Étienne: Saint-Étienne, France, 2003.
43. Gilbert, R.M. *Inclusive Design for a Digital World: Designing with Accessibility in Mind*; Apress: New York, NY, USA, 2019.
44. Bartlett, M. The World Now Understands AbleGamers’ Mission. Keynote Presentation. Games for Change Festival. 14 July 2020. Available online: <https://www.youtube.com/watch?v=qQalLR6v-GI> (accessed on 20 January 2022).