DESIGN OF THERAPEUTIC TOYS FOR CHILDREN IN ONCOLOGICAL TREATMENT

Projeto de brinquedos terapêuticos para crianças em tratamento oncológico

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Abstract: The use of therapeutic toys helps in the treatment of children with cancer, allowing improvement in their clinical conditions and, therefore, providing the continuity of their child development. Researches proved the effectiveness of these toys in the treatment, as well as providing the child with a friendly and trusting environment for those health professionals who are involved in their treatment, collaborates in their psychomotor evolution, allowing self-knowledge of their mental functions and creative ability. For the children’s families, it is understood that the use of these toys allows a greater understanding of the reality for the child. Objective: This work aims to plan and model, in 3D, toys that can collaborate in the treatment of children with cancer, in an accessible and feasible way for a varied social environments. Methodology: It was used the SOLIDWORKS 2016 software for the modeling and development of the therapeutic toy, in 3D. Results: With the use of the program, a toy prototype was conceived as planned, with a variety of forms and models, of easy handling and assembly that stimulates the learning and creativity of the child. The designed toy can be easily manufactured through rapid prototyping. Rapid prototyping as 3D printing is a low-cost manufacturing process. Conclusion: It was concluded that the project of the therapeutic toy was successful, because it was possible to conceive a model within the expected results for its manufacture.

Keywords: Play and Playthings; Medical Oncology; Engineering; Computer-Aided Design.

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Resumo: O uso de brinquedos terapêuticos auxilia no tratamento de crianças com câncer, permitindo melhora no seu quadro clínico e, portanto, proporcionando a continuidade do seu desenvolvimento infantil. Pesquisas comprovam a eficácia desses brinquedos no tratamento, pois além de proporcionar um ambiente amigável e de confiança para profissionais da saúde envolvidos, colabora na evolução psicomotora da criança, permitindo o autoconhecimento das suas funções mentais e da sua capacidade criativa. Para os familiares, compreende-se que a utilização desses brinquedos não só coopera no tratamento, mas também possibilita maior compreensão da realidade para a criança. **Objetivo:** planejar e modelar, em 3D, brinquedos que possam colaborar no tratamento de crianças com câncer, de forma acessível e que viabilize a sua utilização em meios sociais variados. **Metodologia:** Foi utilizado o programa SOLIDWORKS 2016 para a modelagem e desenvolvimento do brinquedo terapêutico, em 3D. **Resultados:** Com a utilização do programa, chegou-se a um protótipo de brinquedo com variadas formas e modelos, de fácil manuseio e montagem, com intuito de estimular o aprendizado e a criatividade da criança. O brinquedo projetado pode ser fabricado por prototipagem rápida. A prototipagem rápida, por impressão 3D, é um processo de fabricação de baixo custo. **Conclusão:** O projeto de desenvolvimento do brinquedo terapêutico foi realizado com êxito, pois foi possível elaborar um modelo dentro dos resultados esperados para a sua fabricação, ou seja, um brinquedo de geometria simples e passível de ser utilizado para interações, como montagem de suas peças individuais.

**Palavras-chave:** Jogos e Brinquedos; Oncologia; Engenharia; Projeto Auxiliado por Computador.
INTRODUCTION

The difficulty that health professionals have in their day-to-day work in transmitting the diagnosis of cancer, for patients and family, is aggravated mainly when this patient is a child. Nowadays cancer is still regarded as a disease without a cure, with considerable obstacles and an ordeal for survival from the time of its discovery. According to the National Cancer Institute, the childhood cancer is among the first causes of death by disease in children and adolescents aged 1 to 19 years. In addition, it was estimated that over 12 thousand new cases of cancer per year in Brazil may arise, being the regions Southeastern, Northeastern and Southern responsible for the largest numbers of new cases, respectively, in descending order.

A worrying clash of reality is faced in Brazil, when compared with developed countries, the delay to perform the diagnosis of children with cancer that, in turn, minimizes the chances of cure for this type of patient, which differs from developed countries, where the chances of cure in children and adolescents exceed 70%.

The act of playing performed by the child has a great importance to his or her healthy, psychomotor development, the emotional structure, the understanding of reality using the environment where he or she lives together with the playful universe that the child develops within the game, exercising and improving his or her creativity and imagination. It is known that every child has the right to play provided by law, which is described in Law 8.069, dated from July 13th 1990, called the Child and Adolescent Statute. It is placed, in Chapter II, Article 16, Section IV, that every child has the right to play, play sports and have fun.

Playing for a child goes beyond the rights, actually it is a matter of extending her or his learning and development. Eliminating the space and freedom for a child to play is to take all her or his essence and interrupt a cycle of evolution. Currently, the action of “playing” has lost its meaning, which was to move, jump, spend energies, think, interact with other children, communicate, imagine and strengthen their skills.

Cases of lonely youth have been observed, immersed in technology and, in many cases, without any interaction with other children. However, it is still by means of playing that many children are able to express their feelings, thoughts, fears and desires, thus allowing for parents and/or their guardians, one more channel of communication for the child, providing a better understanding of their actions.

The scenario worsens with respect to seeking these rights mentioned above, within a hospital environment, with children in oncological treatment. Many of these children have this evolutionary cycle interrupted, when they receive the cancer diagnosis, because they are subjected to invasive procedures and that restrict their mobility both physically and mentally. That is when Therapeutic Toys (TTs) come into action in the treatment environment of such children. The TTs not only enable learning, but also provide continuity in the hospitalized child’s development.

Playing influences the child’s health maintenance. When he or she is steeped within the scenario that he or she himself or herself creates during the play, enabling an expansion of her or his psychic and motor skills, interaction with parents and people who are involved in her or his care, cultivates an environment of trust, which, in many cases, are reduced during the hospitalization.
These children have a greater acceptance of their real situation, where they are immersed in the world of the imagination and bring references in this world to play a better existence during their treatment.

It is realized how valuable the TTs can be represented being inserted into the environment of children’s treatment with this type of disease, because it helps in the understanding of procedures that they will be subjected, in a playful way and enabling a greater interaction with professionals that care them. Another crucial factor would be the intimacy and trust nurtured through these toys, because from the moment that the health professional begins to use them, it creates a better bond among them making the procedures easier and relieving feelings of pain and fear from chemotherapy treatment.\(^9,10\)

There is a range of TTts in the market, since high-value products to simple toys that can be used for this purpose. It suffices stimulating the creativity, interaction, verbal and non-verbal language, concentration, curiosity and reasoning, among other characteristics related to his or her progress and well-being throughout the treatment and socializing within the clinics and/or hospitals.

The rapid prototyping, which can be inserted in this context, consists of a constructive process based on a prototype designed and modeled in software that goes into the physical medium, by 3D printing. 3D printing is seen as an additive process, because it is done the deposit of material for the construction of an object, by means of successive layers.\(^12\)

The rapid prototyping has been used in several areas, for its ease of running the construction of very complex parts. Whereas there are records about its use since the 1970s.\(^13\) The great precursor of this technology has been the cheapening of equipment, even in the raw materials that supply them. Due to the price fall in that area, a great opening for investment was provided for small and medium-sized enterprises associated in this area of rapid prototyping. Having this great accessibility in the present day, the demand for this technology has been growing, as it provides the user an approximation with the perfection of details, reducing failures, quantity of material used during manufacturing, automation and eliminating completely the need for molds for the manufacture of any type of parts.\(^12,13\)

Based on this context, this work aims to create and shape toys in 3D, with the use of software for design of drawing in three dimensions, using practical knowledge in the area of graphical expression. These parts can then be manufactured by rapid prototyping and assist in the treatment of children with cancer. It will be taken into consideration the low cost for the production of toys, simple geometry for handling, diverse colors, shapes and sizes to assemble them.

**METHODOLOGY**

This work involved research in literature, seeking the descriptors therapeutic toys, cancer treatment, designing toys, 3D parts and rapid prototyping. The search was done in English Language, besides Portuguese. The inclusion criteria were studies in the area of Rapid Prototyping for the creation, design and modeling of therapeutic toys using the 3D software, as well as current jobs to speak about cancer, especially the child cancer and its treatment.

The review contributed in the prototypes development, allowing the knowledge of information such as the type of toy ideal for children’s treatment. Simple-shaped t, allowing the interaction among individuals and may be used for
construction or assembly.

It was used the software SOLIDWORKS 2016, frequently used in engineering for design of parts, applying techniques and practices related to the study of graphical expression. The procedure involved basically the development of 2D geometry for, subsequently, make them solid (3D). The steps are described over the results, which involve the design of parts. This software, in addition to well-illustrated and abundant in resources, allows the conversion of the files of drawings to formats that can be printed in 3D printer, a quick, practical and relative low cost way to manufacture products of polymeric material.

RESULTS

For the production process of the toys a sketch was created with standardized and charted measures to have better fit of the parts. In Figure 1, it is found the sketch to be stressed/extruded (term used to say that the figure surface in 2D will become a solid, in 3D).

Figure 1- Creation of initial draft.

After the execution of two sketches, illustrated in Figure 1, along with another, it was done the extruded shoulder/base of sketches, reaching the image in perspective of parts, which can be better understood by Figure 2. Being that the Figure 2A represents the image in perspective of Figure 1, shown previously. Whereas the Figure 2B represents the image in perspective of another extruded sketch.

Figure 2 - Creation of 3D parts from 2D drafts.
Subsequently to the execution of the extruded shoulder/base, one more sketch was made on the upper surface of the workpiece to give origin to the pins that each piece will have, with the same measure and diameter. After the sketch was created, the same was stressed in order to sharpen the pins to fit the part. The manufacture of pins is identical in all parts and where it can be seen, as an example, in Figure 3A, which has four circles with a diameter of 5mm (5 mm) each, with spacing of 5mm from both ends of the part. Done the sketch, the next step, once again, is to carry out the extruded shoulder/base, to sharpen the pins in 3D, which is represented by Figure 3B.

**Figure 3- Shoulder: (A) Construction of drafts for shoulders, (B) under construction.**

(A)  
(B)

For the parts fit into each other, it was necessary to make another sketch on the bottom of each piece, to receive the pins. All parts have the hole with same diameter and depth of cut to fit the pins of different parts. With the purpose of making the cut on the lower level of each part, the tool “extruded cut” was used, of SOLIDWORKS, giving depth and perfect fit, because the depth of the cut was exactly the height contained in pins, as well as the diameters were equivalent (Figure 4A).

To finish the part construction, it was used the tool “Fillet” to round the top edges of the pins and the cuts made in the lower level of the parts, also having the same measures of filleting, both in pins and holes for fitting, observed in Figure 4B.

**Figure 4 - Visualization of parts perspective to show: (A) cut on the lower surface of the workpiece and (B) rimming of ends.**

(A)  
(B)
After the steps mentioned, it was finalized one of the parts in construction within this project (Figure 5A). Using these same processes, other parts were made so that they could be assembled, achieving the purpose of each piece constructed. In Figure 5A some of the parts produced are represented in the course of this work and, finally, in Figure 5B, a simple assembly of all parts shown in Figure 5A.

Figure 5 - Parts designed in 3D finished: (A) different settings, (B) example of possible assembling of pieces.

DISCUSSION

The use of modern resources, such as the advent of software capable of designing toys, as well as the possibility of simplified fabrication, of these products, may contribute to the treatment of children with cancer.\(^6,7,11\) Since that the structural complexity of the toy used is not more important than its ability to generate interaction among users, the present study focused on this aspect for preparation of the toy parts.

The method of manufacturing products through rapid prototyping, including the printing in three dimensions, is very versatile and interesting economically, because they do not require work force, save material and allow standard of reliability and quality of the products.\(^12,13\) With these advantages associated with the manufacturing method, it can be expected that the therapeutic toys designed in this study have good acceptance in clinical practice and care to oncological patients.

Printed products in 3D, along with features of virtual reality, have been used in the medical field for simulations of procedures or even in the design and manufacture of prosthetic material.\(^14-16\) Contribution in the treatment of oncological patients is still a novelty. It is understood that toys have not been manufactured by this method for this purpose, or that the literature on this subject is still scarce, because this is a recent manufacture method. Therefore, the present study contributes to the subject, by the idea presented, along with the prospect of future work related.

CONCLUSION

This work is part of a research at the interface between the areas of Medicine and Engineering. The parts presented can be designed in different colors and dimensions, and subsequently, they can printed to make toys. With respect to the bodies of research on the use of TTs in the treatment of
children with cancer, it is understood that this study has relevance and can be continued, because it can bring many benefits to potential beneficiaries of such instruments. Based on the study and the results presented, it will be possible to improve the toys so that they can meet, in a personalized way, the different cases found in the treatment environment of such children.

A possible perspective, for future work, is the 3-D printing, of the toys herein designed. In addition, these toys, when printed, can be distributed to children in treatment and further research can be carried out, as, for example, about the satisfaction and impact of the use of these objects.

REFERENCES


