# "Do flowers change colour?": the importance of teaching science and how it can develop children's argumentation

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**Short Abstract**

Science education engages children in ways of researching, reasoning and communicating, leading to a process of argumentation. This work focuses on an experimental teaching activity carried out in the context of supervised teaching practice. It was an action-research, including 20 pre-school children, attending the 5 years old class of a kindergarten in a Portuguese city. An activity of experimental science teaching was guided by the question "Do flowers change colour?", aiming to recognizing plants' needs and function. White flowers were placed in water, some with food colouring and some without. Four days after children were asked to explain what happened and confront the observation with their predictions. Children argued their point of view about what happened to the flowers, they were able to come to a conclusion together and recognise the main function of the stem in plants, as well as that water is fundamental in the plants feeding process.

**Introduction**

Since early years we should bring science to children, as they have an innate curiosity about what happens in the world around them. However, this should be a challenging education where children have the opportunity to investigate and create their own knowledge. Only in this way we are training responsible citizens, able to better understand the world, make conscious choices and intervene responsibly in the environment in which they live (Viecheneski & Carletto, 2013). Although this is a core area, it is often left on the back burner for various reasons: sometimes because teachers do not feel comfortable with the content of this area; and sometimes simply because teaching professionals consider mathematics and oral and written language more important. However, and considering that all areas of knowledge have equal relevance, we as educators/teachers are faced with the challenge of leading children to an articulated and interdisciplinary learning of the various knowledge, where science can become the motto for the development of the other areas of knowledge.

In science children have the opportunity to "establish contact with the manifestations of natural phenomena, to experiment, test hypotheses, question, expose their ideas and confront them with those of others". (Viecheneski & Carletto, 2013, p. 217). Thus, the area of science engages children in ways of researching, reasoning and communicating that lead to a process of argumentation. According to Leitão (2007) argumentation consists in an "activity of discursive and social nature that is carried out by the defence of points of view" (p. 454). In other words, Scarpa (2015), states that "To argue is to express reasons about what we think or do" (p.18). In this way, science and argumentation go hand in hand, that is, "Argumentation is considered a central activity in the natural sciences" (Scarpa, 2015, p. 19), because when elaborating hypotheses, predictions and explanations, scientists, or even children, articulate the evidence of phenomena with theoretical assumptions or the conceptions they already hold.

By stimulating argumentation in children we are developing many other aspects such as oral and written expression, critical, reflective and creative thinking, reasoning, reflection, logic and metacognition, all combined with experimentation (Gomes & Sá, 2011). That is, when an

individual defends an idea and argues about it, he is required to "reorient his attention from the object about which he argues and focus on the sustainability and limits of his assertions" (Leitão, 2007, p. 457).
That said, it is up to the school, "from the early years, to promote spaces that enable debate, reflection, argumentation, questioning" (Viecheneski & Carletto, 2013, p.221, 222). The school has the duty to create an educational environment that stimulates and awakens in children their sense of argumentation, becoming aware and able to solve problems taking into account the variables involved in that same solution, i.e., "students have the opportunity to evidence what causes the phenomenon in question." (Gomes & Sá, 2011, p.2). This is a way for them to reflect on their actions while constructing explanations for the phenomenon under study. The educator/teacher has the role of "mediating observations and interpretations, guiding students' ideas" (Scarpa, 2015, p. 26). Only in this way, and by putting children in action and at ease to argue, it is possible to "modify their spontaneous concepts about the phenomena presented evolving to scientific concepts" (Gomes & Sá, 2011, p.2).

**Methods**

The work presented here focuses on an experimental teaching activity carried out as part of an intervention and research project, implemented in the context of supervised teaching practice, with a broader project entitled "Children's Conceptions of Living Beings". The pedagogical intervention was developed with a group of 20 pre-school children, 10 females and 10 males, aged between 5 and 6 years old. The group attended the 5 years old room of a kindergarten located in an urban centre, in the northern region of Portugal.
The main objectives of the activity were to familiarize the children with botany-related subjects, namely identifying the function of the stem and recognizing the needs of a plant. Furthermore, this activity was also designed with the objectives of: anticipating events by forming predictions; encouraging questioning in the classroom; making lessons more dynamic and participatory and encouraging argumentation from the early years.
In order to achieve the objectives, the whole pedagogical practice was guided under the action research methodology, which consists of a practical and applicable methodology for solving real problems, i.e. an interventional practice, and is marked by its participatory nature, where all participants are involved, critically and self-evaluative, in order to improve teaching practices, adapting and producing new knowledge (Coutinho et al., 2009). Furthermore, this methodology has a systematically repeated reflective cycle, which includes planning, action, observation and reflection as stages, based on a triangulation between theory, practice and values (Cohen, Manion & Morrison, 2017; Máximo-Esteves, 2008).

The problem that guided this practical activity of experimental science teaching had as a central question "Do flowers change colour?", as well as having as a purpose the development and sense of argumentation of the children. To this end, an experimental activity was developed with a duration of two days, with an interval of 4 days. On the first day we placed several white flowers in water, some with food colouring and some without. Each child had the opportunity to record their prediction of what they thought would happen to the flowers after 4 days. On the second day of the activity, the children had the opportunity to see what happened to the flowers, contrasting the observed result with their predictions, recording their observations and drawing their own conclusions. The data record was mainly of a qualitative nature, obtained through dialogical transcriptions, productions made by the children and photographs. Content analysis and analysis of the children's argumentation during the dialogues was carried out. In order to identify the argumentation hability, we search for the words that indicate a justification for children’s opinions, like “because”, “but”, and others.

**Results**

To start this activity, the trainee teacher asked the children the following question: "Do you think flowers change colour?". All children, without hesitation, answered that flowers did not change colour. The children were challenged to do an experimental activity to see if their ideas were confirmed or not. The experimental activity began with the mixture of food colouring in water, leaving a glass with yellow water, a glass with red water, a glass with blue water and a glass with transparent water (without colouring). In all these glasses a flower was placed (Figure 1).

Figure 1

Pre-school children doing the activity “Do flowers change colour?”

After this part of the experiment the children were asked to draw what they thought would happen to the flowers. All the children drew the glasses with the respective dyes, but the flowers remained white.

After 4 days of the flowers being in the water, with or without the dye, the children had the opportunity to check what happened to the flowers by comparing the observed result with their predictions. The children were asked what they thought had happened to the flowers. In this way a dialogue was created where all the children shared their ideas. A debate ensued in which the children argued their point of view. Here is just a small extract of the dialogue where we can see the argumentative capacity of the children:

**Trainee: *Do flowers change colour after all?***

Melissa: *Yes, because this flower was white and it turned red, but only because it had red dye.*

**Trainee: *And what happened to the flower that has no food coloring?***

Rachel: *It turned white because we didn't put food colouring on it.*

Fatima: *We had to put the flowers in water, otherwise they would have wilted by the time we got home from the weekend.*

As their answers show, children gave an explanation for the flowers colour changes or not and add the idea that water is need to flowers survive during some days.

The following questions tried to obtain children deep explanation for the phenomena:

**Trainee: *How did the food colouring in the water get to the flower petals?***

Fabio: *Because they drank it.*

Fatima: *I think because they were in the water, the water forced its way up to the flowers and the flowers became coloured.*

Oscar: *Water passed through the stem.*

After all the children had argued their point of view about what happened to the flowers, the group was able to come to a conclusion together and thus in a simple way recognise the main function of the stem in a plant, as well as recognise that water is fundamental in the plant's feeding process.

**Discussion and concluding remarks**

After developing this activity on the function of the stem in plants, and after creating an environment where the group felt comfortable to express their ideas and arguing why that phenomenon happened, the children were able as a group to come to their own conclusions about the function of the stem. It is now recognised that children should participate from an early age in hands-on experimental activities, as a way of linking theoretical and practical knowledge, which is contextualised in children's everyday lives. Furthermore, a science education that provides an investigative learning environment and stimulates reasoning and critical thinking intrinsically promotes a sense of argumentation in children, and as observed pre-school children already are able to think, reasoning and give explanations, that is argumentation. So, we encourage to promote it since pre-school.

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