Article

Learning and well-being in educational practices with children and adolescents undergoing cancer treatment

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Abstract: The use of Information Communication Technologies (ICT) in education brings up new possibilities of promoting the learning and health experiences. In this sense, education contexts of 21st century must consider these two areas of knowledge, especially their integration. This article presents learning practices developed with mobile devices and games, in order to improve learning and well-being in children and adolescents undergoing cancer treatment in non-formal educational setting. The methodology is based on qualitative case studies with content-based data analysis, involving informal interviews and observation methods. The study considers data from 5 patients who participated in the research between 2015 and 2019. The results demonstrate a positive influence of the practices with mobile technologies and games in terms of learning and in the well-being feeling of patients during the treatment.

Keywords: game-based learning; learning practicies; learning with mobility; oncological treatment; well-being.

1. Introduction

Digital technologies, such as computers, tablets, and smartphones, are used worldwide for the production and sharing of innovations in the social environment [1,2]. Besides influencing transformations in different sectors of industry and economy, technology is also present in the educational processes of young people and adults [3–6].Technology in education involves both the teacher's practices and the entire school organization to provide learning conditions for students [7]. With an appropriate methodology, mobile technology can be used in the learning of various subjects, from mandatory content in the school curriculum to subjects of general knowledge, such as health care and disease prevention [8,9].

Thus, in the area of health [10–14] there has been a growth in the development of applications and software with the purpose of contributing to the training and performance of doctors, nurses and health agents [15–17]. Technology, allied to health and education, can help the well-being and quality of life of subjects in different contexts, such as childhood cancer [17,18].

In this scenario, the research project entitled "Learning with Mobility" developed weekly workshops using mobile devices (tablets) and games in the learning practicies with children and adolescents undergoing cancer treatment. The learning activities also involved their families.The Support Association in Oncopediatrics (AMO)[1] was a partnership in this research. AMO is located in Novo Hamburgo, a city in the south of Brazil and assists

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[1]   The Support Association in Oncopediatrics (AMO): http://www.amocrianca.com.br/
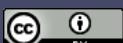
children and adolescents with cancer and in vulnerable social situations. The patients, in general, have the need for accompaniment in school activities due to the periods of absence from school caused by the disease and the treatment. The research developed workshops including mobile learning activities and moments of free use of tablets, joining learning and playing to promote education and well-being.

Therefore, this article presents how mobile learning practices and the use of appropriate digital resources have assisted in the learning process and well-being of subjects undergoing cancer treatment. The text addresses: a) the learning activities developed in the context of the research between 2015 and 2019; and b) the profile of the patients who participated in the workshops, analyzing their learning process and the impact on their well-being.

The article is organized as follows. After the introduction, section 2 presents the background, with emphasis on information about childhood cancer in Brazil and mobile learning. Section 3 approaches materials and methods, in which the methodology and the "Learning with Mobility" project are presented. Sections 4 and 5 present results and discuss them considering the objective of this research. Finally, section 6 addresses final considerations and future works.

2. Background

According to INCA (National Cancer Institute), Brazil reported around 13,000 new cases of childhood cancer in 2019, in addition to an approximate number of 3,000 deaths as result of the cancer disease. The treatment of childhood cancer comes associated with other issues that need attention. The family goes through a restructuring of the routine and organization to meet the needs of the cancer patient [19]. When dealing with the patient in treatment, one seeks to act on the problems that arise with the disease [20], as physical pain and psychological impact. Generally, the patient constantly suffers with malaise, social isolation, and stress. In addition, it is common for patients to have learning problems [21], which can be caused by periods of school absence, specially in the case of childhood cancer.

This scenario stimulates the research related to mobile learning practices and the use of appropriate digital resources in the learning process and well-being of subjects undergoing cancer treatment. According to Masini et al. [22], the school performance is one of the dimensions of health-related quality of life in childhood.

The "Learning with Mobility" project considers learning and well-being important aspects for children and adolescents with cancer. Although patients are going through a difficult period, this project considers that fun of digital games and the learning through pedagogical practices can help them with the disease, having good times and positive learning experiences even during treatment.

Well-being involves subjective issues, but the initial references of well-being are physical health, happiness and pleasure - synonyms of well-living [23–25]. Well-being encompasses several elements that should consider relevant aspects of children, such as health, safety, education and socialization. Therefore, education also influences well-being, since it is an element that impacts the personal development of any citizen.

Learning strategies using technologies have improved the methods applied in education settings. In this sense, mobile and ubiquitous technologies have promoted learning strategies through the mobile learning [26–28] and ubiquitous learning [29–33]. Since mobility enables learning to occur disassociated from fixed spaces, the practices with technology can be an alternative for those subjects who, due to health problems, cannot be present in a conventional classroom, such as children and adolescents undergoing cancer treatment. Thus, mobile and ubiquitous technologies have improved learning strategies, improving students' scientific competences development and self-regulated learning [34]. The use of mobile learning strategies is also important in children's physical activity, contributing to cognitive-motor skills and health [35].

During cancer treatment, the interest of patients is also related to their future. Therefore, for young people in cancer treatment, to continue learning and in contact with the

school routine is related to the future perspective. School represents an important social space for the child's development. School withdrawal is a consequence of cancer that can cause problems and generate uncertainty in patients, which can produce harmful effects to their treatment [18]. By using technologies to learn, young people again faced with a culture of which they are part and with which they identify, contributing to their quality of life.

In addition to learning, technological resources can assist in the cancer treatment of patients in relation to aspects of well-being and quality of life [21,41]. It is important, during cancer treatment, that patients receive attention, have moments of leisure, fun, and play, because the physical difficulty of performing these activities, in addition to periods of hospitalization, can affect their psycho-social development [42,43]. Currently, digital games have become the kind of games that young people like the most and with which they associate a pleasurable practice. It is perceived that playing a digital game is an action that makes the subjects feel interested and entertained with the challenges that arise in the games [21,44]. Thus, through games and apps, the patients divert their attention from the disease and start to have a positive experience at that moment.

The scope of mobile learning, childhood cancer, digital games, and educational practices is a emergent research theme in the Brazilian context. The research of Matos et al. [45] demonstrated that several types of digital technologies can be used and combined in the teaching-learning process, aiming at generating meaningful learning. However, the authors do not consider the context of health or oncology. The work of Brandao et al. [46] analyzed articles published between 2007 and 2017 related to health, reaching the conclusion that most of works dealt with promotion and prevention of chronic diseases, mainly diabetes mellitus and obesity. Cunha et al. [17] reviewed articles that addressed the use of mobile applications in healthcare, not considering the educational context.

Santos et al. [47] presented pedagogical practices carried out in an oncology treatment support institution in the state of Bahia/Brazil. In this work, the researchers used desktop computers and patients developed the school contents through online games. The results demonstrated that both children and adolescents are quite receptive to the use of games as the main means of teaching any subject [47]. This work do not used mobile tablet technologies, which enable outdoor dynamics, mobility, and various applications, among others.

Regarding the use of digital games as a resource to work on patients' well-being and quality of life, Feitosa et al. [48] proposed a digital game for android tablets providing learning about the procedure that is necessary in cancer situation. The game also was used as a way to calm the child's nervousness and tension [48].

Fernandes et al. [52] used a mobile application with augmented reality (AR) for use in the area of health education, more specifically considering a topic of neuroanatomy. The study concluded that the use of mobile technology seems to improve learning when used with other learning materials. Even though they have analyzed a specific mobile resource, the study is strategic to this research, as the authors also concluded the relevance of practices associated with learning technologies.

The project "Learning with Mobility" used games and mobile applications to work on reading, writing, and logical reasoning, proposing activities in which the subjects developed these skills while playing and having fun [21]. Regarding reading and writing, the project developed these aspects by discussing everyday life issues, such as environment, sustainability, literature, among others and developing writing with applications that enable the production of different textual genres. In addition, the project used digital games in conjunction with writing activities, in which subjects have to write short stories, give opinions about the games and mobile learning activities, and tell their experiences [38–40].

3. Materials and Methods

The Support Association in Oncopediatrics (AMO) offers a range of activities involving patients and their families, as physiotherapy, social assistance, tutoring and computer workshops. The research involved weekly classroom-based workshops at AMO, developing activities using mobile devices (tablets) to improve linguistic development and logical reasoning of the children and adolescents between 8 and 16 years.

The methodology is characterized as action research with qualitative data analysis [49]. As technique of qualitative analysis, the project used a variant of the "Life History" method called "Edited Life History", which is characterized as a method of interpretation in which the researcher tries to give explanations of sociological and makes comments and questions related to the material collected. From this method, the project considered the comments of the patients and took into account the observations of the researchers to analyze how the subjects participated in the workshops. The research also selected and organized mobile apps to be applied in learning practices [6,50].

The project was developed from 2015 to 2019, involving 11 patients undergoing cancer treatment. The names of the subjects were omitted, in order to preserve their social integrity, using the term "Patient" (for example, Patient 1, Patient 2, and so on) in the charts and analyses. The study analyzed the data of 5 patients (1, 2, 5, 8 and 9) who participated in the workshops during the research period. Section 4 discusses results and describes the profile of these patients, including age, school year and type of cancer. The learning practices and digital resources used during workshops considered the following aspects:

a) "**Learning**" aspect: The practices should work on logical reasoning and linguistic development, through activities that develop critical thinking, problem solving, writing and reading texts, use of educational digital games, discussion of various subjects, among others;

b) "**Well-being/Quality of life**" aspect: The practices should promote the patients' well-being through activities and games that were also playful, fun, challenging, and interactive.. In addition, patients could also choose games during the learning process.

To carry out the workshops,, the research used mobile devices with Android system. In them, besides the original system resources, the applications from google playstore were selected by researchers or by students, who also have freedom to test games and applications.

Three elements were considered in the **Learning** aspect: **reading, writing**, and **logical thinking**. Digital games are an excellent way to develop logical thinking skill. A game constantly demands an active, quick, and accurate response in solving problems and challenges that arise. Regarding reading and writing, the use of tablets becomes a means to develop these basic skills, as verbal language is a constant element of digital games and apps [51].

In relation to the characteristics of technological resources that can influence the **well-being** aspect, the elements of **Fun, Interactivity, Connectivity, Identification, Accessibility**, and **Adaptability** were considered. All these elements were analyzed in relation to how or how much the use of mobile devices, applications, digital games, and pedagogical practices provided the elements. In the **Fun** aspect, it is perceived that for the patient undergoing cancer treatment, the pleasure generated by playing games using a tablet contributes to ease the stress and stigmas of the disease [3,18]. As for **Interactivity**, interaction via tablet is constant and fast and information is received and sent automatically. By swiping a window with one touch, another opens behind it; by holding an app, one can move it; to open the app, one simply touches the screen. For patients, this helps to stay focused and motivated on their activities.

The third aspect is **Connectivity**. With a mobile device and access to the Internet, the user can interact with other people and with the information available in cyberspace [2]. The fourth aspect is **Identification**. Children and adolescents like to use tablets because

they identify with the habit of playing digital games and using internet resources, which are elements of their culture and generation. The fifth aspect is **Accessibility**. Tablet PCs have functions and resources adapted to the user's needs, such as font size, text insertion by voice command, among others. The sixth aspect is **Adaptability**. Applications and resources can be adapted and selected according to what the user needs to do or learn.

4. Results

This section describes the workshops and analysis the results, mainly considering five specific cases of patients.

4.1. Conducting the workshops

In 2015, the project developed two different themes. In the first semester, the practices with technology focused on developing the theme "identity and history". Through the use of applications such as *Supernote* (writing text notes) and *Comic Strip IT* (production of comics), among others, subjects were encouraged to tell their personal stories and record their routine in the format of a diary in comics. In the second semester, the project focused on linguistic development through the creation of short stories, writing them in the *Evernote* application, which allowed students to organize the texts in virtual notebooks, being able to share them virtually with other people. A total of 5 children and adolescents participated in the workshops, including Patient 1 (9 years old, 3th grade, Leukemia). This patient was in a controlled stage of the disease and participated in almost every workshop of the year. Figure 1 shows a textual production in *Evernote* created from the inspiration of the games that this subject used. This activity also developed a textual structure chosen for providing patients with the expression of their interests on various topics such as music, game characters and hobbies.


Figure 1. Writing in *Evernote* (text is the original in Portuguese)

In 2016, in the first semester, the project developed logical reasoning and computational thinking through the *Code.org* initiative. Figure 2 shows an activity involving *Code.org* programming. This tool presents key programming concepts using a game-based perspective. Therefore, during the activity they developed reasoning skills while programming in a playful way.
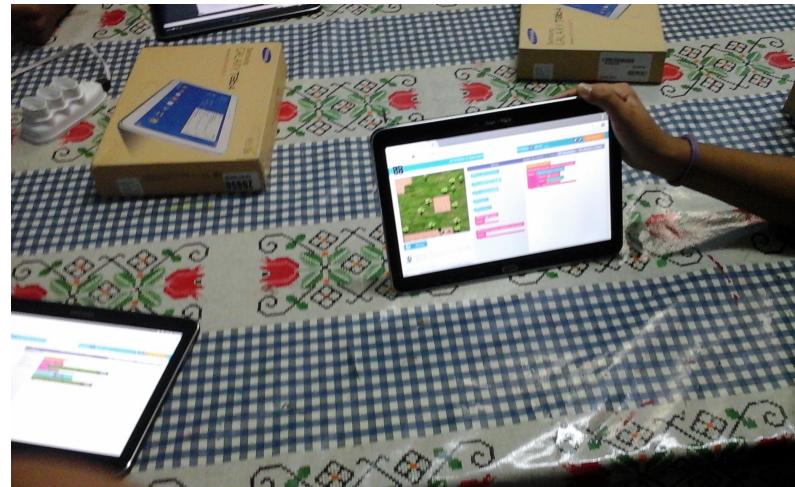
Figure 2. Activitie involving Code.org game programming

In parallel, the project carried out reading and writing practices. In this case, the participants produced short stories about digital games, written in the *Evernote* application, inspired by the games they were playing. In the second semester, the project worked on a Role Playing Game (RPG)[2] created by researchers. For this, students used the *Google Docs* application to write the story. Figure 3 presents the patients using tablets in RPG activities. Students created their own characters for the RPG and wrote a story based on their point of view. They also had to develop activities involving drawing, speaking, and writing. For this, they used the AMO spaces to produce photos and videos to be included in their stories.

Figure 3. Examples of the RPG activity using tablet PCs

This year, 3 patients and 2 family members participated in the workshops. The same patient from the previous year, Patient 1 (now with 10 years old, 4th grade, Leukemia), kept coming to workshops and participated in almost all meetings. Patient 2 (16 years old, 6th grade, Malignant Neoplasm) was able to come to most of the meetings during the year. Patient 3 (11 years old, 5th grade, Osteochondromatose) participated in a few workshops during the period.

During 2017, the project developed the theme "sustainability of water resources". The learning activities involved debates, readings, writing various texts, and using games, all related to the discussion on the sustainable use of water. Among the main resources used, the game *Water Generation*[3] stands out. In this game the player must help a family to

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[2]   In a role-playing game, participants take on the role of characters and act out the story narrated by the narrator, making decisions to win the game.
[3]   Water Generation, Feevale: http://games.feevale.br/loa/watergenerations/

improve the infrastructure of their home so that water is not wasted. This game was developed by the research team and addressed more specific gameplay focused on the needs of patients, as control buttons, layout and text message. Figure 4 shows the participants playing the game.

Figure 4. Water Generation game

This year the project had a total of 4 patients in which only Patient 1 (now with 11 years old, 5th grade, Leukemia) participated in all workshops. Among the others, Patient 4 (12 years old, 7th grade, Osteosarcoma) participated in some workshops, coming sporadically. Patient 6 (15 years old, 10th grade, Craniopharyngioma) participated in only one meeting due to the advanced stage of the disease. Patient 5 (17 years old, 10th grade, Osteosarcoma) was able to attend 4 meetings, but had to be absent during treatment because the stage of the disease.

In 2018, the project worked with the theme "identity and personal history", discussing with the subjects issues such as personal tastes, routine, dreams, interests, among others. For this, they wrote micro-stories. The main resources used were applications such as *Google Docs* (writing), *Autodesk Sketchbook* (drawings) and *Google Classroom*, as a virtual classroom space for collaboration and information sharing. Figure 5 shows a group working with micro-stories about the digital theme proposed.

Figure 5. Production of micro-stories using write editor

This year, a total of 7 children and adolescents participated in the workshops. As in the previous year, Patient 1 participated in all workshops. Patient 7 (6 years old, 1st grade, Sacral Teratoma) came to one workshop and Patient 4 (now with 13 years old, 8th grade, Osteosarcoma) was only at the first meeting, coming with his sister.

In 2019, the project worked with diverse activities for a few months and, in the second semester, participants developed the project "Guardians of the Waters - An RPG adventure". This activity used the logic of narrative and decision-making of a Role Playing Game, as support for the activities about the digital game called Guardians of the Waters [53], which deals with issues related to environmmental sanitation and water preservation. Figure 6 shows the patients doing the activities during the workshop.

Figure 6. Playing games

In this year, a total of 7 children participated, among which 3 patients. Patient 10 (5 years old, Kindergarden, Malignant Neoplasm of Supra Renal Gland) participated in all workshops. Patient 11 (6 years old , 1st grade, E.S Medulloblastoma) attended one workshop. Patient 8 (13 years old, 4th grade, H.S Leukemia) started to participate after some months. Patient 9 (7 years old, 2sd grade, Craniopharyngioma) participated in several meetings since the beginning of the year, but had to be absent during the semester for a surgery.

During all workshops, participants also used the mobile application to search information and to capture and manipulate images. Sometimes they also used email to share their productions with colleagues.

4.2. Analysis of the results

As not all patients were able to participate for long periods of time, the specific cases were selected according to the year of participation or according to their regularity of participation. Therefore, cases discussed in this research analyzed data of 5 patients who coming during the whole project or participated in 4 workshops (around 1 month), which allows an evaluation of their educational contexts and response to practices.

Each case is presented based on a qualitative analysis of the data and reports based on the "edited life history" method, to understand [49] how educational practices with mobility and digital resources assist in the learning process and well-being of subjects in oncological treatment. For two patients, the study presents interviews that were addressed, considering the questions:

1. Do you think that the workshops are helping you to better understand the contents worked at school?

2. What did you most enjoy learning and doing in the workshops?

3. Do you feel that the workshops help you at school? Why?

4. For you, is learning using games interesting? Why or why not?

5. How do you feel about accessing game networks to learn new subjects or remember content you have already seen in school? Why or why not?

The folllowing subsections describe the five cases considered in the research.

4.2.1. Patient 1 (Case A)

The first case is a girl who participated in the workshops from 2015 to 2018, totaling four years of engajament in the research. Despite being in a school year appropriate for her age group, the young girl had learning difficulties related mainly to grammatical issues, such as spelling, punctuation, phonemic-graphemic correspondence, among others. Throughout each semester, **reading** and **writing** were worked through text production in applications such as *Google Docs, Evernote* and *Supernote*. These activities helped her to improve the texts, since the **adaptability** of mobile devices allowed an adequate selection of the resources needed to develop writing.

She highligthed in answers how the *Code.org* game contributed to the development of her logical thinking, citing that the games and applications helped her to review the contents and learn meaningful things.

Table 1. Patient 1 (Case A) - Answers taken from questionnaire

Question	Response
1	Yes, because they worked on about commas and writing, helping me in the school.
2	Code.org, I enjoyed learning the right and left turn phases and the writing parts as it helped me to write faster
3	Yes, because in the workshops I learn not to confuse letters like "C" and "S" and so I do better in school
4	Yes, because we can play and learn at the same time.
5	Cool, because we can review content that we didnt see rigth at school.

4.2.2. Patient 2 (Case B)

This patient attended 20 of the 34 meetings held in 2016. Patient 2 participated, mainly, in the **logical thinking** from games of the *Code.org* and writing micro-stories with *Evernote* application. During the workshops, the patient mitigated his difficulties and the technological resources motivated his **learning**, as the subject himself highlights in his answers (Table 2):

Table 2. Patient 2 (Case B) - Answers taken from questionnaire

Question	Patient Response
1	Yes, because the Code.org game helps to learn some things like left and right.
2	Play Code.org
3	Yes, I started to pay more attention in class, because in games we have to pay attention to do it right.
4	Yes, we learn while being distracted by the game.
5	It is very cool, because I like to compare the results and be the best.

The **fun** factor is also seen in Patient 2's answers, as he mentioned that he is "distracted by the game". In addition, the relevance of connectivity can also be seen, as when playing

with other users he felt motivated to achieve better results compared to what other players are able to do. In addition Patient 2 also revealed during the workshop that the *Code.org* game promoted a pleasant, **learning** experience: "With CODE I learned better what is right and left, what are degrees and what are they for. I learned how to think faster and how to solve mathematical problems more efficiently."

4.2.3. Patient 5 (Case C)

The following case is of a boy who participated in four workshops in 2017. This patient was 17 years old. Although the project on "sustainability of water resources" was already being developed since the beginning of the year, the game *Generation Water* was used to insert him in the discussions of the theme.

During the period he participated in the project, and even though he was undergoing treatment, this patient made an effort to contribute to the most focused activities, in addition to exploring the features of tablets and enjoying a moment of **fun**. The experience made him have a **fun** and **learning** time, discussing important knowledge for his life. Therefore, the workshops also acted as palliative care, favoring his **well-being** regardless of the outcome of the treatment.

4.2.4. Patient 8 (Case D)

The following case is a 13-year-old boy, who participated in the workshops in 2019. He was away from school and stagnant in the 4th grade (repeating school), with learning difficulties prior to the disease. This patient was very shy and had difficult to stay together with others. However, when he explored the tablets and discovered new applications and games, he was motivated to participate and interact. In this case, the tablet was an object of **identification** and with the right incentives, it was possible to him had **fun** and **learning**.

The interactivity, connectivity and fun aspects of mobile devices started to positively influence his **well-being**, as his behavior in the workshops gradually changed. This patient used the *YouTube*® to record videos about the games. For him, being a content creator was a way to overcome the difficulties of the disease.

In an activity, in which they needed to imagine a "*slumber night*" theme party and created invitation cards using a suitable application, Patient 8 produced his card with a lot of motivation, because he could choose the theme of "*Mortal Kombat Games*". In this association between the game that interested him and writing, it was possible to observe how he made an effort to participate in the practice and produce his text. Thus, the games motivated his **learning**, because even away from school, he was able to continue developing his **writing** and **reading** activities. During the workshops, the researchers also helped him with his grammatical difficulties (punctuation and spelling).

4.2.5. Patient 9 (Case E)

The participation of the Patient 9 involved to play the game called "The Amazing Adventures of Apollo and Rosetta in Space"[4], which develops the control of Executive Functions. In this case, the player needs to think when acting and does not make decisions driven by impulses. **Adaptability** and **accessibility** were important, as the game helped to work on the motor issues in which Patient 9 was having difficulties due to the disease.

A game called "Pizza Maker" provided a **fun** experience and allowed him to develop logical thinking correctly following the steps of producing a pizza according to the ingredients ordered by the customers and **reading**, since the instructions were given through text contributing to his **learning**. The movements that he needed to make to play the game were adequate to his physical limitations (**accessibility**), demanding simple movements such as touching the tablet screen, holding and dragging objects through the game scenario. Through the adaptability of tablets, the group selected games that were suitable for the patient, promoting **learning** and **fun** at the same time.

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[4]   Apollo & Rosetta: http://games.feevale.br/loa/home/jogos/apollorosetta.html

Patient 9 also did word reading activities with *QR CODES*. The researches also took care to display the applications and games in a larger size, because his vision was slightly impaired. So, the **accessibility** of the tablets was an important aspect at this moment. After about 30 minutes of activities, Patient 9 generally began to complain of fatigue and asked to walk a bit, showing signs of pain and fatigue.

5. Discussion

The main difficulty in this research was following the patients on a regular basis for a long period of time. As the subjects can be in different phases of treatment, some patients were able to participate in the workshops for a short time, or not regularly. As solution to this problem, activities were planned to last for 1 or 2 meetings, although the general theme lasted the whole semester. Regardless of which period patients attended, on the day of their participation they would be able to participate in the discussions, play a game, use an application, learn something, and they had moments of fun, even if they participated only in one workshop.

The practices with technological resources positively influenced the **learning** of Patient 1, especially in relation to **writing**, which was one of the main difficulties of the patient. It was also observed an improvement in well-being, since the delay in studies compared to other schoolmates was being attenuated. This information was reported by the patient's parents, who emphasized the importance of the workshops for the patient's development. Moreover, regarding the characteristics of the tablets, the influence of the **fun** aspect can be noticed, since, in her statement the patient mentioned that the act of playing and learning at the same time makes learning interesting. Patient 1 was discharged from the AMO in 2019, after the end of the 6-month period after clinical discharge.

For Patient 2, the games were resources that contributed to his quality of life through the **learning** and **logical thinking** that they provided. In addition, there was a contribution to his **well-being**, since the playful and interactive aspects of the games were important for the subject, who was away from school and interacted with other subjects during the workshops. Unfortunately, this patient could not return to the workshops and passed away during the following year.

Based on the report about the participation of Patient 5, even though he participated in few workshops, it is clear that the practices with technological resources contributed mainly to his **learning**, because the game "Generation Water" allowed the patient to make connections with his reality and build knowledge, sharing his reflections with colleagues and actively contributing to debates and discussions.

The workshops also influenced his **well-being**, since the practice of the game opened a space for the subject to receive attention from colleagues and positive feedback about his ideas. This patient was in a delicate stage of treatment and had to leave after a few workshops, passing away the following year.

Regarding Patient 8, the practices contributed to **learning** thanks to activities that involved the association with games, mainly writing texts, research in the *playstore* and *storytelling*. In addition, the resources contributed to the improvement of the subject's **well-being** due to the aspects of **fun**, **interactivity**, **identification**, and **connectivity**, which kept the patient motivated to interact with his peers, express his opinion, and share things he liked. For Patient 8, the workshops allowed a socialization environment in which he enjoyed being, participating in something good and positive. Patient 8 was in a controlled stage of the disease.

In the case of Patient 9, the workshops contributed mainly to his **well-being**, as they provided a pleasant experience, contributing to his quality of life. The **accessibility** of the applications, allied with the **adaptability** of selecting those that best developed his cognitive and motor skills, made it easier for him to enjoy the workshops. The patient played games, developed **reading** and **logical thinking** skills, interacted with peers and played fun games, moments in which the difficulties caused by the disease were not a

barrier for him to have happy experiences, in which he could concentrate on something he liked, like any other child.

6. Final Remarks

This work presented learning practices and appropriate digital resources to assist in the learning process and well-being of children and adolescents undergoing cancer treatment. Results allowed to conclude that the practices of the workshops favored the subjects' learning and well-being, resulting in benefits for their quality of life. They felt motivated and interested in participating in the practices, engaging both in the interaction through the tablets and in the production of the activities. In addition, patients who were away from school could have their learning problems alleviated, as they developed writing, reading, and logical thinking in practices in which playing was associated with learning. The integration of digital games and applications with pedagogical practices motivates young people to participate in the meetings.

This research contributed to the knowledge related to the use of technological resources in the learning of young patients undergoing cancer treatment. The results will allow the project to continue improving educational practices in search of a learning experience that meets the needs of school-age youth who, due to illness, face problems of personal, social and educational development. In this sense, the research aims to allow them to continue learning using technological resources with appropriate methodologies. "Learning with Mobility" project continues nowadays, in the same general scenario described in this article, but with new approaches and practices guided by the restrictions imposed by COVID-19 pandemic. These results will be presented in future articles.

Finally, in recent years Ambient Intelligence [60] and Smart Environments [55] have used time series of Contexts [56] to organize and analyze data. This type of data organization is called Context Histories [57–60]. Future work will explore the use of Context Histories to organize the data produced during the workshops, allowing the use of these data to include intelligence in patient care environments. In this sense, the project will explore advanced data analysis strategies such as pattern analysis [61], context prediction [62], learning analytics [63,64], and similarity and similarity analysis [65,66]. These strategies for handling context histories will be applied in the analysis of project data, mainly enabling prediction, personalization and content recommendation to improve the user experience.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AMO	The Support Association in Oncopediatrics
ICT	Information Communication Technologies
INCA	National Cancer Institute
RPG	Role Playing Game

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