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Peg.Ada: uncovering digital footprint's career impact for girls

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Abstract This article introduces an educational game designed to teach girls about the concept of digital footprinting. The primary objective of the game is to impart knowledge on the significance of safeguarding their online privacy and security while encouraging responsible digital citizenship. The game's design incorporates a playful and interactive approach, integrating challenges that engage and sustain the players' interest. We envision this game as a valuable resource for educators and professionals working with girls, aiming to enhance their comprehension of their online presence. The game was applied in a workshop at a high school in Brazil, providing a hands-on opportunity for female students to use acquired concepts and stimulate meaningful discussions on digital security. The results showed that usability, gameplay, and learning issues were all well evaluated.

Keywords: Digital footprint, Educational game, Digital inclusion

1 Introduction

The topic of digital inclusion has received increasing attention with the advancement of technology. Digital inclusion can be defined as the activities necessary to ensure that all individuals and communities, particularly the most disadvantaged, have access to and can effectively use information and communication technologies. According to Warschauer [2004], digital inclusion extends beyond merely providing computers and internet access; it encompasses considerations of physical, digital, human, and social resources.

The effectiveness of digital inclusion is closely tied to the accessibility of quality education, as individuals with greater financial resources and better instruction are more likely to navigate technology effectively, leading to advantages such as enhanced employment opportunities. In Brazil, data from 2021 highlights stark disparities in digital access based on social class; only 10% of classes D and E report having a computer at home, compared to 41% in class C and 83% and 99% in classes B and A, respectively CETIC.BR [2022]. Additionally, findings from the same survey indicate that women predominantly access the internet via mobile phones compared to men. This trend implies a reduced likelihood of participating in online courses and remote work, given the challenges associated with smaller screens and the absence of a mouse and keyboard. This inefficiency not only hampers motivation but also contributes to negative impacts such as lower wages and less satisfying job opportunities for women. However, with proficient knowledge of digital tools, women could positively impact their careers and unlock more advantageous opportunities. Employers are increasingly using digital resources for recruitment, and the lack of efficient internet access among women has excluded them from such selections. A more effective approach to digital inclusion for women has the potential to significantly boost their income Mariscal *et al*. [2019].

The concern for gender equality in the utilization of information technologies has grown in significance, particularly due to persistent gender disparities in global access and usage of these technologies. The United Nations (UN) responded to this challenge by launching the 2030 Agenda, a global initiative dedicated to fostering sustainable and conscientious development worldwide. Comprising 17 objectives and 169 targets, the agenda articulates the Sustainable Development Goals (SDGs). In this context, SDG 5 is dedicated to achieving gender equality. Within SDG 5, sub-objective 5.b specifically addresses the need to "increase the use of basic technologies, particularly information and communication technologies, to promote women's empowerment" UN [2015]. Through this initiative, the UN aims to enhance women's and girls' access to and utilization of information and communication technologies.

With the goal of democratizing access to technology in Brazil, the Digital Girls Program, established in 2011 by the Brazilian Computing Society (SBC), seeks to inspire young women to pursue careers in Information and Communication Technology. The program achieves this objective by providing short courses, workshops, events, and other activities Maciel *et al*. [2018]. As a national initiative addressing the underrepresentation of girls in information technology fields, which are predominantly occupied by men, it becomes imperative to implement measures that guarantee equal opportunities for women in utilizing technology. Such measures are crucial to prevent women from being relegated to the background due to social and cultural inequalities.

The concept of a digital footprint is closely intertwined with digital inclusion, as individuals who effectively manage their digital footprints often gain more opportunities and enjoy better social placements. Digital footprints are traces of data that internet users leave behind intentionally or unintentionally McDermot [2018]. To define it more broadly, it can be said that "digital footprints are an aggregate of data derived from the digitally traceable behavior and online presence of an individual" Micheli *et al*. [2018]. Some examples

are posts on social media and participation in forums. In 2022, 80% of people using the internet in Brazil accessed social media CETIC.BR [2022]. This implies more people using the networks recklessly and without instruction, leaving traces of their lives in the virtual world without realizing the potential consequences. In this context, educating individuals about digital footprints becomes imperative. This knowledge equips people to understand what they should or should not post on their personal profiles, safeguarding them from potential disadvantages and enabling them to derive benefits from creating a positive digital footprint.

In this context, there is a need to create more efficient methods for learning about digital footprints, especially among young people. One of these methods is learning objects (LO), which are resources used to help teach students. LOs can be text, images, videos, animations, and even educational games. Among the many advantages that LOs offer, it is possible to mention that they make students more interested in the content and develop logical reasoning and creativity McGreal [2004].

The objective of this work was to develop an educational game focused on digital footprints, aimed at instructing high school girls on the importance of conscientiously managing their online presence. The game can guide them about ethics, digital security and provides practical examples of navigating various internet scenarios. The goal is to share knowledge on how to prevent the formation of a negative digital footprint, in a playful and engaging manner. Additionally, the game seeks to educate players on the significance of maintaining professional social networks and the correct strategies for managing them, thereby fostering the creation of a positive online footprint. The intention is to observe a tangible, long-term improvement in the digital footprint of girls impacted by the game, enabling them to uphold a positive digital image and secure enhanced employment opportunities in the future.

As part of this effort, a workshop was conducted at a high school involving female high school students, providing a practical application of the concepts of inclusion and digital footprint. Furthermore, a form was applied to assess the girls' knowledge about digital footprint, before and after playing. Following the gameplay, a discussion session was facilitated to explore the specifics of the game's development. This hands-on experience not only enriched our comprehension of the significance of affording proper access to technology but also underscored the critical importance of imparting knowledge on its conscientious and responsible use. The inclusion of women in the gaming industry and the creation of games that address relevant themes for them are important steps towards promoting diversity and gender equality in this sector. In this regard, Peg.Ada plays a significant role by providing a concrete example of a game developed by a woman, aimed at educating and engaging players, while also inspiring other women to enter the gaming industry

This article represents an expanded edition of a previously published work Vinhal and Odakura [2023]. This version brings a new dimension by presenting the Peg.Ada game specifically with female students in a high school environment and conducting a comprehensive evaluation within the target audience.

The work is organized as follows: Section 2 covers related work. The developed game is described in the Section 3. The results obtained after evaluating the educational game are presented in Section 4. Some details about the workshop with the girls at school and the related results are shown in Section 5. Section 6 covers the limitations of the study. Finally, the conclusions are reported in the 7 section.

2 Related works

An interesting digital footprint tool is "DataMirror" proposed by Htait *et al*. [2020], which allows Internet users to group their digital data so they can search and view what they have already posted on the internet. The aim of the tool is to investigate and explore people's awareness of their online projected data. "DataMirror" aims to educate people on how they should act on the internet to avoid leaving negative footprints in the digital world. "DataMirror" collects and shows the footprints that have already been left by the user, but does not specifically address what the digital footprint should look like. In the same way as "DataMirror", this work addresses the topic of digital footprint but will be done in the format of an educational game, which provides more fun and engaging learning for those who are using it.

The project presented by Mancheno Gutiérrez [2021] is an attempt to develop chatbots specifically designed to engage users in discussions about digital footprints. These chatbots employ Natural Language Processing (NLP) and the Chatterbot Python package to attain a level of intelligence conducive to meaningful interactions with users. While both this project and the aforementioned work share a commonality in employing interactive and enjoyable methods for education, it's essential to note a distinction: a game offers diverse forms of interaction, including a more intricate visual aspect, setting it apart from a chatbot. Notably, the chatbot in the mentioned project is designed for children, whereas the current work targets high school students and addresses more mature themes, such as considerations related to the job market.

An earlier work, "Mundo Bit Byte" Araujo *et al*. [2022], serves as a foundational project in the field of educational digital footprint tools. This initiative created an interactive platform aimed at teaching younger audiences about the importance of managing their digital identities. By incorporating gamified elements and engaging storytelling, "Mundo Bit Byte" successfully raised awareness and promoted best practices for online behavior.

3 Peg.Ada

The "Peg.Ada" game was developed with the aim of teaching high school and college girls about digital footprinting. Andressa Vinhal, the developer of the game and computer engineering student at the time, designed it as an educational tool that helps raise awareness among players regarding the risks and repercussions associated with sharing personal information on the internet. The game is designed to be played on desktops and offers an interactive experience that supports teaching digital footprint concepts in an engaging and fun

way. Through “Peg.Ada”, players have the opportunity to obtain insights into privacy, security, and best online practices, all while enjoying the gaming experience. The name of the game, ”Peg.Ada,” is derived from two sources. Firstly, it draws from the term ”pegada”, which in Portuguese means ”footprint”. Secondly, it pays homage to Ada Lovelace, an influential mathematician and writer, often regarded as the world’s first computer programmer. Ada Lovelace holds immense significance for women in computing.

The game was designed for desktop use because it would facilitate future workshops in schools, as it could be easily downloaded onto the computers in the labs, and also because the author had more experience with desktop game development. There was no attention given to accessibility features. Nonetheless, addressing accessibility remains an important aspect for potential future enhancements and research efforts. The game was developed using the Unity[1] tool, with C# as its main programming language. All of the game’s arts were created using a free online *Pixel Art* editor called Piskel[2]. The game is available for download in two places, Google Drive[3] and GitHub[4]. The game’s initial screen is depicted in Figure 1, while Figure 2 showcases an image capture of one of the scenes.

Figure 1. Home screen of the game. The game is in Portuguese. Besides the game title, there is a button labeled ’Play’ and ’Exit’.

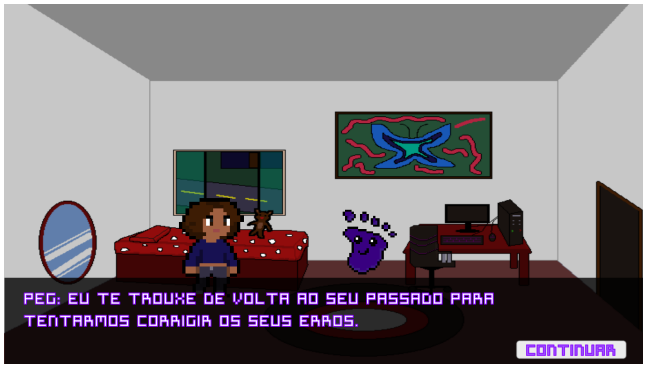


Figure 2. Screenshot captured in one of the game’s scenes. The game’s dialogue is in Portuguese. In the scene, the character Peg is saying to Ada, ’I brought you back to your past to try to correct your mistakes.’

[1]Unity, Available at: https://unity.com/pt Accessed in April 2023.

[2]Piskel, available at: https://www.piskelapp.com/ Accessed in April 2023

[3]Google Drive, Available at: https://bit.ly/Peg-Ada Accessed in April 2023.

[4]GitHub, Available at : https://github.com/AndressaRV/Peg.Ada Accessed April 2023.

The game’s development began with the preparation of a Short Game Design Document (SGDD) as presented by Motta and Junior [2013]. The SGDD is a game plan encompassing all essential details of the project. Within the SGDD, a summary of the story, gameplay, arts and sounds, interface, and overall game flow are outlined. Figure 3 briefly describes the game’s plot and some information about the main character. The main character is Ada, a girl who embarks on an incredible journey accompanied by Peg, a footprint who helps her revisit and reflect on her digital footprint. The game flow, depicted in Figure 4, illustrates the player’s available choices and the corresponding outcomes. It functions similarly to a flowchart, elucidating the consequences of each option and providing a comprehensive overview of the game. This includes the sequence of screens, exemplified by transitioning from the ”home menu” to the ”game summary” screen, elucidating the game’s progression. Figure 5 offers a detailed glimpse into the game’s artistic, auditory, and programming components. The game is not open-source. This means that the source code is not available for public access and modification.

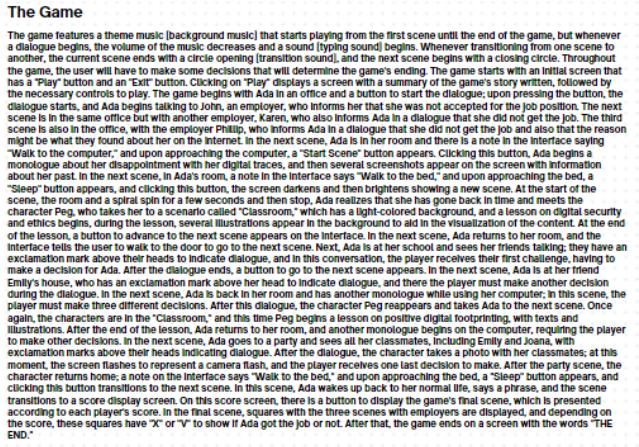
Peg.Ada

Short Game Design Document

Story

Ada, the main character, a 23-year-old who has just graduated from university. After many failed attempts to find a job, she begins to question why no company wants to hire her. Later, she discovers that what is hindering her entry into the job market is the terrible digital footprint she left on the internet throughout her life. One day, she wakes up in her bed and realizes that she is in the same room where she slept in her parents' house when she was a teenager. After calming down, she realizes that she is in the past, when she was 16 years old, and meets Peg, a being shaped like a footprint, who has brought her back in time to learn about digital footprinting to correct her mistakes during high school and try to change her future.

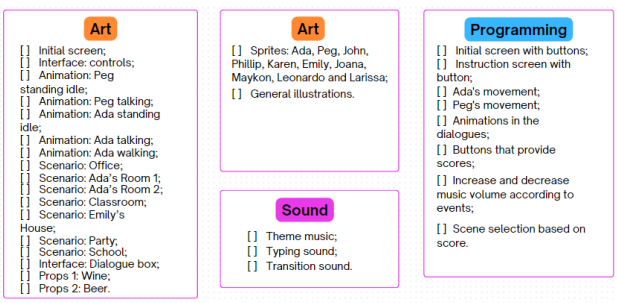
Figure 3. The story described in the Short Game Design Document.



The Game

The game features a theme music [background music] that starts playing from the first scene until the end of the game, but whenever a dialogue begins, the volume of the music decreases and a sound [typing sound] begins. Whenever transitioning from one scene to another, the current scene ends with a circle opening [transition sound], and the next scene begins with a closing circle. Throughout the game, the user will have to make some decisions that will determine the game's ending. The game starts with an initial screen that has a "Play" button and an "Exit" button. Clicking on "Play" displays a screen with a summary of the game's story written, followed by the necessary controls to play. The game begins with Ada in an office and a button to start the dialogue; upon pressing the button, the dialogue starts, and Ada begins talking to John, an employer, who informs her that she was not accepted for the job position. The next scene is in the same office but with another employer, Karen, who also informs Ada in a dialogue that she did not get the job. The third scene is also in the office, with the employer Phillip, who informs Ada in a dialogue that she did not get the job and also that the reason might be what they found about her on the internet. In the next scene, Ada is in her room and there is a note in the interface saying "Walk to the computer," and upon approaching the computer, a "Start Scene" button appears. Clicking this button, Ada begins a monologue about her disappointment with her digital traces, and then several screenshots appear on the screen with information about her past. In the next scene, in Ada's room, a note in the interface says "Walk to the bed," and upon approaching the bed, a "Sleep" button appears, and clicking this button, the screen darkens and then brightens showing a new scene. At the start of the scene, the room and a spiral spin for a few seconds and then stop, Ada realizes that she has gone back in time and meets the character Peg, who takes her to a scenario called "Classroom," which has a light-colored background, and a lesson on digital security and ethics begins, during the lesson, several illustrations appear in the background to aid in the visualization of the content. At the end of the lesson, a button to advance to the next scene appears on the interface. In the next scene, Ada returns to her room, and the interface tells the user to walk to the door to go to the next scene. Next, Ada is at her school and sees her friends talking; they have an exclamation mark above their heads to indicate dialogue, and in this conversation, the player receives their first challenge, having to make a decision for Ada. After the dialogue ends, a button to go to the next scene appears. In the next scene, Ada is at her friend Emily's house, who has an exclamation mark above her head to indicate dialogue, and there the player must make another decision during the dialogue. In the next scene, Ada is back in her room and has another monologue while using her computer; in this scene, the player must make three different decisions. After this dialogue, the character Peg reappears and takes Ada to the next scene. Once again, the characters are in the "Classroom," and this time Peg begins a lesson on positive digital footprinting, with texts and illustrations. After the end of the lesson, Ada returns to her room, and another monologue begins on the computer, requiring the player to make other decisions. In the next scene, Ada goes to a party and sees all her classmates, including Emily and Joana, with exclamation marks above their heads indicating dialogue. After the dialogue, the character takes a photo with her classmates; at this moment, the screen flashes to represent a camera flash, and the player receives one last decision to make. After the party scene, the character returns home; a note on the interface says "Walk to the bed," and upon approaching the bed, a "Sleep" button appears, and clicking this button transitions to the next scene. In this scene, Ada wakes up back to her normal life, says a phrase, and the scene transitions to a score display screen. On this score screen, there is a button to display the game's final scene, which is presented according to each player's score. In the final scene, squares with the three scenes with employers are displayed, and depending on the score, these squares have "X" or "V" to show if Ada got the job or not. After that, the game ends on a screen with the words "THE END."

Figure 4. Game flow described in the Short Game Design Document.



Art

[ ] Initial screen;
[ ] Interface: controls;
[ ] Animation: Peg standing idle;
[ ] Animation: Peg talking;
[ ] Animation: Ada standing idle;
[ ] Animation: Ada talking;
[ ] Animation: Ada walking;
[ ] Scenario: Office;
[ ] Scenario: Ada's Room 1;
[ ] Scenario: Ada's Room 2;
[ ] Scenario: Classroom;
[ ] Scenario: Emily's House;
[ ] Scenario: Party;
[ ] Scenario: School;
[ ] Interface: Dialogue box;
[ ] Props 1: Wine;
[ ] Props 2: Beer.

Art

[ ] Sprites: Ada, Peg, John, Phillip, Karen, Emily, Joana, Maykon, Leonardo and Larissa;
[ ] General illustrations.

Sound

[ ] Theme music;
[ ] Typing sound;
[ ] Transition sound.

Programming

[ ] Initial screen with buttons;
[ ] Instruction screen with button;
[ ] Ada's movement;
[ ] Peg's movement;
[ ] Animations in the dialogues;
[ ] Buttons that provide scores;
[ ] Increase and decrease music volume according to events;
[ ] Scene selection based on score.

Figure 5. Art, programming, and sounds described in the Short Game Design Document.

3.1 Gameplay

The game employs a non-linear iterative narrative, meaning that the user's choices impact the final scene displayed, determined through a scoring system. Throughout the game, players will encounter questions, and their responses will result in a positive, negative, or neutral score. At the end of the game, the system will determine, according to the player's score, which scene should be shown. This outcome could either depict Ada successfully altering the past and achieving professional success or a scenario where she cannot change events, concluding the game similarly to its beginning. In Figure 6, there are representations of some of the situations involving professional social networks that the player will have to experience throughout the game. In Figure 7, it is possible to visualize two issues that will be worked on within the theme of digital security. Finally, in Figure 8, some situations are exposed that will aim to work on issues of digital ethics. These situations were designed with inspiration from research from Buchanan *et al*. [2016].

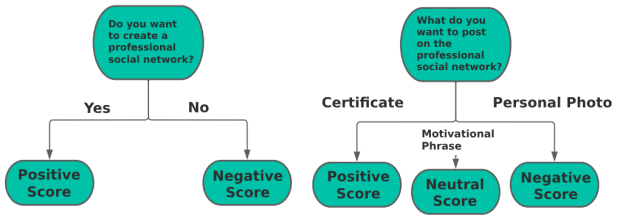


Figure 6. Examples of decisions related to professional social networks.

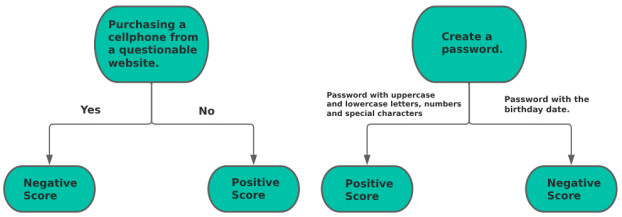


Figure 7. Examples of decisions related to digital security.

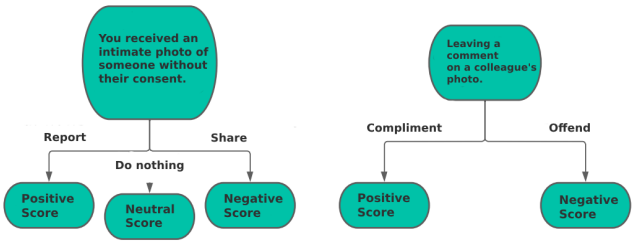


Figure 8. Examples of decisions related to ethics.

4 Evaluation

To obtain public feedback on the Peg.Ada game, a folder containing files to run the game was made available on Google Drive. This test aimed to evaluate the game's usability, satisfaction, relevance, learning, and other factors. The game was tested by 35 people who had no connection with the development of the work.

The feedback collection from players was conducted using a form[5] hosted on Google. The research included participation from high school and university students of various genders. A total of 35 responses were gathered, with 34.2% identifying as male, 60% as female, 2.9% as non-binary, and 2.9% choosing not to respond. Regarding age distribution, among the 35 players, 11.4% fall into the 23-26 age group, 65.7% are between 18-22, and 22.9% are 17 or younger. Figures 9 and 10 present a visual representation of this data. Given that the research involved high school and university students, Figure 11 illustrates the distribution across different grades and courses.

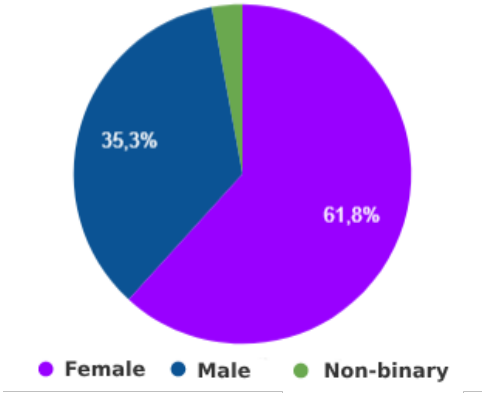


Figure 9. Gender distribution.

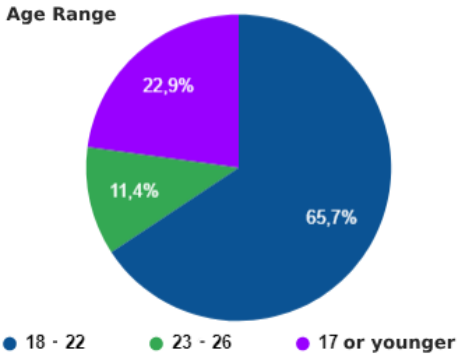


Figure 10. Age distribution.

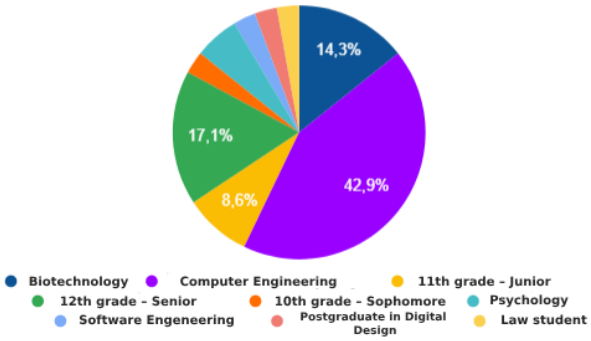


Figure 11. Distribution by grades and courses.

The questions in Figure 12 were based on the *System Usability Scale* Brooke *et al*. [1996] to evaluate the usability of

[5] Google Forms, Available at: https://forms.gle/J3sT9A5EmN8BV7xHA Accessed in April 2024.

the game. The answer options for the questionnaires in Figures 12, 13, 14 are: Totally disagree, disagree, indifferent, agree and totally agree. These options were created according to the Likert scale by Likert [1932]. From the responses about the game's usability, shown in Figure 12, it is clear that the public had a positive experience. All respondents totally disagreed that they would need technical help to play the game, 94.3% totally agreed with the statement "I found it easy to play" and 97.10% totally disagreed that they needed to learn many things in advance to be able to play.

In Figures 13 and 14, the questions were created based on important concepts in the evaluation of an educational game, such as: fun, learning, attention, challenge, satisfaction and relevance as stated by Amory and Seagram [2004]. The majority (80%) of players strongly agreed that they would recommend the game to their colleagues. For 80% of people, the game content is completely relevant and 77.1% completely agree that this game is a suitable method for this content. In terms of fun, 34.3% of players agreed that they had fun with the game, and 57% completely agreed. Some questions were asked to check whether the game's learning objectives were met. In Figure 14, it is clear that the objectives proposed by the game were achieved. All questions about learning received more than 80% of "I completely agree" responses, which means that most players considered that the game was effective in teaching them.

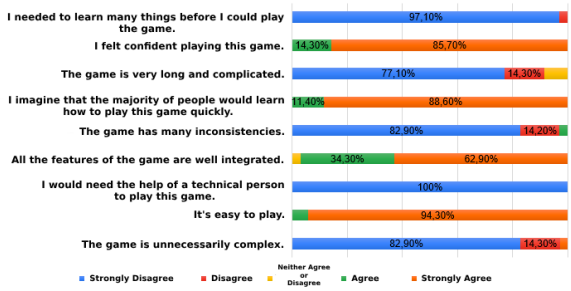


Figure 12. Usability questions.

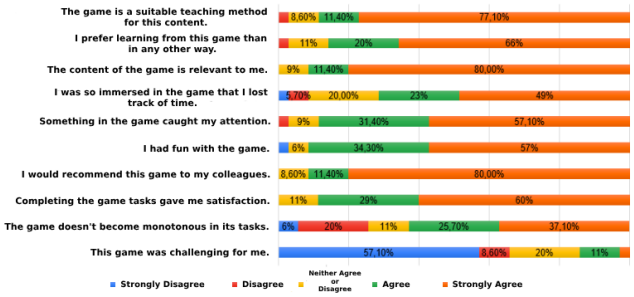


Figure 13. General questions.

At the end of the questionnaire, a space was made available for the player to write suggestions, criticisms and comments in general. From this, some relevant comments were selected. One of the compliments provided by a psychology student was: *"Very didactic game, and can even be recommended by psychology professionals, considering that it addresses important topics such as ethics and empathy."*. The font used in the game was pointed out by four respondents, citing a certain difficulty in understanding the writing due to

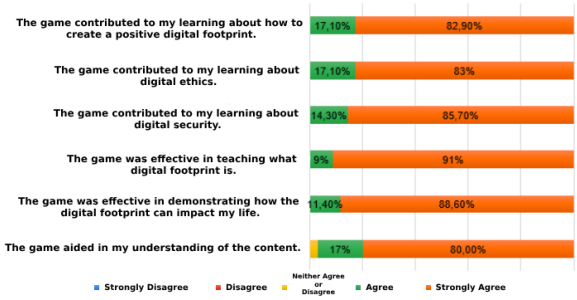


Figure 14. Questions about learning.

the pixelated design. This point will be reviewed in the next version of the game, in which the font will be changed.

Despite having girls as its target audience, the game was created to be accessible to all audiences, regardless of gender. However, it is expected that girls will have a greater identification with the game, because of the main character. The game obtained very positive results in research, which indicates that it was successful in its objective.

5 Workshop

To present the game in a practical setting, a workshop was conducted at Escola Estadual Professor Alício Araújo in the city of Dourados, Mato Grosso do Sul, Brazil. During this event, direct interaction took place with 19 high school girls, creating an environment conducive to the hands-on application of the Peg.Ada game. It was particularly rewarding to witness the active engagement of the participants as they connected with the characters and identified with the situations and challenges presented by the game. The computer lab was equipped with Windows computers and internet access. The game was pre-installed, and the students simply launched and used it. A teacher participated in the activity, and the feedback indicated that the students enjoyed and were engaged with the game. They also inquired about future sessions. The teacher approved of the content and suggested that similar workshops be conducted for boys as well.

Direct interaction with the students provided valuable feedback about the experience. Their opinions and suggestions proved crucial in enhancing the game's gameplay and its effectiveness as an educational tool for digital footprints.

A survey was conducted during the workshop at school in order to evaluate the effectiveness of the Peg.Ada game. It is important to highlight that the evaluation was specifically aimed at the game's target audience, made up exclusively of girls. Among the participants, 84.2% were 17 years old or younger and 15.8% were aged 18 to 22 years old. In relation to education, the significant majority, that is, 73.7%, were in the 2nd year of high school, while the rest were in the 3rd year of high school. These statistical details are visually represented in Figures 15 and 16. This exclusive approach to evaluation with the target audience provided a more accurate analysis of the effectiveness of Peg.Ada game with the group for which it was developed.

Feedback was collected by reusing the form applied in the previous survey. To assess the girls' prior knowledge before they start playing, the first question in the questionnaire is: "What is a digital footprint?" The results showed that 47.4%

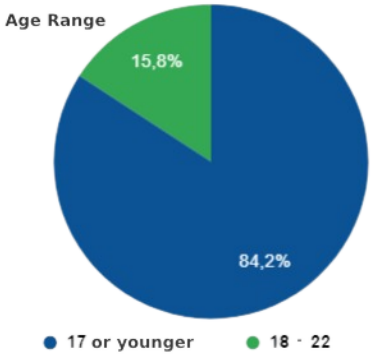


Figure 15. Age distribution.

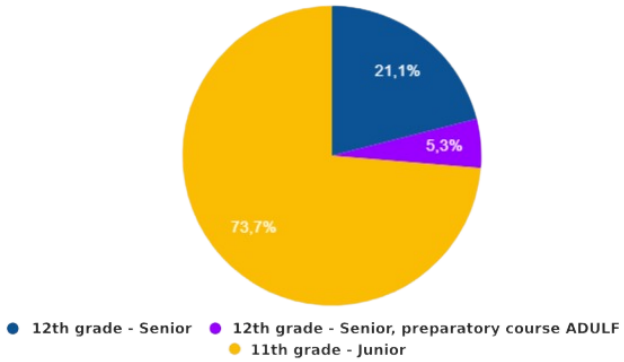


Figure 16. Distribution by education level.

of participants had a low level of familiarity with the term, as they answered "I don't know". And only 15.8% of the girls were able to answer the question in a very brief way. The remaining girls, 36.8%, answered it incorrectly. Examples of responses include *"it's an educational game"* or *"it's a digital era."* This highlights the importance of addressing the topic of digital footprint and offering clear, accessible information to promote awareness and understanding of online security. Figure 17 shows the results.

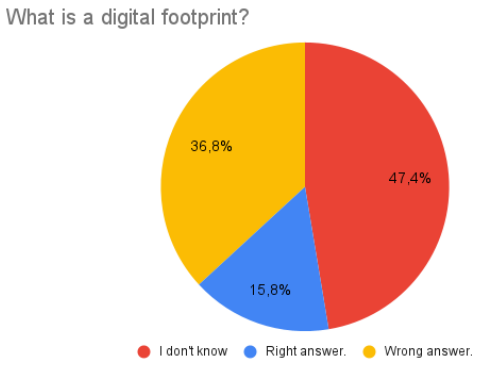


Figure 17. Students' responses to the concept of a digital footprint prior to engaging with the game.

The participants individually played Peg.Ada and after that, a second phase of the research was conducted in which they were asked again about the meaning of 'digital footprint'. The results were positive, with 94.7%, practically all the girls demonstrating a correct and precise understanding of the topic. This success highlights the game's effectiveness in conveying the concept of digital footprint in a clear and accessible way. The participant's ability to assimilate and apply this knowledge highlights the positive impact of the game's educational approach. Next, you can view the results in Figure 18. It is worth noting that, although specific questions about usability, gameplay and learning issues were included in the questionnaire, these aspects have already been covered previously in the previous survey results. The results obtained in these areas were equally positive in the current research, confirming the effectiveness of Peg.Ada in providing an effective and engaging educational experience for participants.

In addition to answers to the questionnaire questions, participants also shared their comments in the section designated for this. Expressions like *"Come back often"* indicate positive feedback and the girls' enthusiasm for the activity. Some students highlighted the importance of the game, stating that it is essential for learning about the digital world, promoting positive practices on social networks and strengthening character when faced with situations on the internet. At the end of the workshop presentation, some participants showed a notable interest in game development. They expressed curiosity and even asked for tips to start creating their own games. This reception not only highlights Peg. Ada's effectiveness as an educational tool, but also highlights its inspirational potential for future game developers.

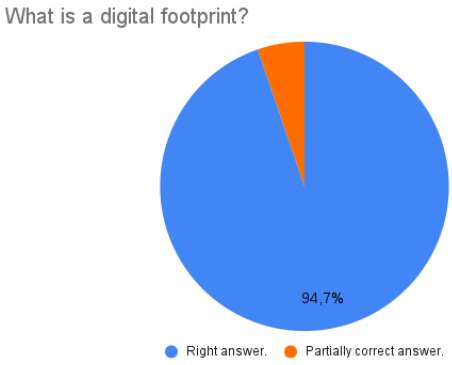


Figure 18. Students' responses to the concept of a digital footprint after to engaging with the game.

The school workshop played a crucial role in testing and interpreting the project's results. Direct interaction with the participants not only enriched the game's development but also highlighted the continued need for innovative approaches to promoting digital inclusion and digital footprint awareness.

In our research, we ensured that students participated voluntarily with school approval. Before students took part in the questionnaire, we clearly informed them about the study's purpose and potential impacts. We handled data collection, processing, and provision carefully, prioritizing confidentiality. To protect anonymity, we anonymized all collected data. Our approach reflects our commitment to ethical research practices and the well-being of all participants. The collection of data was conducted with the highest respect for privacy, with no personal identification of the students obtained, thus ensuring the complete anonymity of the dataset. Additionally, explicit permission for the collection of game evaluation data was obtained from all participants through the use of a comprehensively explained and consensual In-

formed Consent Form.

6 Threats to Validity and Limitations

There are some threats that might compromise the validity of this study that should be considered. The sample size was small, consisting of students from a single school, which limits the generalizability of the results. The demographic diversity of the sample was limited, which may influence the applicability of the results to different population groups. The specific conditions of the school environment where the study was conducted may have influenced the receptivity and engagement of the participants, which may not be replicated in other contexts.

The study's duration was short, potentially not capturing the long-term effects of the game on the participants' digital behavior. The evaluation was primarily based on subjective perceptions of usability and learning, which may introduce response biases. Future research should include larger and more diverse samples to enhance the generalizability of the results.

7 Final Considerations

This work described the creation of the educational game Peg.Ada, with the aim of educating young girls about digital footprinting. The importance of this educational game for the digital inclusion of girls and as a source of knowledge for building a positive digital footprint were confirmed by the evaluations carried out. The evaluation results showed that usability, gameplay and learning issues were all well evaluated. These results are quite encouraging.

Furthermore, it is important to highlight the positive impact that the workshop provided. The Peg.Ada game was well received by the girls, demonstrating a notable effect on them. The practical and interactive approach of the games workshops aroused great interest and engagement on the part of the participants, reinforcing the importance of dynamic and engaging educational methods to promote learning about digital security. This activity also aligns with SDG5 UN [2015] of empowering girls and women in the use of information technology, effectively promoting digital inclusion and empowerment.

As future work, there is the intention to continue improving the game and expanding its application to other schools. In addition, the game is being planned to be made available to be played via *web*, aiming to reach an even wider audience and promote education about digital footprint in an accessible and comprehensive way.

Declarations

Authors' Contributions

Andressa Vinhal is the primary contributor, responsible for conceiving the study, developing the game, and conducting experiments. Valguima Odakura significantly contributed to the manuscript through writing, translation, revision, and as the work supervisor. All authors read and approved the final manuscript.

Availability of data and materials

The Peg.Ada game is available at https://bit.ly/Peg-Ada and https://github.com/AndressaRV/Peg.Ada

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