LOOKING FOR THE GOOD SHAPE IN THE POLY-UNIVERSE MATERIAL

Inês de Vasconcelos Martins
Faculdade de Psicologia e de Ciências da Educação
Universidade de Coimbra, Portugal
inesvasmartins@gmail.com
Graça Bidarra
Faculdade de Psicologia e de Ciências da Educação
Universidade de Coimbra, Portugal
gbidarra@fpce.uc.pt
Piedade Vaz-Rebelo
Faculdade de Psicologia e de Ciências da Educação
Universidade de Coimbra, Portugal
pvaz@fpce.uc.pt

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ABSTRACT

This communication reports a set of activities carried out with a three-year-old male child in residential care, using the Poly-Universe material. This material involves sets of 24 pieces of geometric shapes and basic colours (square, circle and triangle), which allow puzzle-like constructions, transforming into a colourful geometric skill development game based on the symmetry of scale change, created by the artist János Szasz Saxon. In cooperation with the child, the educator made the material available, introducing circles, then squares and finally triangles, letting the child explore the material, which led to the construction of creative patterns and playful solutions, associated with other objects (eg the car track and the box to be used as a garage). Through participant observation, it was possible to record, in addition to the knowledge of geometric shapes and colours, through their naming, the development of curiosity, motivation, attention and visual perception. It was registered the placement of series, based on pieces of the same shape, geometric and enlarged forms of a wider set. In this way, the child's curiosity and desire to learn gave way to intentional processes of exploring the material and understanding different mathematical concepts. It was possible to observe a gradual evolution in terms of material handling, showing an increasing willingness to make/discover new connections. In an autonomous way, he sorted the pieces by colour, created imaginary shapes or shapes that he could play with, put together equal sizes and was able to create new geometric figures.

Keywords: poly-universe; development; preschool; guided-play

RESUMEN

Ponerse en forma con el material de Poly Universe. Este artículo presenta el informe de un conjunto de actividades realizadas con un niño varón de tres años en régimen de internado, utilizando el material del Universo Poly. Este material se compone de conjuntos de 24 piezas de formas geométricas y colores básicos (cuadrado, círculo y triángulo), que permiten construir puzzles, convirtiéndose en un colorido juego geométrico de desarrollo de habilidades basado en la simetría del cambio de escala, creado por el artista János Szász Saxon. En colaboración con el niño, el educador puso a su disposición el material, introduciendo círculos, luego cuadrados y finalmente triángulos, dejando que el niño explorara el material, lo que llevó a la construcción de patrones creativos y soluciones lúdicas, a las que se asociaron otros objetos (por ejemplo, la pista de coches y la caja como garaje). A través de la observación de los participantes fue posible registrar, además del conocimiento de las formas geométricas y los colores, a través de su denominación, el desarrollo de la curiosidad, la motivación, la atención y la percepción visual, en la colocación de piezas en serie, a partir de piezas de la misma forma geométrica y de formas ampliadas de la misma forma utilizando un conjunto mayor. De este modo, la curiosidad y el deseo de aprender del niño dieron paso a procesos intencionados de exploración del material y de comprensión de diferentes conceptos matemáticos. Se pudo observar una evolución gradual en el manejo del material, mostrando cada vez más voluntad de hacer/descubrir nuevas conexiones. De forma autónoma, ordenaba las piezas por colores, creaba formas imaginarias o con las que podía jugar, unía magnitudes de igual tamaño y era capaz de crear nuevas figuras geométricas.

Palabras clave: poly-universe; desenvolvimento; pré-escolar; brincar guiado

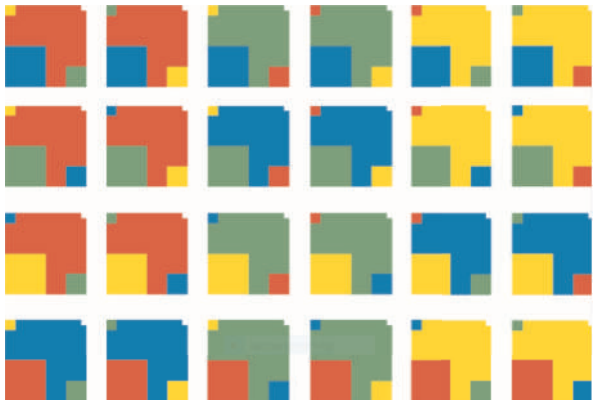
INTRODUCTION

Poly-Universe is a geometric ability development game, including three base forms (circle, triangle, square) and four colours (red, yellow, blue, green). A basic object is conceived from the base shapes with shapes of various sizes and colours (Figure 1). A set is a package of 24 elements of the same base form originated. In Figure 2, the example of square set is presented.

The game was invented by Janos Saxon Szasz. Considering the elements described, endless figures can be done, and although the tool consists of simple elements (basic shapes, basic colorus, proportions), it is extremely complex because there are virtually endless possibilities for changing proportions.

Figure 1 - Examples of Poly Universe basic elements (Poly Universe, 2022)

Figure 2 - Squares set (SAXON, Szász János, 2019)



Poly-Universe can be implemented with participants of any age and in different contexts and can be used for both entertainment and educational purposes, in non-formal and formal education. The tasks address visual and mathematical ways of thinking and constitute cognitive challenges of all levels. 'Preliminary research has shown that the tool can be used in a wide range of education, especially in the fields of geometry, combinatory, logic, graphs, and algorithms'. Several examples of activities with different levels of complexity can be found in PUSE Handbook (Poly-Universe in School Education, 2022; Saxon, & Stettner, 2019).

Althoug Poly-Universe can also be used with different groups and ages (Saxon, & Stettner, 2019), until it has not yet been explored in early age children, in kindergarten or preschool contexts. Just like with other ages, in early ages, Poly-Universe may be implemented using different pedagogical approaches. However, it may be relevant to explore a play pedagogical approach, taking in account the characteristics of both Poly-Universe and preschool education.

The role of play in development has been extensively evidence in educational theories and research (e.g. Dárdai, 2022, for the role of play pedagogy in geometry, Vaz-Rebelo, Bidarra. Santos, in press). After reviewing the place of play in education, Dárdai (2022, 53) refers 'these few examples show that the educational role of play is now well known from centuries of experience. This is why play pedagogy is now taught in all educational establishments with nursery school teachers, primary school teachers and teachers; there is a vast literature on the subject and the teachers concerned can learn about the educational value of the various types of play - movement, skill, development, social, etc. - not only from textbooks, but also through national and international professional events, conferences and campaign.

In particular, early childhood educators understand the importance of play in their children' development. Play can take different facets and aims. The role of the educator during play bring the distinction between free play and directed/ instructional play (Weisberg, Hirsh-Pasek, Golinkoff, Kittredge & Klahr, 2016). As referred in Vaz-Rebelo, Bidarra and Santos (2022. 98) 'Free play is spontaneous as children chase their creative fantasies. While, on the one hand, free play is aimed at children and without adult intervention, on the other hand, guided play takes place in an intentional environment that has been carefully planned to stimulate and support children's curiosity and creativity. As students interact with each other and with the materials, teachers observe and record this information to plan next steps, it is the children who decide how they will explore and interact with the materials, not the teachers. In guided play, learning opportunities can be explicitly structured, but the activity is conducted by the child.

A key issue is that is actually under discussion is then how to guide children play, which may be educators' role in order to keep the benefit of free play and also of direct guidance. In this scope, guided play emerges as a

way to consider both free play and educators' guidance and may take several facets and characteristics (e.g. Weisberg, et al., 2016).

In this work an example of using Poly-Universe with a three years old children is presented.

RESEARCH OBJETIVES

The Poly Universe material has already been used for teaching mathematics to children over the age of six, with several activity proposals for different age levels (e.g. Saxon & Stettner, 2019). It is now intended to extend the use of this material to other contexts and preschool level. In this sense, the study we are now presenting took place in a Residential Care setting, in a guided-play approach, which aimed to promote the knowledge of simple geometric shapes (circle, triangle and square), colours (yellow, blue, green and red), as well as the promotion of creativity, intrinsic motivation, attention and visual perception among the child.

PARTICIPANTS

This is a case study with a three-year-old male child in residential care, in which the Poly-Universe material is used, in a guided-play approach, seeking to describe the way he acts with this material.

METODOLOGY

Considering that this is a case study, the best data collection technique is observation. This proved to be a crucial instrument for this study because it allows us to find out, in fact, how the action took place. Observation does not only integrate visual perception, but also tactile, olfactory, and auditory perception. In this sense, the qualitative researcher uses all five senses to collect information, which only gains meaning when obtained in its natural environment (Flick, 2013). Following this line of thought, throughout this research, it is used participant and indirect observation, thus allowing for a more accurate data collection.

Participant observation allows the researcher to integrate the environment under investigation, "wearing" the role of social actor, thus being able to have access to the perspectives of other human beings when experiencing the same problems and situations (Amado, 2013). In this way, we sought to develop moments that met the child's tastes and interests, thus providing the development of his/her creativity and motivation.

According to Flick (2013), participant observation occurs on two levels: in the first, the researcher becomes a participant, gaining access to the person and, in the second, he/she continues the observation, focusing more on the objective being investigated. Thus, in the first plan we tried to get to know the child, gaining her/his trust and creating a safe and calm environment so that she/he could express her/his opinions and emotions (it is necessary to consider that this is a foster child due to a Promotion and Protection Agreement, so this first contact becomes crucial). On a second level, we implemented strategies in the development of the activities that were in line with what was previously observed, focusing on the child's handling of the material.

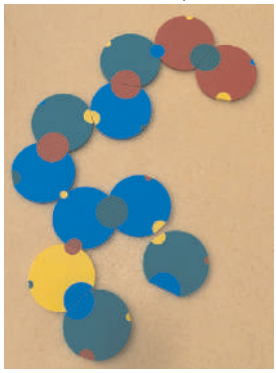
Indirect observation was also a method used, through the taking of photographs, allowing the recording of the child's constructions throughout the moments, for future observation and analysis. Photography aims to document the practices analyzed, allowing for the confrontation of presentations and interpretations in text form, often perceived and interpreted from a specific point of view (Flick, 2013).

The introduction of the material was divided into four moments: (1) circles; (2) squares; (3) triangles; and (4) the child's "favorite". In the initial moments of the first session, the child was allowed to handle the material freely, without any intervention from the adult, thus promoting free play and autonomy. Later, we opted for the guided play method, structuring the learning pathways taking in account the learning objectives, but still letting the child lead the activity. In this approach, the adult is seen as a collaborative partner who creates flexible and interest-oriented experiences that stimulate the child's natural curiosity, active involvement and "meaning" processes (Fisher, Hirsh-Pasek, Newcombe & Golinkoff, 2012). In this context, the adult protects the child's learning by commenting on discoveries, playing with the child and creating learning sequences using well-planned materials.

All sessions were held in the Institution's living room, in a neutral, safe environment where the child is used to being and playing. It was always mentioned that this was a game chosen for him, but that everyone could play and handle the material, something that was not very well accepted by the child at the time of play.

The first session took place three months after the child's arrival at the Institution, which allowed a regular approach process without creating any stress or discomfort in the child. Initially, he started by joining the halves of larger and intermediate circles, making a correct connection with the colours, and when questioned about the construction he had made he said: "Can't you tell it's a caterpillar straight away?", which led to a joint laugh. He was asked if he knew what shapes he was working with and the answer was positive, saying that they were "circles that look like balls".

Figure 3 - First constrution, "The Caterpillar"

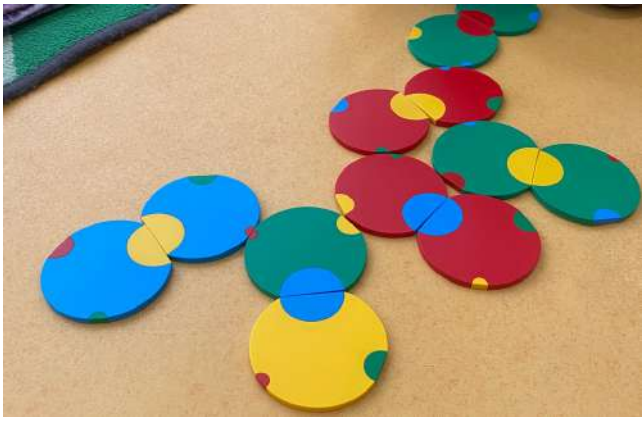


During the process of this construction, the learning objectives were explored, questioning the child:

- "Have you noticed that you put several equal colours together?";
- "Together halves together give one...?", to which the child replied "Circle!";
- "Have you seen how there are circles of so many different sizes?".

This led the child to change him construction and make the connection of even more semicircles, as shown in the picture.

Figure 4 - Second construction, "The New Caterpillar"



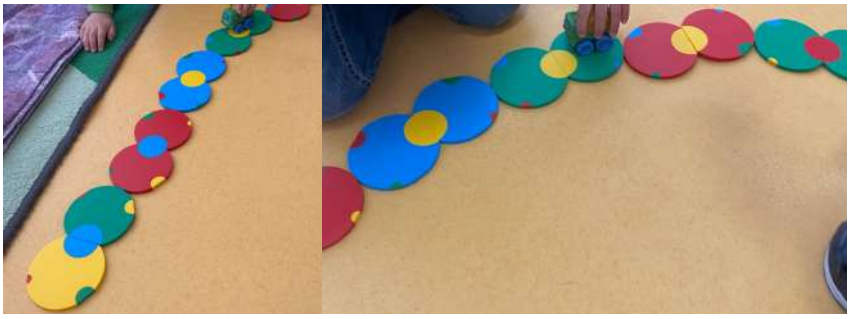
After this moment and being asked if there was anything else he could build with the circles, the child connected the pieces through the biggest semicircle, paying attention to the colours, and created a road, which he could travel with one of his favorite toy cars.

It should be noted that this moment was not timed and lasted approximately thirty to forty minutes due to the child's frustration, as the other children also wanted to join in the fun by destroying their constructions, which was not to their liking.

During this new assembly, the child was several times directed to the connection of equal colours, questioning "Can't we exchange these two pieces to get a circle with the same colours?", which led to the child naming the colours at the adult's request.

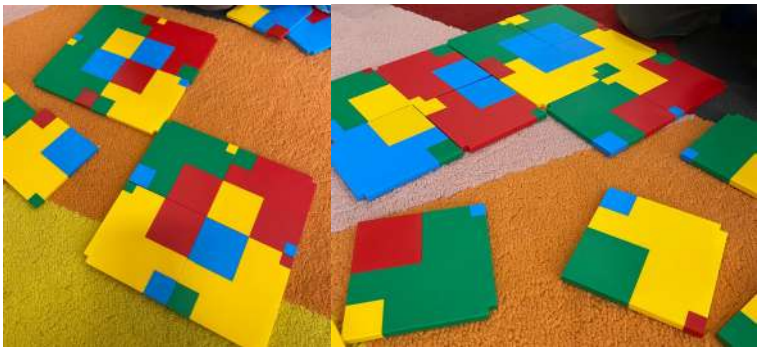
Finally, there was an attempt to guide the child in joining smaller sized semicircles, which could also be connected in their construction, but the child did not adhere to this suggestion, saying "No, on the road there can only be a hole", referring to the semicircles he had already joined.

Figure 5 - Third construction, "The Road"



In the second session, one week later, the child was already more familiar with the material and squares were introduced. The child started to build squares of larger size, without considering any of the colours, joining them together, building a square of even greater size. During this process it was always pointed out to the child what he was building, showing him that "several squares together make an even bigger square, do you want to try?"

Figure 6 - Fourth construction and evolution of the square



When he reached the biggest square he could, he was asked what it was, to which he replied "It's a car park, and the box is the garage", also using the game box as a play element.

Considering that the colours had been put aside so far, the focus was then on changing the pieces to create "smaller squares within the big square", thus adding the colours inside. What frustrated the child in this process

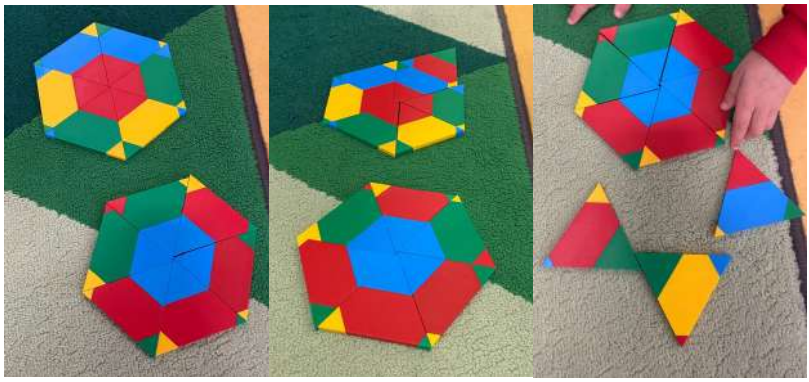
was the fact that the colours were odd numbered, which did not allow him to have interior squares with the same colour, circumstance overcome by the discovery of a car with exactly the colours present in the game (yellow, blue, green, and red), with which he could drive through the "car park" that he built.

Figure 7 - Fifth construction, "The Car Park"

We asked the child if it was posible to record his construction, to which he replied 'yes', but only if the car could get out of the "garage" (game box) first and so we did, also bringing him into contact with technology, viewing the video afterwards.

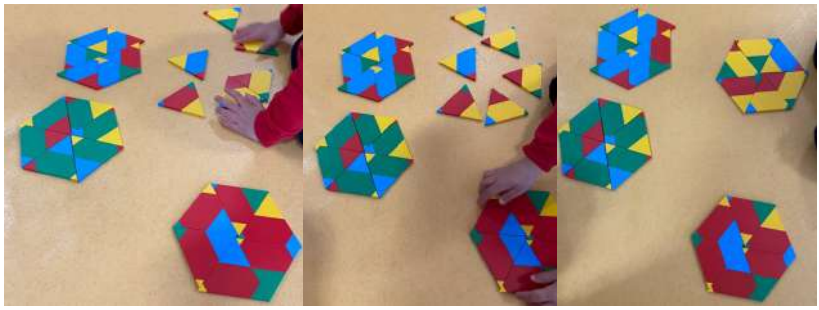
The third session, where triangles were introduced, took place the following week. Knowing that this can be one of the most complicated shapes to construct, in a first moment it was explained to the child that "six triangles together make a hexagon", which is also a geometric shape. The child was very interested in this connection, which allowed to further demonstrate to him that "if we put all the same colours together in the center, it makes an even smaller hexagon".

Figure 8 - Sixth construction, "The Hexagon"



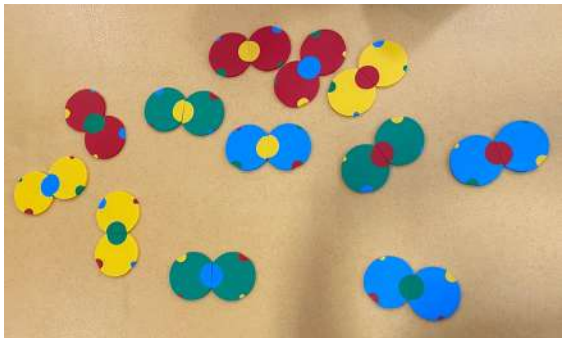
After this moment, the child was allowed to handle the material freely, and the first thing he did was to separate the pieces by their main colours, and build four different hexagons, separated by each colour. This ability to perceive the connections and union of the same colours proved to be increasingly better over the course of the sessions.

Figure 9 - Seventh construction, "The various Hexagons"



Afterwards, when asked "Of all the geometric shapes, which was your favorite?", the child chose circles and that was the motto for the next game. When the circles were handed to him, the child hurriedly took all the pieces out of the box and separated them by matching main colours and matching larger semicircle colours as well, two by two.

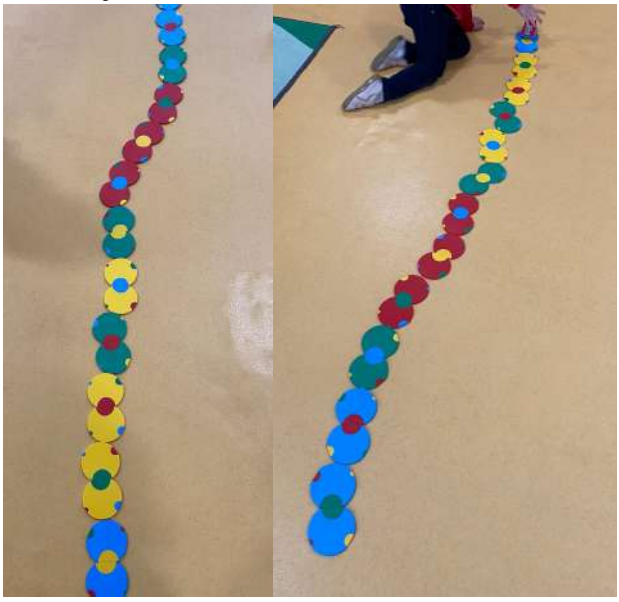
Figure 10 - Eighth construction



This ease and instinctiveness were only possible due to all the sessions developed, which led him to understand the material so well.

Finally, and maintaining the colour links, the child created the biggest road he could, he went to get the trolley which had the same colours as the game and played for some time on his road.

Figure 11 - Ninth construction, "The Final Road"



RESULTS

Through participant observation, it was possible to register, in addition to the knowledge of geometric shapes and colours, through their naming, the development of curiosity, motivation, attention and visual perception, in placing pieces in series, based on pieces of the same geometric shape and enlarged forms of the same shape using a larger set.

In this way the child's curiosity and desire to learn gave way to intentional processes of exploring the material and understanding different mathematical concepts. It was possible to observe a gradual evolution in the handling of the material, showing more and more willingness to make/discover new connections. He autonomously arranged the pieces by colour, created imaginary shapes or ones he could play with, joined magnitudes of equal size and was able to create new geometric figures.

DISCUSSION

Poly-Universe materials were presented to a 3 years old children that could explore them in a free way. The child expressed interest, starting to organize the materials by colours, shapes, creating objects and narratives. The educator scaffolded the process, formulating some questions, but only with the aim to contribute to develop child own ideas. Although the child early ages, he managed to find some patterns through which Poly-Universe materials may be organized, evidencing mathematics competences. Other studies in guided-play approach proved be efficient with children of the same age, handling with geometric shapes (Weisberg et al, 2016). In our case, the combination of Poly-Universe material and guided-play approach proved be a good strategie.

CONCLUSIONS

Poly-Universe can be used in Residential Care, with children aged three and up, due to its simplicity, its universality, and its attractive appearance with vibrant colours. The best part of this game for the child was the fact that it did not have any rules, leading him to put the pieces together based on him own criteria and stimulating him creativity in him assemblies/constructions.

It is known to any professional in the educational field that playing is one of the most important ways for children to learn. Through play the child expands its imagination, leading it to create imaginative fantasies and it may begin to compensate for the pressures it suffers in the reality of its experiences.

With this material, it is possible to promote basic knowledge from informal play situations, such as communication and social skills; spatial vision; whole-part perception; algorithmic thinking; sensorimotor skills; synthetic and analytical thinking; seriality; etc. Poly-Universe thus stands out among the familiar Legos, board games, wooden cubes, and other logical games, being a game that can be adapted to different age groups.

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