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Introducing Science to Primary School Students with Autism Spectrum Disorders

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Abstract. Education policy over the past years has pointing the need for scientific literacy as evidenced by the rise of the awareness of the importance of science, technology, engineering, arts and mathematics (STEAM) education. Many programs have begun to target the need for STEAM education for all students from kindergarten through high school. For students with Autism Spectrum Disorders (ASD), the need to increase their scientific literacy is further difficult to achive by the need of an individualized instruction necessary when approaching new skills. This study was implemented at a structured teaching room with ASD early primary school students. The results of this qualitative study aim to reveal the potential for creativity and the role of inclusion and STEAM in early primary education with this group of ASD students. The way the education for students with ASD is approached is changing. The principle of inclusion has become strongly supported and recognized by national educational authorities in Portugal. However, barriers prevent students with autism from being genuinely engaged in school STEAM activities, especially at the early age levels. We need to do more to improve these students' access to STEAM studies. The present paper presents the analysis of data in relation to one case study that involved one teacher and children working in classroom context. The case study reported addresses simple science hands-on activities on static electricity, through the lens of creativity.

Keywords. Autism Spectrum Disorders (ASD), Creativity, Inclusive Education, Primary Science Teaching, Static Electricity, STEAM.

1. Introduction

Teaching strategies are practices used by adults (e.g., family members, practitioners) or, in some instances, by other children to help facilitate children's participation in everyday routines, learning experiences, and activities. Using these strategies engages children in activities, maintains their interest, and provides opportunities for them to learn concepts and thinking skills that support STEAM learning when using adaptations [1].The early years provide an exceptional opportunity to introduce STEAM, but that this potential is often left unrealized, especially for young vulnerable children, who live in poverty, are members of linguistic and ethnic minority groups [2].

Incorporating science experiments into learning is a great way to involve children and make lessons more hands-on and fun. While autistic students may have different needs in the classroom, they enjoy science experiments. However, there can be some sensory needs that need to be taken into consideration when planning science experiments, to ensure that autistic children are as comfortable as every other student. Many children on the autism spectrum have sensory processing disorder or struggle with certain sensory issues. A very oversimplified definition of this is just that their brain processes sensory input (touch, taste, sight, smell, sounds) from the environment around them differently than most children. For some children this can mean they crave extra sensory input and for others it can cause an aversion to certain stimuli all together. [3].

Since the discovery of autism as a human condition by Kanner (1943) and Asperger (1944) in the 1940s, individuals responsible for education and care of children and youth with autism spectrum disorder (ASD) have striven to provide effective practices and programs. Such efforts continue today. The increased prevalence of ASD has intensified the demand for effective educational and therapeutic services, and intervention science is now providing evidence about which practices are effective [4]. This study was realized in a structured teaching room with children with autism spectrum disorders (ASD). Creativity is not confined to special people or to particular arts based activities, nor is it undisciplined play, it is however, notoriously difficult to define. It has been described as "a state of mind in which all our intelligences are working together "…involving", seeing, thinking and innovating" [5]. In the context of the classroom, developing opportunities for children to "possibility think"

their way forwards is therefore critical. This will involve you in immersing the class in an issue or subject and helping them be playfully and explore options [6].Creative teaching is a collaborative enterprise which capitalises on the unexpected and variously involves engagement, reflection and transformation, patterned at such a rate as to invite and encourage a questioning stance and motivate self directed learning. [7].The case study contains three activities, documenting examples of science through the lens of creativity with autistic students. In this study, the activities and photographies will illustrate creativity in science and / or arts in the early years. These were based from selected observations and supported by information gathered through several types of data, non verbal comunication, communication tables and pictograms. This study was realized in a structured teaching room with children with autism spectrum disorders (ASD). The findings of this qualitative study aim to reveal the potential for creativity in the classroom realities of primary science education for students with ASD. For our article, we have picked three “clean” science experiments that are quiet and don’t require children to get their hands messy, since these can be typical triggers for autistic children.

2. Instruments and methodology

2.1. Instruments

The instruments used to record and to analyse the data were, in this case we report only on the field notes [8] and photographs [9] taken by the teacher and reflections of the teacher [10] and inputs collected with children [11].

2.2. Methodology

The objective of the observation during this activity is to spot and to characterize children creativity [12] through non verbal comunication, communication tables and pictograms.The notes taken include the children’s interventions, observation facial expressions, the emotions, the actions the events occurred. The pictures taken, enable to better identify and to characterize the quested creativity.

3. Characterization of the class

The school, located in Guimarães, in northern Portugal, is a public educational institution covering two levels of education: preschool and primary school; the students in a total of 60, are aged between three to ten years old, The structured teaching room is wide with perfectly identified functional areas endowed with suitable materials, and obeys to TEACCH program [4], that uses a method called Structered Teacching. This is based on the unique learning needs of people with ASD, including strengths in visual information processing and difficulties with social communication, attention and executive function. Five early school students (four boys (one of the first grade, two of the third grade and one of the fourth grade, and one girl of the first grade) participated during the work groups area of the TEACCH Program. Only two students are verbal (one boy of the third grade and one boy of the fourth grade).

4. STEAM activities

The objective of these activities is to mention and recognize that objects are made of different materials and the materials differ in surface, shape, color, size, etc.; to develop science process skills, mainly observation and categorization skills in simple inquiry activities; to develop ability to construct simple, but objective conclusion to realized inquiry activity; to develop preconceptions about static electricity. The used materials were balloon; confetti; ball of wool; plastic spoon; ruler, tissue paper; colored styrofoam and orange flannel cleaning duster and a dish.

4.1. Static electricity - Snake

This first activity is mainly focus on teacher scaffolding, involvement, during the presentation of the main themes of the activities that the children will develop. Main general science aspects are focused in the scientific contents that are going to be part of this activity. Obviously teacher is very concerned about this aspect; and teacher as the ability to guide the group through the “static electricity” concept. One student have already knowledge about the theme, others haven’t so. In this learning activity creativity was present when teacher encourages children to make connections between previous ideas and cross curriculum concepts and ideas. In particular one student that we might consider that recognizes one situation from out of the school learning “that gives shock”, referring to plastic

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bench: *"The plastic bench outside sometimes gives shock in our hands."* After this, the teacher asks the students to cut a snake in tissue paper. Then asks the students to rubber the plastic spoon with a orange flannel cleaning duster and "whisperer" the snake.

Figure 1.1. Child D "whisperering" the snake with static electricity

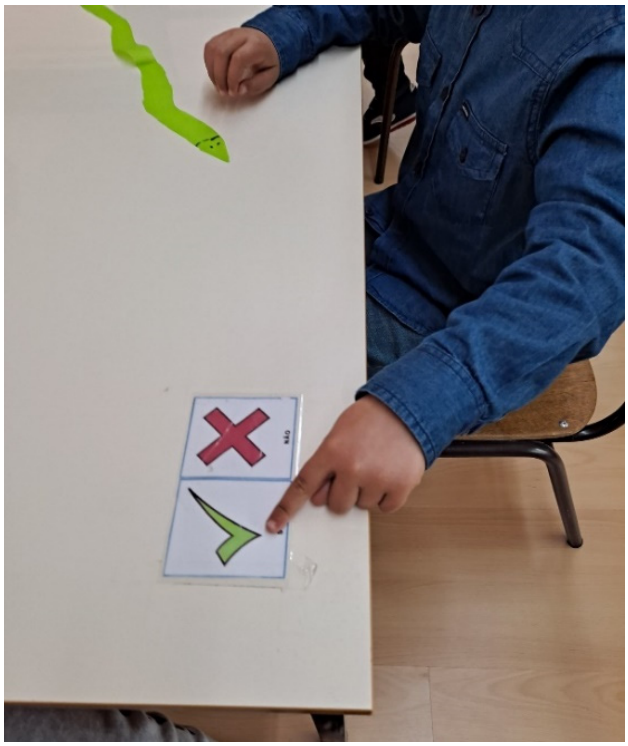

Figure 1.2. Child D pointing to the yes pictogram when asked if he enjoyed the activity

Figure 1.3. Child DA "whisperering" the snake with static electricity

Figure 1.4. Child M "whisperering" the snake with static electricity

Figure 1.5. Child N “whisperering” the snake with static electricity

4.2. Static electricity experiments- Balloon

Figure 2.1. Rubbed Ballon with orange flannel cleaning duster

Figure 2.2. Child DA rubbed ballon attracting small pieces of paper

Figure 2.3. Child D. rubbed ballon attracting small pieces of paper

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The teacher promotes the pupils to think like an inquiring person which is looking for an answer to the identified question (what kind of objects can cause rising up static electricity, in what kind of cases we can experience effect of static electricity). The teacher asks the pupils to point the pictogram √ (yes) or X (no) to an object considering what they think about behaviour of the balloon when it will be rubbed against orange flannel cleaning duster (making prediction).

Further the teacher offered the pupils balloons for verification of their predictions. She explained that it is important to rub all the inquired material against the orange flannel cleaning duster the same way to get the comparable results.

Figure 2.4. Child D. trying to fix more papers by hand

Figure 2.5. Child L. rubbed ballon attracting small pieces of paper

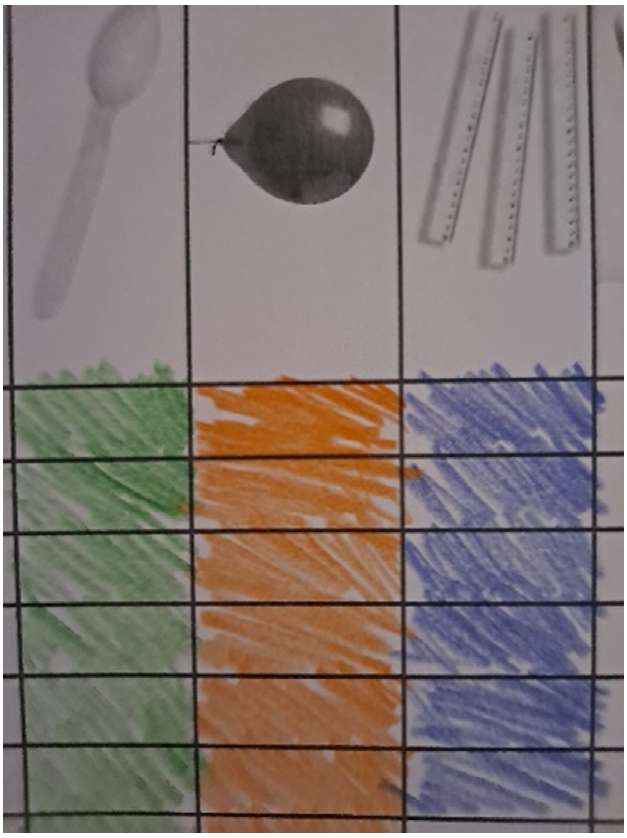

Figure 2.6. Worksheet with colour as many squares in the table as many pieces of paper the rubbed object attached

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4.3. Static electricity – plastic spoon and styrofoam

Pupils should rub a plastic spoon in a orange flannel cleaning duster and put it near to small pieces of colored Styrofoam. They have to colour as many squares in the table as many balls of colored styrofoam the rubbed object attached.This activity was supposed to measure the “power of attracting” between the object and the tiny objects like confetti and/or Styrofoam and they have to colour as many squares in the table as many pieces of styrofoam the rubbed object attached.

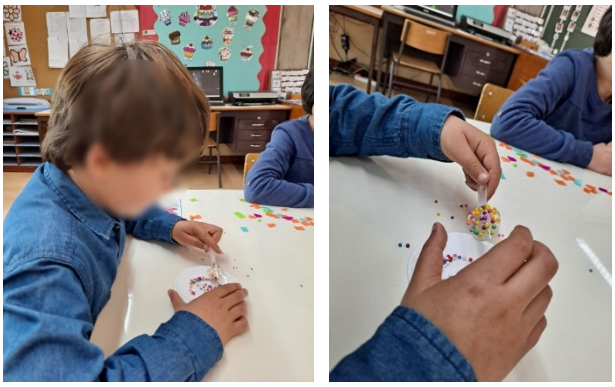

Figure 3.1. Child D with a rubbed plastic spoon attracting styrofoam

Figure 3.2. Child DA touching colored styrofoam.

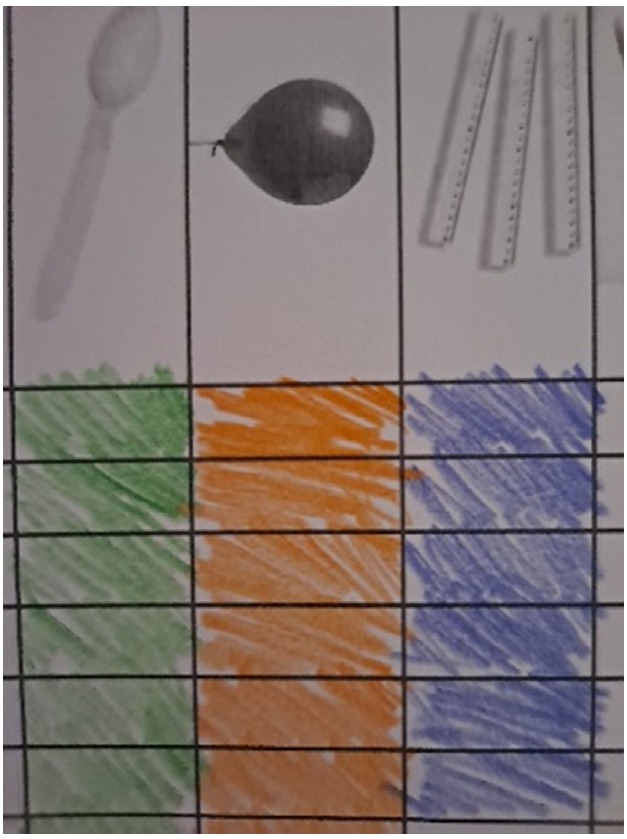

Figure 3.3. Worksheet with colour as many squares in the table as many pieces of styrofoam the rubbed object attached

Figure 3.4. Child N with a rubbed plastic spoon attracting styrofoam.

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Figure 3.5. Child N with a rubbed plastic spoon attracting styrofoam.

5. Summary and conclusions

Incorporating science experiments into learning is a great way to engage children and make lessons more hands-on and fun. The teacher initiated activities promoting the interest and curiosity of students.During the activities, the teacher was always careful to guide students in their learning and guiding them to a way forward. The teacher has many years of experience, that means she is very sensitive as to when to guide. She fosters observation, encouraging students in simple science activities. These three activities showed creativity through children's agency, curiosity, engagement and entusiasm. Teacher prepares her lessons depending on students' interests, not forgetting the national curriculum and student achievement, looking to find activities that promote students' interest in mathematics, science, arts and creativity. Teaching approaches appear to provide children with a "starting point" from which they can experiment, observe phenomenon and so on, mainly teacher provides guidance so the students can achieve the purpose of the activities proposed and building their knowledge. As noted, teacher has the ability to foster creativity.Teacher fostered rich motivating contexts for play and exploration. Collaboration, promoted by use of group work, played important roles in involving children specially in childrem with autism spectrum disorders. The potential of sensitive and responsive teacher scaffolding both to support autonomy was emphasized, particularly in relation to when to mediate and when to stand back. Across the episodes there were many examples of children *observing.* The teacher made reference to the importance of encouraging and supporting children's engagement in early years science and mathematics as an important starting point for learning. Also emphasised the need to foster motivation and collaboration and provide a rich environment with space and time for exploration and, underlining key role for teacher in encouraging making connections to promote children's conceptual understanding.

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