INTERNATIONAL CONFERENCE

Successful Experiences and Good Practices in Chemistry Education

MAY 21, 2014

Polytechnic Institute of Bragança

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Conference Proceedings

Eds. - M. F. Barreiro, O. Ferreira, A. I. Pereira

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WILL IT DISSOLVE IN WATER?

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Abstract

Conducting scientific experiments with preschoolers can make the difference between a positive and a negative attitude towards future science education. Everyday experiences allow children to observe materials behaviour in contact with water. Through daily observation, children know that some materials dissolve in water thus being able to ask questions, make predictions, and collect data. As a consequence, children construct conceptions, some of them alternatives, to the scientifically acceptable. Therefore, it is important that children observe the dissolution process, by means of practice and experiments allowing them to make predictions, observe, verify and report what happened. The kindergarten teachers are the key elements in this process, supporting children in the construction of their scientific conceptions.

This paper presents a learning experience, developed with a five years old group, concerning dissolution phenomena of different materials in water. Initially, it is intended to know if the selected materials (olive oil, coffee, rice, peas, sand, sugar, salt, flour and egg shell) dissolves in water. Subsequently, it was investigated if the substance amount influenced or not the dissolution process. The experiment was conducted in small groups (8 elements) and started with the elaboration of a plan to identify the involved variables. This stage contained images to identify what children wanted to know, what they wanted to change and to maintain. This process was carried out through questioning. Children were asked to register their predictions about what would happen. The pedagogical resources have been carefully prepared and the children were encouraged to be rigorous in the procedures to follow. After the hands-on, children registered the observations and compared them with the predictions. The scientific explanations were given as they were questioning and communicating what they observed.

This learning experience stimulated children's natural curiosity, promoting their desire to learn more and to explain the phenomena that occur in everyday life. This learning process expands some fundamental skills of the child, such as observation, recording, measuring, comparing, counting, describing, and interpreting, requisites required for their scientific literacy development.

1. Context

Scientific activities, particularly the ones that involve chemical processes, are interesting and rich experiments, in knowledge dissemination and for understanding of the world as it exists and transforms [1]. In this sense, it is seek to stimulate the natural curiosity of children, arousing their desire to know more and to explain daily phenomena. This knowledge of the world occurs through several fundamental skills, such as: observing, annotating, measuring, comparing, accounting, describing and interpreting.

Water is a theme that provides a great number of informal explorations to children [3], such as when different materials are mixed with water. The dissolution process was selected to be explored in the context of the kindergarten. Dissolution is an important process in which one or more substances, the solutes, are homogeneously mixed with another substance, the solvent.

Experimental work was chosen as the strategy for children scientific literacy development [2], since it requires their active participation in the decision making process, in problem formulation, in the quest for answers, in the collection of data, among others. One of the main characteristics of experimental work is that it implies variable manipulation, process that when explored with children also contributes to the development of the above mentioned skills.

2. Implementing experimental work about dissolution

The activity was developed with a group of 5 years old children and had the objective of determining if specific substances, when in contact with water, are able to mix. A script was made, describing all the necessary steps for the development of the experimental activity.
According to Martins et al. [4] materials behaviour in water is one of the quotidian domains that can promote children interest since early ages. Moreover, the identified alternative conceptions, considered scientifically adequate, in small children can also be an evidence of this interest.

The work started by contextualizing this activity by placing a question to children:

> Do you know something, yesterday I was at home and I thought: since we are exploring sciences, do you know what happens if we put some substances, such as coffee or salt in water? (Kindergarten teacher)
> We mix, mix and it's ready. (Rodrigo)
> What's ready? (Kindergarten teacher)
> It stays inside. (Rodrigo)
> Any substance? (Kindergarten teacher)
> We don't know. (Sandra)
> Do you want to try it? (Kindergarten teacher)
> Yes. (Lia)
> I brought some substances for us to try. (Kindergarten teacher)

The small group was organized and some transparent bags containing different substances (olive oil, coffee, rice, peas, sand, sugar, salt, flour, and egg shell) were put on a table. The substances were identified by the group.

> Do you think we should organize our work? (Kindergarten teacher)
> Yes. (Rita)
> I brought several pictures for us to make our planning sheet. Do you remember talking about this? (Kindergarten teacher)
> Yes, you talked about this in the other day, in another group. (Sandra)

Next, a record sheet was distributed to each group element, for them to realize their conceptions. Children registered their predictions with help, using different symbols for "it mixes with water" and "it does not mix with water".

As Martins et al. [3] notes, "Find ways to register previous ideas of children, illustrating what they think that will happen in a specific situation/activity" is important. "These records should be made together, valuing the reasons why they express those ideas".

Afterwards, children started organizing the activity and, for that, they started placing the images in what we wanted to know, change and maintain them in the planning sheet. To help children fill the sheet the following questions were made:

> What do we want to know? (Kindergarten teacher)
> What happen if we add something to the water? (Kindergarten teacher)
> What are we going to change? (Kindergarten teacher)

Children remained in silence. Upon continuing:

The things we will add to water are always the same or do they change? (Kindergarten teacher)
They change. (Rodrigo)
We have many things: peas, rice… (Óscar)
And what are we going to maintain? (Kindergarten teacher) (silence)
Think about this, we want to know if these different substances dissolve in water. So, what do you think will be different? The peas, the egg shell, the salt… Where will we put each of these substances? In water; thus what we will change is the added substance and what we will maintain is water. And the weight of the substances should also be the same. (Kindergarten teacher)
Right. (Sandra)
If we change the amount of water, this could be the reason for mixing or not the substances. If you want, we can try this in another day. (Kindergarten teacher)
So, what are we going to maintain? (Kindergarten teacher)
The amount of water. (Óscar)

At this point it was realized that children lack confidence, but the significance building processes were complex. However, persistent and reflected practices will produce effects on children's conceptions.
Children place the images in the planning sheet, as they answer some questions:

What are we doing, when we put this substance in water? What do you know?
After some time, Rodrigo asked with uneasiness:
Mixing? (Rodrigo)
Very well, Rodrigo, that's it. (Kindergarten teacher)

To advance the experiment, a transparent bottle was distributed, cut in half with a mark, to define the amount of water. A bottle cap and a plastic spoon were also distributed, and children were asked to choose a substance randomly.

Children started to reveal enthusiasm.

I'm super-curious. (Óscar)
Me too, but I think I did it right. (Lia)

Every child used the bottle cap as a measure and, at a time, they put the chosen substance in the water. They stirred with the spoon, and observed if the substance mixed or not with the water. Martins et al., [3] note that "it is through the interaction of the child with the objects that she learns that 'if I do this, that happens' and, therefore, 'for that to happen I have to do like this".

The observation and reflection processes about what happens are important for the significance building about phenomena. We agree with Martins et al. [3] when they say that "it is during the observations performed on the actions she develops, either together or autonomously, the [the child] starts to form her own ideas about the phenomena that surrounds her, whether natural or induced".

At the end of the activity the following questions were made:

Did you check if your initial ideas are right? Who has right? (Kindergarten teacher).

It was an interesting discovery moment, when children confronted their previsions with what they observed and have registered in the record sheet, about the substances that mixed with water. A dialog was quickly established, using the correct terms, because it is through oral language that bridges are laid between the everyday knowledge – which explains the phenomena in the informal language of children – and the scientific knowledge, the target of the intentional exploration of phenomena, knowledge expressed in a more specific and elaborate language (Sá, 2004, p.36).
In that moment, these questions were formulated:

What happened to the salt? (Kindergarten teacher)
It mixed with the water. (Rodrigo)
Disappeared. (Rita)
It didn't disappear. We say that it mixed or dissolved in the water. And what about the sand? (Kindergarten teacher)
It didn't disappear. (Sandra)
We can thus say that sand did not dissolve in water. (Kindergarten teacher)

At the end, we placed the planning sheet and the respective records in the room wall. In order to systematize the experimental activity, together with the children, it was concluded that there are substances that, after mixed with water, could not be distinguished, such as salt and sugar, and others that remain distinguished, such as sand, egg shell and peas.

3. Final considerations

The developed scientific work with the children allowed integrating the remaining curricular areas. This was one the main concerns, to perform an integrative approach of Science, Technology and Society [STS], because, as Rodrigues [2] points out, it is important that kindergarten teachers give "an integrative vision of sciences and not a decontextualized perspective" [2, p. 9].
According to Fialho [1], it really matter to perform "an 'education in science' and 'about science', centred in its conceptual and procedural structure; and 'about science', focusing the training of scientific literate citizens" (p. 4). Both the ideas became milestones in our praxis and, because of it the process and not only the product is valued. What really matters is that children develop competences of reflection and thought and not to only understand the content as a goal to achieve.
According to Sá [5], science is important for the children as part of their education process, i.e., of their personal, social and intellectual development. Only then it matters in terms of science itself.
This was further reinforced by Rómulo Carvalho, cited by Fialho, [1] "it is not necessary to be a professional scientist, nor have laboratories available, to perform scientific experiments" (p. 20). This idea gives us courage to perform experimental activities and to become witnesses of the how true it is. It is possible to perform experimental activities, in its majority, with waste materials and with off-the-shelf materials. In this situation, all that is necessary is to have the will and to think how advantageous science learning is for our children in order to become adults with scientific literacy.

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