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Innovation in the Design of Inclusive Toys: Development and Evaluation of a Prototype for Visually Impaired Children

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ABSTRACT

A visually impaired child, if not stimulated, may face delays in motor, cognitive and social development. A simple, didactic and playful method to stimulate these skills is through toys. Although the importance of toys is recognized by child behavior' researchers, it is noted a lack of inclusive toys available in the market. This paper presents the development and evaluation of an inclusive toy prototype for visually impaired children in preschool adopting inclusive design principles in the project. We conducted an electronic research with 31 health and education professionals, evaluating their perceptions about the inclusive features of the prototype, to understand if these features can be considered as an innovation strategy to the industry and if the prototype has potential as an instrument of stimulation for visually impaired children. The results show that 90% of the participants believe that the prototype is attractive for visually impaired children and 81% that it is suitable for preschool children. In addition, 97% considered it inclusive and 64% as innovative. Regarding the stimuli provided, the agreement was always positive: 97% believe that it will stimulate touch, 65% sight, 62% motor coordination, 78% imagination, 84% curiosity, and 58% autonomy of the child.

Keywords: Toy design; Inclusive design; Visual impairment.

INTRODUCTION

The importance of playing for child development is a subject that has concerned researchers over the last years and has been approached in several studies, such as the French philosopher Henri Wallon (1879-1962), studious of child's universe, who verified that playing is an important resource of learning and communication between children (Galvão, 1998; Pedroso *et al.*, 2013). Playing is a universal and multicultural practice that is part of children's every day since the beginning of civilization. Archaeological finds from the 4th-century b.C., and references in literature, like the Odyssey by Ulysses, show that child plays already existed in ancient times (Dias, 2013).

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The toy is a simple object that provides a playful activity while, at the same time, stimulates the development of motor, social and cognitive skills of children. By playing, children experience, discover, invent and learn the environment around them (Pereira, 2009; Pedroso *et al.*, 2013; Santos; Medola, 2016).

Toys and games enable child's development through a search for overcoming the limits, using challenges as learning situations in a scenario where the biggest goal is to have fun. According to Kamisaki (2011) and Pedroso *et al.* (2013), toys arouse curiosity and, for their diversity and richness in shapes, colors, sounds, and materials, they become ideal tools for learning, developing thought, concentration and attention. Child play, due to the pleasure involved, becomes an important instrument for developing and overcoming for children with disability.

Although the importance of toys for children's development of skills and senses is recognized by researchers of children's universe, one can observe low investment in the industry in Brazil.

Toy industry represents a dynamical and competitive industry, with a huge dependence on the entertainment and marketing industry. It is a field directly related to creativity and innovation because it is always searching for the creation and development of new lines (Santos; Medola, 2016). The Brazilian industry billing had a significant growth in the last 25 years, increasing from R$ 450 million in 1990 to R$ 5,728 million in 2015, showing that it is a market expanding (Mefano, 2005; ABRINQ, 2015).

Even with an auspicious scenario, the toy industry is still little explored nationally. That occurs due to the preference that most companies still have in importing toys instead of investing in national production, or the preference to copy products that are already success of sales instead of taking a risk to create something new, as highlighted by Ed Catmull, superintendent of the animation studios Pixar and Disney (Catmull, 2011). According to Mefano (2005) and ABRINQ statistics (2015), most of the toys sold in Brazil comes from Chinese companies, who have the most tradition in the production of toys and lead the importations raking. Considering the relation between toy industry with creativity and innovation, the investment in design and national production may offer advantages for this industry that it is constantly searching for news.

Besides the lack of investment in the toy industry, there is also a gap in the production of inclusive toys in Brazil. Only a few companies produce this type of toys in industrial scale.

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Most of them still use artisanal process in the manufacture, which makes the final product more expensive (Kamisaki, 2011). Toys available for children with disability, mostly, focus on their functionality. There is not a concern regarding the aesthetics, which characterizes these products with an excluding and unappealing appearance, emphasizing the stigma of disability. In addition, it can be observed the predominance of adaptation of traditional toys sold in the market, which emphasizes the lack of investment in innovation of these consumer goods (Santos, 2016).

According to Schumpeter (1961), a productive organization must become competitive by creating or adopting new commodities, technologies, sources of supply or types of organization. His affirmations are still applicable in a technologically balanced environment, in which the competition for prices or quality is no longer enough. It is necessary to be ahead of the development of a new solution, offering products that change the way people live their lives, which means, to innovate (Silva, Botura Junior, Paschoarelli, 2013). The link between innovation, design, and market is well described in the study of Mercaldi *et al.* (2015, p. 11), based on national companies, that concluded that "design can configure as an aggregator agent for companies". The authors explained that innovation is a business strategy that can be translated into shape of products, languages or innovative ways of relationship with the market, searching the creation of value in differentiation.

In a market that released 1.5 thousand toys, in the year of 2015, according to ABRINQ (Brazilian Association of Toys Manufacturers) (2015), inclusive toys arise as a differential because they consider the user needs and expectations. The investment in toy innovation, and specifically in inclusive toys, has a great potential to leverage feedbacks for those that invest in them, and to become a differential to get a valuable space in the store's gondolas and, hence, in the sales (Rodrigues, 2015).

One method to identify the level of innovation in a country is through the number of patent requests. With the purpose of identifying the number of patents registration's request existents in Brazil, we conducted a data collection in the National Institute of Industrial Property (INPI in Portuguese abbreviation), on October 27, 2017. The search with the term "toy" (in Portuguese) showed that 1,676 patents were requested since 1976. Therefore, it can be noticed an average of 41 requests per year; however, not exclusively of toys developed in Brazil, because part of this number represents toys idealized and patented initially in their country of origin and, later, had their patents registration requested also in Brazil. Other words were also added to the word "toy" in the search. The word "disabled" resulted in only one patent request, in 1994. The search for "inclusive toy" did not have

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feedback, showing that these words have never been used together in a patent request in Brazil. In other words, there is a huge gap for the development of innovation in inclusive toys, dedicated, also, to a target that is not served until the present moment.

The search did not differentiate whether the patent request was a patent of invention (PI) or utility model (UM), the two categories of patents available by the IPNI. To be considered a patent of invention, the product must meet the requirements of novelty, inventive activity, and industrial application. Thus, the invention must bring a solution not available in the market yet. The utility model refers to objects that already exist that "... present a new shape or disposition in its use or manufacture" (Dirpa, 2012, p.10). Therefore, the object already existent must bring a new configuration that results in significant improvements in functionality.

According to Silva *et al.* (2013), in the current economic scenario, scientific and technological production are directly related to economic and social development. For the authors, contemporary societies can be classified as much as producers (exporters), as consumers (importers) of knowledge. In the same way, there is a distinction between added value to the commodities and to the technological products. With this, Silva *et al.* (2013) highlight that innovation represents a great concern of Brazil in the worldwide scenario.

Considering the correlation between design and innovation, inclusive design provides value aggregation to the product, implementing characteristics, during the development of toys, that both users and industry can be beneficiated, since it could become the propeller shaft for great releases that will move the sector, coming to constitute as a key point for this industry.

This paper presents a discussion of the contributions provided by the adoption of inclusive design principles in the development of a toy, both from the perspective of the users and the innovation of new products in the industry. For this, it was created a prototype of a toy for visually impaired children at preschool age (3 to 6 years) and submitted to the evaluation by professionals that have previous experience with children to identify the degree of innovation and interest aroused by it. The results do not allow generalizations due to the convenience sample used and because it is a single project and it was not tested by visually impaired children; however, they suggest that the use of inclusive design principles can be seen as an innovation strategy for the toy industry and well as having potential to be adopted by the target group. The study also contributes with guidelines to design more inclusive toys.

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1. THE VISUALLY IMPAIRED CHILDREN

Visual impairment is defined as total or partial loss, congenital or acquired, of the vision, being divided into low vision, in which is possible to see with the support of enlargement lenses, and total blindness, in which there is no luminosity perception (Fundação Dorina Nowill Para Cegos).

According to the 2010 Demographic Census, 18.6% of the Brazilian population stated having visual impairment (IBGE, 2011). The World Health Organization (WHO) estimates that about 19 million children in the world have visual problems (ONUBR, 2013; WHO, 2014).

Although visually impaired children go through the same stages of development as other children, studies about child neuropsychomotor development point out that the absence of vision compromises the ability of locomotion and orientation and, in some cases, may cause delays in cognitive, social and language development (Dias, 1995; Farias, 2004; Cunha; Enumo, 2003 Apud França-Freitas; Gil, 2012).

França-Freitas and Gil (2012) explain that motor skills related to locomotion (such as crawling and walking) are significantly late in blind children due to limitations such as the absence of visual feedback and lack of opportunities to mimicry, which is fundamental during child development. Besides the delay in locomotion, visually impaired children also face difficulties to perform tasks that require the use of fine motor skills such as touching, pulling, loosening, and scratching (Kamisaki, 2011).

With the absence of vision, people with disability use their reminiscent senses to perform activities. Studies have found that, for visually impaired people, the tactile sense takes over the role of main sense and the auditory sense is presented as a complementary sense, working in a mutualistic way during the perceptual act (Oliveira *et al.*, 2010). In other words, audition and touch exercise together the role of perception and interaction between user and environment that involves him.

As shown by Kamisaki (2011), the socio-affective coexistence and interaction with the environment are extremely important during language development. Therefore, it is indispensable that a visually impaired child interacts socially with other children at the same age, because receiving constant and specialized stimulation during early childhood, he or she could have performances similar to a child who sees in the scholar environment (França-Freitas; Gil, 2012). As pointed earlier in the studies of Henri Wallow, child play is an important tool of learning and communication for children.

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2. DESIGN AND INNOVATION

Although there is a shortage in investment in national projects and in the Brazilian toy's design, Mefano (2005) points to a change in the scenario because, according to the author, the design has been recognized as an improvement tool in the product's performance in the market. In this scenario, beyond design, innovation also inserts itself as an important element to offer a competitive advantage to the Brazilian toys market (Dias Filho, 2004).

Considering that innovation is related to the generation of ideas; design, that has the creativity as the base in its process, "translates" the user's expectations and needs (Dias Filho, 2004). Therefore, it configures as a way of obtaining innovation.

The Oslo Manual defines innovation as

> "implementation of a product (assets or services) new or significantly improved, or a process, or a new method of marketing, or a new organizational method in the business practices, in local organization of work or the in external relations" (OECD, 2006, p. 55).

The Manual defines four types of innovations: product, process, organizational and marketing. A toy has its innovations related directly to those attached to a product or process for its achievement, including improvements in technical specifications, components and materials, ease of use or other functional characteristics (OECD, 2006).

Other authors explain technological innovation. To Barbieri (2003), technological innovation can be understood as a process that introduces new technical, functional or aesthetical solutions. Dias Filho (2004), on the other hand, relates design to innovation by explaining that design is a way of technological innovation because of its concern with aesthetic, functional and symbolic elements in the products, that are the three functions of a product, as proposed for Löbach (2001).

The Designer, within this context, takes the responsibility of being, alongside with the engineer, the conductor of the whole process, from its conception and initial project of product, with the inclusion and incorporation of its innovations, going through adjusts and changes, supervision of analyses, test and experimentation, productive process, until it is placed in the market and, later, follow up of its impact, with satisfaction research along with the user.

The innovation in the use of visual plastic elements (such as color, shape or texture), as highlights Dias Filho (2004), is a type of innovation of aesthetic solution that can be used in the toy industry. We can mention two examples of companies that, over the XVIII century,

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used design as an innovation tool and competitive advantage. The first one is the English ceramic factory Wedgwood, that arose in 1750 and whose competitive advantage was based on, mainly, the differentiation of its products through the innovation in the use of colors, shapes and textures, using design as a strategic tool. Another pioneer and successful example was the businessman Boulton, who distinguished his products through an eclectic design that met the most varied tasted and segments, creating suitable products to determined targets (Dias Filho, 2004).

An innovation in the toy industry is not only totally new toys (radical innovation). In this industry, incremental innovation is very present and important, as for example, the card game UNO, released in the decade of 1970 by the American Merle Robbins, who is until nowadays one of the most sold card games in the world. This fact can be explained because the company inserts constantly incremental innovation, as, for instance, accessories and characters of the child's universe, showing how the same product can be modified and released multiple times and still be a success of sales (Rodrigues, 2015).

The designer in the toys industry has an important role, because when projecting a toy, it is his job to develop something that transmits to the child the maximum of possible information, at the same time that serves as a helpful tool in the formation of a more dynamic and creative mentality (Kamisaki, 2011). Mefano (2005) emphasizes that it is important that the designer be a spokesman of the needs, curiosity, and interests of the child.

When designing a toy for children with disability is necessary, besides knowing their interests and needs, to also understand their limits. Thus, he or she can project it in an inclusive way enabling the interaction between children and toy, as well as with other children and with the environment. For that, the designer can use inclusive design principles as tools in the creation process.

3. INCLUSIVE DESIGN

The inclusive design is a concept that aims to create products, services or environments that can be used by the largest number of people possible, independently of their limitations and without needing to make adaptations or specific creations (Pereira, 2009).

Medola and Paschoarelli (2014) explain that social inclusion used to be summarized in suiting products or environments to the needs and characteristics of people with disability and that nowadays; however, it is also necessary to offer opportunities and attractive conditions so that these people can be active in society. The authors emphasize that the main

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challenge of the design, under the inclusive perspective, concerns to create products for egalitarian and indiscriminate use to include without differentiating. In other words, the main question is to create inclusive products that do not exclude anyone, and can be used at the same way by people with and without disability, because when creating a product only for people with disability, it is, in a certain way, to differentiate it for a group and to exclude it from others.

Introducing inclusive design as an innovation strategy in a company is to think equally in the user, by offering egalitarian conditions of use and improvements in life quality; and in the industry, by obtaining an advantage over its competitors, once that it adds value in its product. Considering that, currently, inclusive toys have the highest cost, in comparison with others, because they are artisanal manufactured and in a smaller scale; when transferring this production to an industrial environment, the costs will be reduced, making accessible to a greater number of people.

As proposed by Löbach (2001), when creating an inclusive product, it is important to consider the three functions of the product. The practical function refers to the product functionality considering its resistance, ease of use, maintenance and comfort. The aesthetic function is related to the appearance of products and its interaction with the user. The symbolic function is related to the semiotic in products, that is, the interaction established between product and user. While the practical function refers to the physiological aspects of use, the aesthetic and symbolic functions refer to the psychological aspects. The investigation of the design functions of a product for people with disability was reported in Lanutti *et al.* (2015)'s study. The aesthetic of a product is an important factor because it arises the primary interest of users at the moment of buying. In the competitive market, where there is the need to highlight a determined object, the aesthetic function is configured as a factor of great influence (Löbach, 2011). The same occurs in the toys market. It is the appearance of a toy that arises the interest of a child. Naturally, a toy must present an attractive appearance.

In a project for people with disability, aesthetic and symbolic functions must be equally considered by the designer. To Medola and Paschoarelli (2014), when idealizing a product for egalitarian and indistinct use by all people, both aesthetic and symbolic aspects must assume great relevance, once that is necessary to make the product attractive to everybody, at the same time that does not transmit the meaning of "assistance" that emphasizes disability. The authors also explain that the practical function of such product refers to aspects of the use of it, that is, to improve the functional abilities and reduce or even eliminate the disabilities of their users.

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4. DEVELOPMENT

The prototype evaluated was developed based on an analysis of similar toys and interview with professional from the Visual Rehabilitation department of APAE (Association of Parents and Friends of Exceptional), in Bauru - SP. A search in the existent bibliography was also done through scientific papers and masters dissertations, aiming to find the state of art in this line of projects (França-Freitas E Gil, 2012; Kamisaki, 2011; Pereira, 2009; Matos, 2007).

The concept of the prototype aimed to develop a toy that allowed the inclusion of visually impaired children and the stimulation of auditory, tactile and visual senses, at the same time that it was equally playful for all the children.

The prototype was made with pine wood, felt, foams and different fabrics to offer a contrast of textures and stimulate tactile perception of children. Rattles were used to offer sound stimuli and mechanisms such as wheels, spinning head, fittings and materials like Velcro and nylon rope were used to stimulate motor skills. The materials were chosen considering the ease of access and manipulation, besides its price, so that the product did not have a high final cost. All the materials chosen are commonly used by the industry of toys.

The design process took into consideration the characteristics identified from a survey carried out with professionals that work at APAE, besides of characteristics that make feasible its reproduction in industrial scale. The prototype project also respected the Brazilian Standards of Security for Toys (Technical Regulation of Quality for Toys, Portaria nº 310, July 1, 2014), and the Directive European Standards of Toys Security. The project also followed the Seven Universal Design principles defined by the Center for Universal Design (1997) as observed in Table 1.

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4.1.The design process

Table 1: Seven principles of Universal Design used in the development of the prototype. Based on Centre for Excellence in Universal Design.

Principle	What it is	How it was used
Equitable use	The product can be used by all the people in the same way, no matter their limitation	The toy can be used in the same way for both sighted and visually impaired children. The design was thought in order to avoid segregation and stigmatization of any users and appealing to all the users.
Flexibility in use	The product accommodates a wide range of individual preferences and abilities.	Children can choose the methods of use. The size of the geometric pieces facilitates the child's accuracy and precision during the play. The textures provide adaptability to the child's pace.
Simple and intuitive use	The product is easy to understand, regardless of the user's experience or knowledge.	The toy has a simple design without complex mechanisms and it is consistent with the child's expectations.
Perceptible Information	The product communicates necessary information to the user, regardless of the user's sensory abilities	The toy provides different modes of presentation of information. It has different textures for tactile information, different colors for visual information and also sounds. All the parts of the toys have big sizes.
Tolerance for Error	The toy minimizes hazards and the adverse consequences of accidental or unintended actions	The sizes of the elements are big enough to avoid risks to the physical health of children. The material used was natural because it would be in touch with children and the design process also follow the requirements of toy safety requirements.
Low Physical Effort	The product can be used efficiently and comfortably and with a minimum of fatigue	There are not repetitive actions, the toy can be used in multiple ways, it does not require forces to use, and does not require a change in the body position.
Size and Space for Approach and use	Appropriate size and space is provided for approach and use regardless of user's body size, posture, or mobility.	The size of the toy as well as of the parts were thought so it could fit in the hands of a child between 3 to 6 years.

Figures 1, 2 and 3 show the toy prototype projected and manufactured. Figure 4 shows a 4-year old child testing the prototype.

Figure 1: Inclusive toy prototype for visually impaired children.

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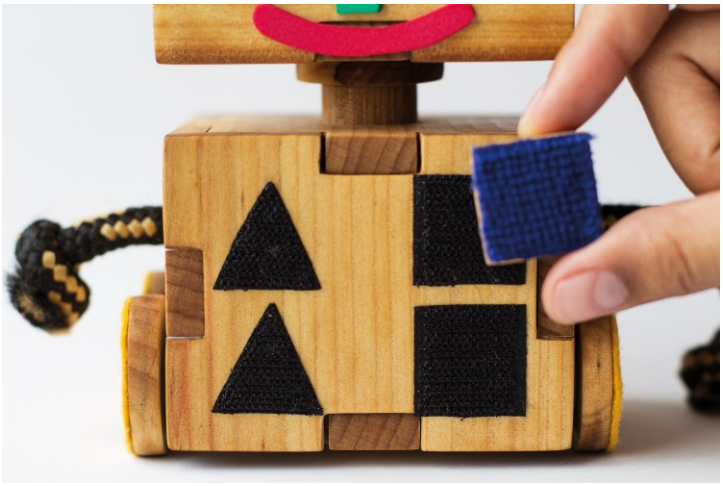

Figure 2: Detail of the prototype fitting.

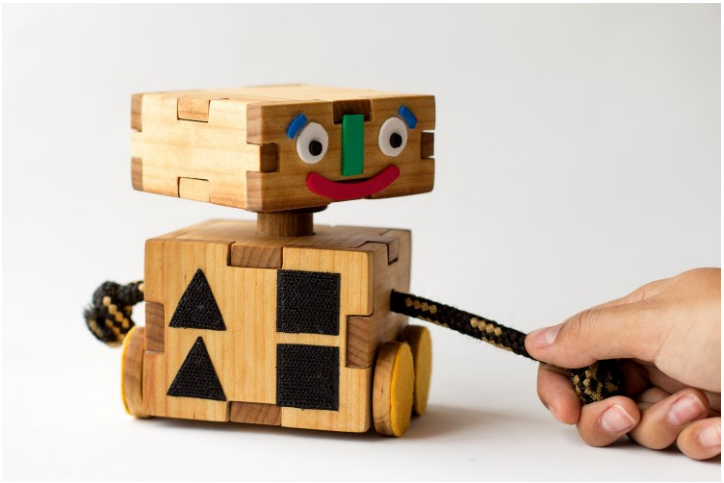

Figure 3: Inclusive toy prototype for visually impaired children.

Figure 4: Prototype in interaction with the child.

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4.2. Validation

The prototype created was evaluated through electronic research using online questionnaires available in Google Forms platform. The evaluation included questions with a movie of the toy being used, so the participants could see the toy's mechanisms.

The prototype was not evaluated by children because that would require a specific authorization as well as the approval of the Brazilian Standards of Security for Toys, to ensure the safety of children. Since this project was the first prototype, the research was done initially with professionals in order to know if the prototype would have potential to be interesting for children as well as a stimulant. After the result, the next step would be the evaluation with children.

The research was performed between the months of February and April of 2017 with 31 health and education professionals, that were addressed through emails and social media. As selection criteria of the participants, everybody should have professional experience with preschool children (3 to 6 years). The professions of the participants included: Occupational Therapist (29%), Preschool teachers (25.8%), Psychologist (22.6%), Pedagogue (6.5%), Physiotherapist (3.2%), Dentist (3.2%) and others, as shown in Figure 5. The results show the predominance of Occupational Therapy, Psychology, and Educational professionals. One could presume that this fact occurred because these professionals act directly with children that have impairments, which does not happen often with other careers. All the participants were female, and 71% reported having or having had contact with visually impaired children.

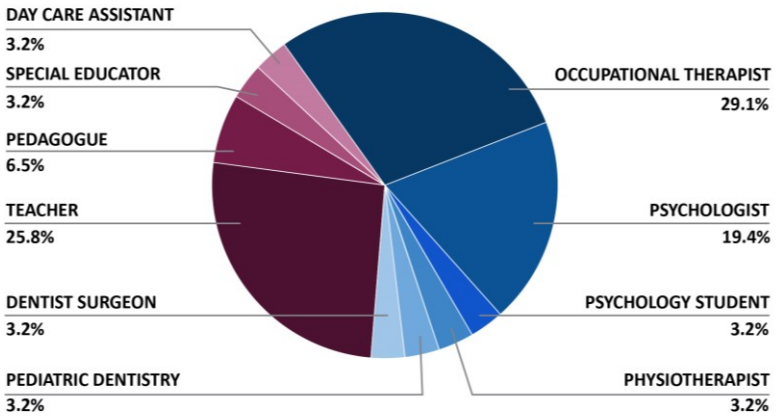

Figure 5: Participants professions.

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4.3. Colleting procedures and data analysis

The participants were informed, in the first page of the questionnaire, about the study objectives and procedures, as well as guaranteed of the absence of any risk to their health and the possibility of ending or refusing the participation at any moment, through the Free and Informed Consent Form (TCLE), meeting the 466/2012 resolution - CNS-MS. The participants answered questions about their occupation and experience with visually impaired children in their professional practice.

An explanatory movie, around one minute long, about the toy's functionality and characteristics was available. The participants were oriented previously about adjustments required in their computer so that the exhibition could happen properly.

The questionnaire elaboration included open and closed questions for qualitative and quantitative purposes, as recommended by Alexandre and Coluci (2011). Closed questions were based on the Likert scale of five points, with an indication of agreement or disagreement degrees in relation to each statement, in which the value 1 corresponded to total disagreement and the value 5 to total agreement with the affirmative. Open questions approached perception aspects of the professional with security, ease of use, attractiveness, innovation, social inclusion and stimuli provided by the toy.

The data analysis identified the agreement or disagreement degree using frequencies' sum of participants' answers. In the analysis, values 1 and 2 were considered as discordant and values 4 and 5 as concordant. The value 3 was considered as a neutral point, in which the participant did not agree nor disagree with the affirmatives. The frequency sums of each attribute were transformed in percentages.

5. RESULTS

The results show that most of the participants considered the prototype innovative, inclusive, attractive and with the potential to stimulate the child's sense, being able to be implemented as a stimulation instrument for the neuropsychomotor development of visually impaired children. This result suggests that the principles considered for the design of the inclusive toy were adequate, and the value added to it would be a differential to the industry that produces and releases it in the market.

Figure 6 shows, in a bar chart, the agreement, disagreement and neutrality percentage of those who evaluate the toy and answered the questionnaire.

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The results show that the prototype was positively evaluated in all questions, with a minimum percentage of agreement of 52%, among all evaluated parameters. Items with larger agreement among the participants were, respectively:

- offers tactile and motor stimuli (both with 97%);
- inclusion (97%);
- attractiveness for visually impaired children (90%);
- child receptivity (90%);

Among the identified characteristics with the smaller agreements highlight:

- stimulus to hearing (52%);
- stimulus to autonomy (58%);
- stimulus to interaction (62%).

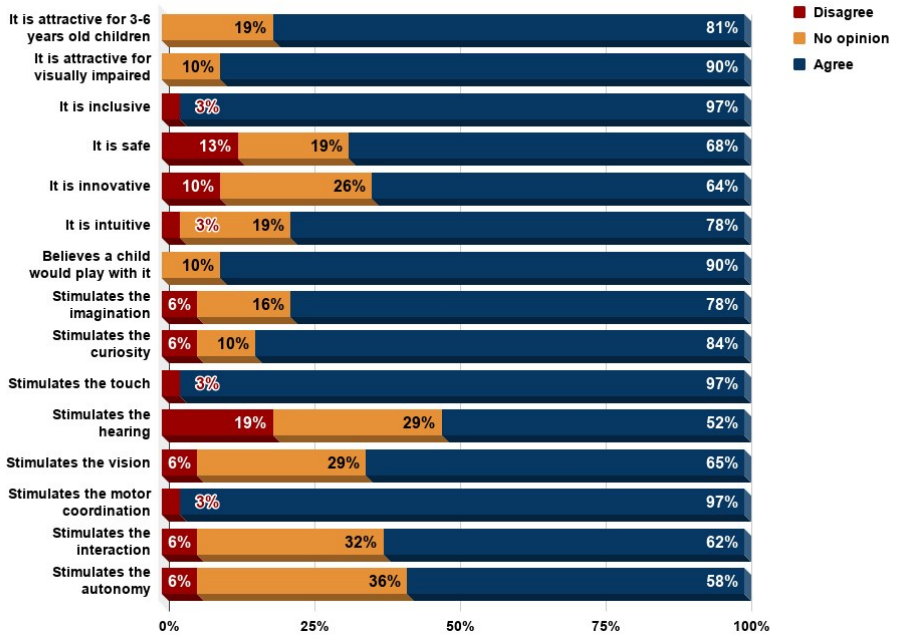

Figure 6: Participants agreement percentage in relation to the affirmatives presented in the questions.

The evaluation regarding sound stimulus did not show, clearly, that this characteristic is significant because it obtained 52% of agreement, 29% of disagreement and 19% without a

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formed opinion, which suggests that there is a difference of only 4%. The same happened with the evaluation of autonomy stimulation. However, in this case, the difference was higher (17%), but still in an indefinite range.

The Figure 7 presents the information of agreement in a format known as radar chart, by which it can identify, through radial axes, information related to agreements, disagreements, and neutrality, basing their positions within a circle and the variation of distances relative to its center.

The area circumscribed by the points marked by concordant and discordant opinions confirms that the toy's positive evaluation was far superior than the one that considered it inadequate to its purposes.

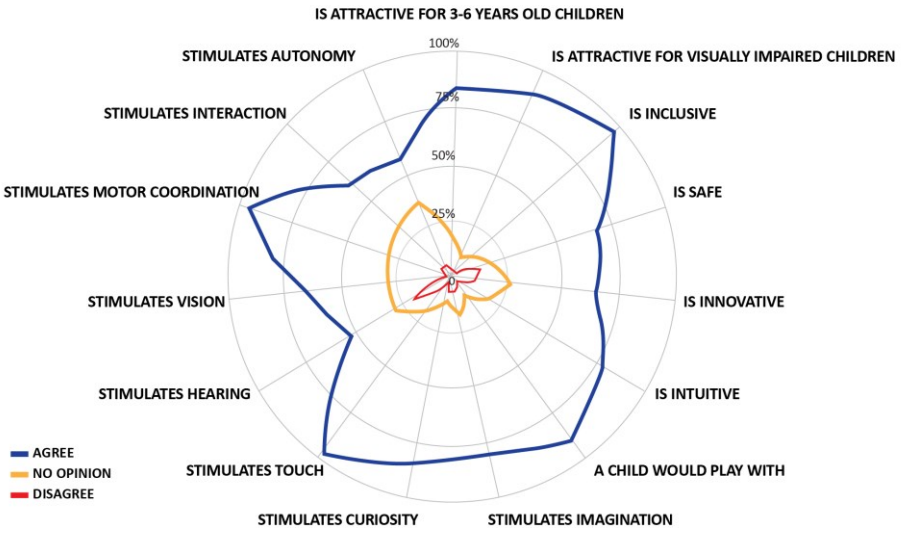

Figure 7: Participants agreement percentage with the evaluated affirmatives

In to the characteristics that make the toy innovative or not, the participants had the possibility of selecting multiple answers, from a series of attributes previously listed and available in the questionnaire, besides of issuing their own opinion about it, once they had access to an area dedicated to this purpose. The answers are presented in Figure 8. 64% of the participants considered the toy innovative, and the main reasons listed were: "it is different" (67.7%), "it does not exist in the market" (32.3%), "it is new and modern" (19.4%). Other characteristics were also listed: "offers stimuli", "it is versatile", "it is integrated", "it is adapted and interesting" and "it is inclusive", as can be observed in Figure 9. It is important to emphasize that the respondents, without being induced and by their own initiative, related the innovation with sensorial, cognitive and learning stimuli that the toy offers. The

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participants that did not consider the toy innovative (10%) justified their answers arguing that there are similar or more attractive toys in the market.

One of the main points identified and presented in Figure 8 relates directly to the market and the opportunity of the toys industry to explore this niche. Among the respondents, 32.3% answered that there is not a similar product in the market to be bought, and 67% classified the toy as different, which already attracts, naturally, the attention to it.

Figure 9 presents the agreement percentage among the attributes that the participants, voluntarily, added in their answers. We identified that the characteristic "offers stimuli" was highlighted by 25.8% of those interested in letting their opinion registered because did not find this answer among those listed in the questionnaire.

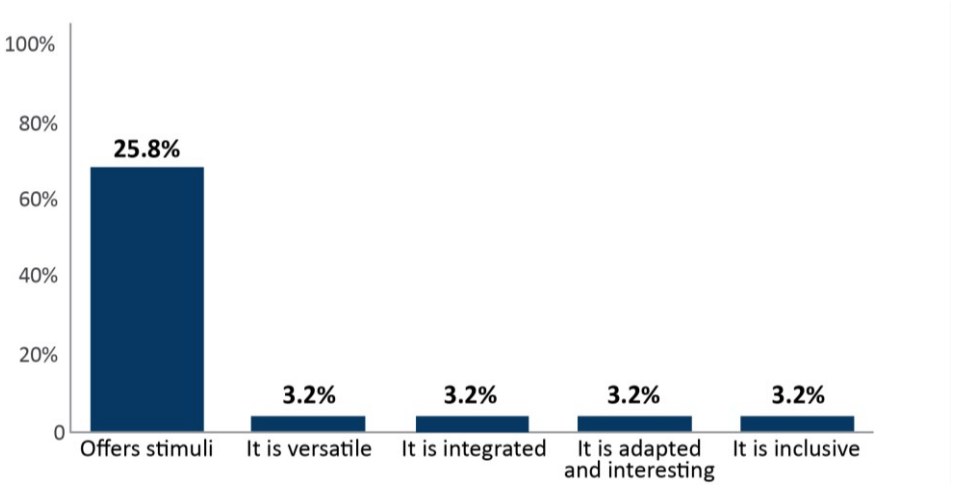

Figure 8: Toys characteristics associated with innovation. (Obs: because it is a multiple answer question, the sum of percentages overcomes 100%).

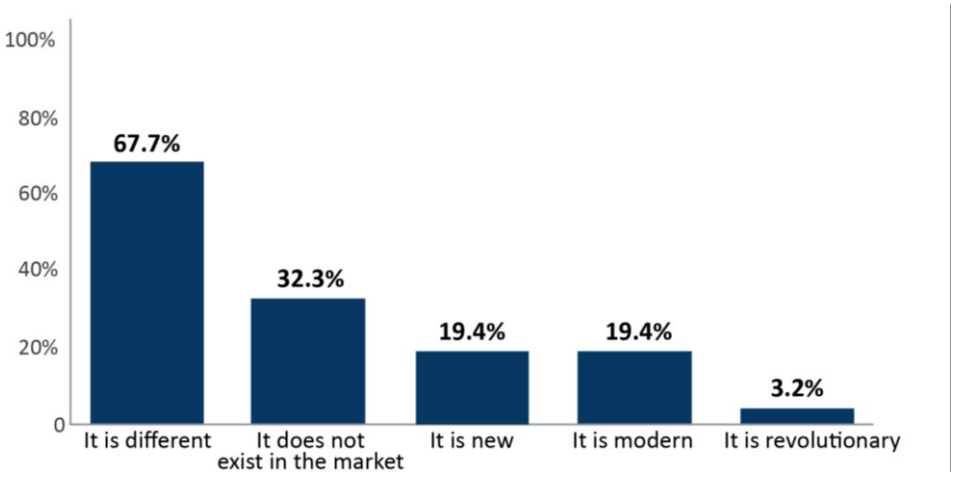

Figure 9: Toys characteristics associated with innovation added by the participants.

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The prototype was considered inclusive by 100% of those who declared that have had already experience with visually impaired children. This population corresponds to 71% of the total of respondents, which means, there was unanimity in the agreement of this point, as presented in Figure 10. Among those who declared that did not have previous experience with visually impaired children, 3% did not consider it inclusive while 26% classified as such.

Thus, 97% judged the toy as inclusive, showing that the main purpose, when conceived, was reached by its designer, and that the premises and specification that outlined its project were adequate.

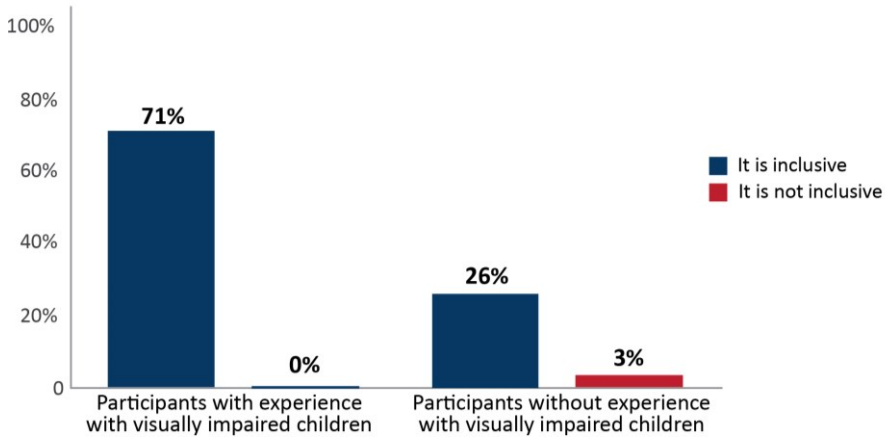

Figure 10: Comparison of agreement percentage of the attribute "inclusive toy" among subjects with and without experience with visually impaired children.

The range from 3 to 6 years was judged the most appropriate to children to enjoy the toy by 81% of the participants. The remaining 19% did not have an opinion formed about it. The agreement about the toys attractiveness for visually impaired children was 90%. None of the respondents disagreed with this attribute; however, 10% did not issue an opinion about it. Figure 11 presents these data.

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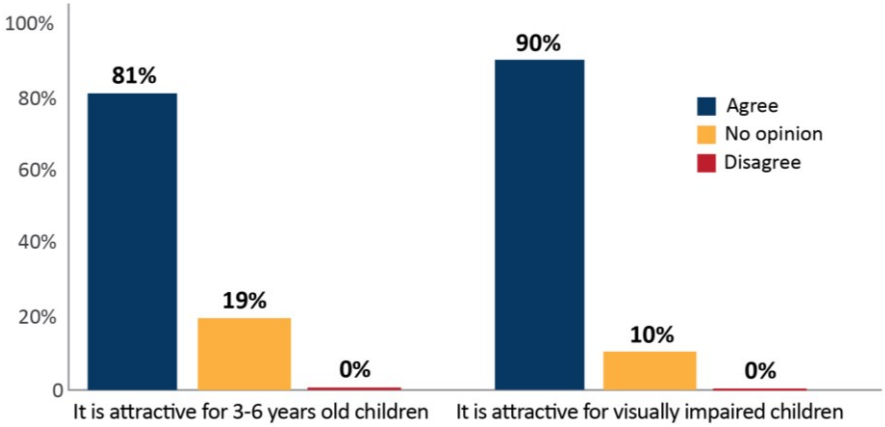

Figure 11: Comparison of subjects percentage that considered the toy attractive for a child of 3 to 6 years and for a visually impaired child.

One of the analysis showed that the toy is inclusive and, at the same time, innovative for 65% of the participants, as presented in Figure 12, with 97% considered it inclusive.

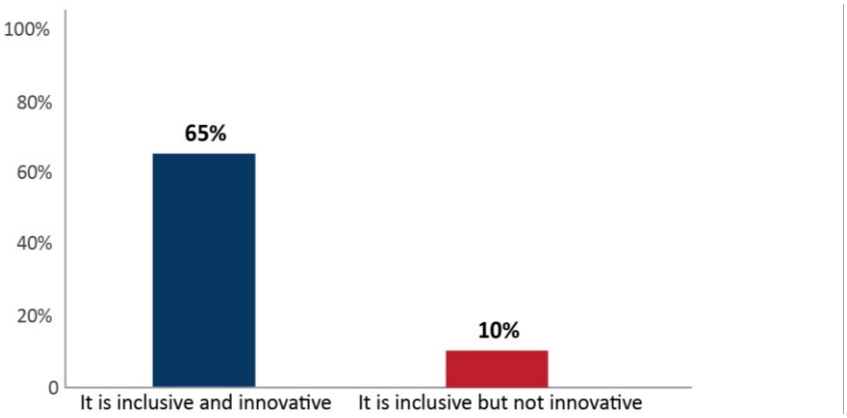

Figure 12: Comparison of participants percentage that considered that toy inclusive and innovative.

The section with open question, in which the participants could comment their answers, criticize or give suggestions, received, in general, positive feedback, like for example: "I am a teacher in child education, I know the focus is for visually impaired children, but it will be very welcomed for children from 2 to 3 years too because it is a stimulant toy. Besides that, I think it should have more colors and noises, they love it!"; or "I would like to congratulate for all the work! It was very nice to have the opportunity to meet a toy made with characteristics based on inclusion. This will result in a more human future once that, nowadays, almost there is not toys sold with this look". The most highlighted items were the importance of sensorial stimuli provided by different shapes and textures of the components; ease and

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simplicity of use; the fitting of the pieces and the stimulus of thin and thick motor coordination.

Some suggestion were made like increasing the number of geometric shapes, changing the toys classification age range from 3 to 6 years to 2 to 4 years; using more contrasting and bright colors, adding more sonorous objects, and, also, implementing the use of the toy for children with autism due to the stimuli that it provides, such as the follow: "I would opt for more contrasting color and at the face I would use bright. Once that the low vision makes necessary less environmental light and a focal light in the object. Contrasting color and bright would facilitate the location of the object, focalization for its exploration"; or "Thinking about visually impaired children, I suggest to use more contrasting colors, like black/white (instead of brown), red/yellow"; and still "I suggest to rethink the duplicity of the geometric shapes in the same toy. It could be only one and increase the number of geometric shapes"; among others.

6. CONCLUSIONS

A toy for visually impaired children at preschool age using the seven principles of inclusive design in its development was evaluated by 31 health and education professionals. The results suggest that the novelty factor was associated with innovation, having the options "it is different," and "it does not exist in the market" as the most selected. Even though the participants manifested not having knowledge about the concept of innovation, there was a value added to the toy in their opinion, which effectively corresponds to the existence of innovation in the product evaluated.

The results also showed that the prototype was qualified as attractive for visually impaired children by 90% of the participants and for children between 3 to 6 years by 81% of the respondents. The fact of the prototype has received a great agreement with the parameters of attractiveness, both for children from 3 to 6 years old as for visually impaired children, confirms that inclusive toys can arouse the interests of these children, justifying, even more, the advantage of investing in its creation and manufacturing.

Besides that, 97% of the respondents considered it inclusive and 64% as innovative. Regarding the provided stimuli, the concordance occurred was always positive: 97% considered that it will occur tactile stimuli, 65% visual, 62% motor, 78% of imagination, 84% of curiosity and 58% of child autonomy.

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The fact of the prototype has received a high degree of agreement with characteristics related to tactile and motor stimuli shows that the toy has potential to provide improvements in the quality of life of the user, and that the adoption of inclusive design principles in the toy design is a differential that arouses the attention to a niche of market little explored and that, as the data suggest, meets a needy target of toys with similar characteristics.

From the observed data, we can conclude that the developed prototype was positively evaluated and that the use of inclusive design principles in the creation process of a toy can act as a strategy for innovation in the toy's design, being able to generate benefits both to the users, by providing the inclusion and offering stimuli to the senses; as well as to the industry, setting as a competitive advantage.

Limitations of this study include the convenience sample, which does not allow to generalize the data, and the fact that the prototype was not tested by visually impaired children because that would require safety and specific tests with the prototype.

The lack of physical interaction of the volunteers with the prototype may have lead the participants of the research to attribute a low degree of concordance, with only 52%, for the sonorous stimuli item. The adjustment required in the configuration of the computer, as explained and requested at the beginning of the questionnaire, may have possibly collaborated to the concept attributed, due to the prejudice in the judgment of the respondents.

Regarding the child's acceptance, since the toy was not tested by children, this cannot be generalized. However, this question was judged by experienced professionals that declared to believe that a child will have his or her interest aroused by the use of this toy, showing that it may have a good receptivity among them.

This study was performed with professionals of health and education areas so that specialists with experience with children in preschool age could evaluate the prototype with proficiency. The data collection was done through the online platform Google Forms that has advantages and disadvantages. The biggest advantage of using electronic search as a mean of collection is the possibility of obtaining a great number of participants. The difficulties faced; however, refer to the lack of interaction of the participant with the prototype, mainly with the audition stimuli item, that obtained the highest percentage of disagree.

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Although, the results of this study cannot be generalized, an important aspect raised in the data collection was the guidelines for future projects of inclusive toys, provided by the participants in voluntary comments, based on their experiences. The most emphasized item was related to the importance of the stimuli provided by the different shapes and textures of the components. Regarding the aesthetic characteristics, there were some suggestions regarding the numbers and types of geometric shapes, colors and sound objects. It was also emphasized the possibility of using the toy for children with autism, due to the stimuli provided, besides of its easiness and simplicity of use, showing that a simple toy can be interesting, attractive and useful for the children. In this case, the principle of simple and intuitive use adopted in the design shows that the toy can be used by other children, fulfilling one of the objectives of the project.

Although the importance of toy for child's development is recognized and theme of several studies, we identify that the investment is still insufficient to make it an effective instrument of development, finding in the national market little diversity, especially regarding inclusive toys. The results presented showed the existence of real interest of its use as an inclusive tool for child's development, among the professionals of health and education areas, providing that the particularities are considered in the project.

Considering that the industry is always searching for novelty, the innovations provided by the adoption of inclusive design principles in the project of toys, if used properly, will transform the way of conceiving these products, modifying the profile of toys available and driving the market for making feasible its access by a new niche of consumers.

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