



INTERNATIONAL CONFERENCE

Successful Experiences and Good Practices
in Chemistry Education

MAY 21, 2014

Polytechnic Institute of Bragança
BRAGANÇA • PORTUGAL

Conference Proceedings

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



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Title

INTERNATIONAL CONFERENCE Successful Experiences and Good Practices in Chemistry Education - Conference Proceedings

Edited by

M.F. Barreiro, O. Ferreira, A.I. Pereira (Org.)

Graphic Design

Soraia Maduro - CIPweb IPB

First edition 05/2014

ISBN 978-972-745-168-5

DL 375616/14

Printed by

Bringráfica

Edition

Instituto Politécnico de Bragança

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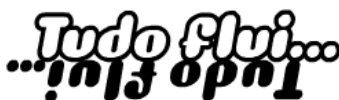
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SCIENCE PROJECTS



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WINNING THE RACE

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Abstract

In Portugal some official documents (Curriculum Guidelines for Preschool Education [1]; Circular N.º 17/DSDC/DEPEB/2007 [2]; Learning Goals for preschool education [3]) and the scientific literature [4] emphasize the importance of the experimental sciences, such as chemistry, inserted in the area of World Knowledge. This area is seen as “a path to science awareness, which should provide to children experiences related to several domains of human knowledge” [4, p. 14]. This introduction to science approach involves exploring subjects related to history, sociology, geography, physics, chemistry, biology, astronomy, geology and meteorology, among others. However, an integrative and broad approach is necessary, respecting the holistic nature that characterizes this education level. Moreover, the current orientations point out to a humanistic approach of science, in a Science-Technology-Society perspective.

In this context, this paper presents a chemistry experimental activity related to liquid viscosity, considering that this subject is part of the children daily experiences and that this discussion can help them to understand the environment surrounding, according to pre-school education orientations. This activity allows children to experiment and compare the speed of fall of a marble in liquids with different viscosity.

This approach fosters the usage of several procedures and skills, such as questioning, observing, variables manipulating, registering, measuring, comparing, counting, describing, and interpreting data, among others. Although not science exclusive, this enhances a broad and integrative view of the world, contributing to children scientific literacy.

1. Context

Science activities provide opportunities for cooperation, negotiation, rules to follow, rights and duties to understand, group learning involvement, and education for citizenship. These are essential skills for critical thinking and to create, conscious, participatory and supportive autonomous citizens. This extends the cognitive dimension that can be seen in open-mindedness, curiosity, creativity, objectivity, intellectual honesty, persistence and thought agility. This highlights the importance of developing learning experiences for science literacy promotion, which is understood as:

Knowledge and understanding of scientific concepts and processes required for personal decision towards the participation in civic and cultural activities and economic productivity, also including thinking skills. Scientific literacy means that a person has the ability to explain and predict phenomena, being able to read and understand a scientific article, engage in public dialogues about the validity of the conclusions presented in the article and expressing positions that are scientifically and technologically informed. It also means, being able to evaluate information based and deriving conclusions from such arguments [5, p. 22].

The learning experiences developed in kindergarten constitute an excellent way to use procedures and skills such as: observing, recording, measuring, comparing, counting, describing, and interpreting. These skills are not science exclusive; these are capabilities that enhance a holistic worldview.

The experimental activities should help children to realize what is happening around them and understand how things work, supporting their understanding how the world works, helping them to find the relationships between phenomena. It seems to be the way forward for early childhood

education. Scientific concepts and principles can be selected and designed so that children can see the relevance of science in their daily routine. Specific experiential activities help the children to understand the importance and the nature of technology and the relationship between technology and science.

In this study we describe an experimental activity, in the scope of chemistry, associated with viscosity of liquids. This subject is present in the everyday life of children and the discussion of these issues enables them to understand the world.

Supported by the model of Goldsworthy and Feasy, Martins [6], argues that kindergarten teachers, in the context of action, should consider the following principles: (i) identification of children previous ideas; (ii) clarification of the problem; (iii) designing the procedures to be adopted; (iv) prediction of results; (v) implementation of the experiment; (vi) analyzing results and their meaning; (vii) draw conclusions; and (viii) raising new questions.

According to Martins [6], question rising requires explicit decision-making on planning, i.e. requires considering all the aspects of the experience: (i) what we will change (independent variable); (ii) what we will measure (dependent variable chosen); (iii) what we will keep (independent variables to maintain controlled); (iv) what we think that will happen and why (predictions and justification); (v) how we will record data (making tables, charts, graphs, etc.); and (vi) what equipment we will need (materials, resources, etc).

With this activity we intend that children observe and compare the speed of fall of a marble in liquids with different viscosities. The experimental work is used for the reasons underlined previously.

2. Implementing experimental work about the viscosity

The experimental work reported here is part of a more extensive project which took place for two months, entitled: "How does the water looks like? How do we see it? ". This activity in particular, arose from a situation experienced by children when they washed their hands, noting that water and liquid soap had different behaviors.

Children spoke about what they observe, commenting: "both are liquid and transparent", "both spread in the hands ", "but do not spread in the same way"; the soap is thicker and water is thinner", "the water flows well and the soap gets stuck". The curiosity of children and their observations have created conditions to plan experimental work. This situation led to the development of an experimental activity in order to predict and compare the speed of the fall of a marble in liquids with different viscosities. The children wanted to know who would win the race.

In order to identify children background ideas, the Kindergarten teacher questioned them. She wanted to know what they thought about: the difference of movements of liquids; the way they are stirred by the spoon and trickle down, when they are poured.

Children were encouraged to discover, through their senses, in what kind of liquids they were moving on and what their characteristics are. Children must express their ideas based on the smell, color and viscosity of the liquids. [8]. Kindergarten Teacher asked them:

The liquids that reveal more movement are those who pour more or less quickly?

The children ideas were:

The yellow liquid drips moves slower, the blue drips faster. - Rita

The transparent liquid flows, it drips well - Marlene

Why do you think it's hard to stir yellow liquid? How is it? - Kindergarten Teacher

Yellow takes longer to drip because it seems glue. It gets stuck on the spoon and is hard to move. That does not happen with the transparent one— Lara Rafaela

The yellow liquid is heavier so does not flow well. The transparent one is not so much heavy so it flows well – Leonor

Which of these two liquids do you think is harder to move, it is more viscous? - Kindergarten Teacher

Viscous mean *stronger* and *harder* to move? – Leonor
The others children helped Leonor:

Yellow liquid is more viscous because it has more glue – Jessica
Yellow liquid is more viscous because it is thicker - Micaela Lara
One is more liquid than the other. The yellow one is not very liquid so it is more viscous, the transparent one is more liquid, it is less viscous – Hugo
The transparent liquid is not viscous because it has no glue – Leticia

Then, the kindergarten teacher asked:

When I pour the liquids onto this surface (mosaic) they spread in the same way?
No, because some are more *skinny* and other *thicker* – Maria
The transparent liquid, the one which is more liquid will run away – Rita
I think the yellow goes nowhere, it is almost solid – Leonor
If you turn it (mosaic) they also go more quickly than others – Martin
Yellow smells like washing up liquid! - Leticia

The blue is OMO, because it smells like when mother' washes clothes – Hugo
The green is soap, it is so viscous as the soap used to wash hands, the only difference is that one is green and the other is transparent – Diogo
The transparent is water because has no smell, no need to push the spoon to mix and it slides well.

The next step in the experimental process was to complete the plan.

What will we observe? Ask the Kindergarten Teacher
Look, here's a clock! We will see how long it takes the marble to get to the bottom of the tube. - Leonor
What are we going to change? - Kindergarten Teacher
The liquid type – Jessica
What we can't change? - Kindergarten Teacher
The marbles have to be all equal; no one can be bigger or smaller than the others – Marlene
We can't, also change the tubes. All of them have to be skinny and tall, all must be sized Hugo
All the tubes are sized (the child compare, putting the tubes side by side). They have all the same height and width, see? – Martim
But, we must put in all of them the same quantity of liquid and we need a measuring cup to be sure that we have the same quantity- Leonor
We have also, to turn down the tubes at the same time. We are going to do a race and we must count one, two, three, turn down. –Diogo

The four tubes were distributed to four children, and all of them took into account the experiential rules defined previously to control the variables [8]. During the experimental process, children verified which marble was the faster. They realized that if the liquid contained in the tube was less viscous the marbles get faster to the bottom. The discussion of the observed data was focused on the speed difference reached by each marble crossing the chosen liquids (different viscosity) and in the relationship between speed and the viscosity. Some children conclusions were:

The yellow liquid is more viscous because it makes more strength and because of that the marble doesn't fall fast - Leonor
Who will win the race will be the marble of the transparent liquid, then the blue ... – Marlene

Then the green ... and the last one will be the yellow – Samuel
In the transparent tube there is only water, since it does not make strength the marble fall faster.
I think it's not viscous - Amir

The activity ends with the systematization of discoveries, where children are encouraged to express their conclusions and the teacher translates them using an appropriated language to express results.

3. Conclusions

This approach fosters the usage of several procedures and skills, such as questioning, observing, variables manipulation, registering, measuring, comparing, counting, describing, and interpreting data, among others. Although not exclusive of science, this enhances a broad and integrative view of the world, contributing to children scientific literacy.

During the experimental work the flowing observation/conclusions were made:

Learning was valued by discovery and the adoption of different practices, focusing on cooperation and respect for children interests;

Educational opportunities that favored cooperative learning and children involvement were created, contributing to the success and learning process of all;

The kindergarten teacher was an active mediator of children learning and development, being alert to the learning processes and trying to understand children conceptions to organize the experimental work.

The children were encouraged to interact with the world around them, so that their learning could be meaningful to them;

The children were valued as competent, having the opportunity to expand their knowledge concerning subjects of their interest.

In this paper we share the opinion of Rodrigues [9] and Pereira [8] that argues that experimental work is an important strategy for science education within the context of pre-school education.

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