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► **To cite this version:**

Estelle Blanquet, Eric Picholle. Inquiry-based analysis of early years children books: developping skills for later science education. ESERA 2011 - 9th conference of the European Science Education Research Association, European Science Education Research Association, Sep 2011, Lyon, France. hal-01352639

**HAL Id: hal-01352639**

**<https://hal.science/hal-01352639v1>**

Submitted on 9 Aug 2016

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# INQUIRY-BASED ANALYSIS OF EARLY YEARS CHILDREN BOOKS: DEVELOPING SKILLS FOR LATER SCIENCE EDUCATION

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*Abstract:* Distinguishing fact from fiction is a key feature of science. We investigate the use of children literature to develop this ability among 4-6 year old pupils. To this effect, we chose a children book where special laws, different from real-world natural laws, govern the fiction. Eight teachers were trained to teach a specially designed inquiry based teaching sequence. During the sequence, the children built a real-world device (well and pulley) of which the narration can be considered a literary model. They were then brought to compare the predictions of the model with their observations, and to comment on the contradictions. It appears that children can easily be brought to cross the gap between a literary fiction and a real-world experiment, and to awarely use the results of the latter to confront the predictions of the former.

*Keywords:* Modelling. Children literature. Experimental verification. IBSE. Impossibility.

## INTRODUCTION

While inquiry-based science education has been since 2002 the recommended method in France for introducing very young children to science, it seldom gets beyond “discovery of the world” practices. Classical activities at the kindergarten level (*école maternelle*) are discovery of the five senses, plantation of seeds, actions on materials (making apple juice, dissolution...) (M.E.N., 2005; B.O.E.N., 2008). Such activities are usually intended to give the children a first impression of basic scientific methodology, mostly by insisting whenever practicable to implement the sequence: Proposition of an idea / Test / Conclusion (Coquidé & Giordan, 1997; N.R.C., 2005).

Yet, very young children can be also introduced to other skills involved in science education. We will focus here on those called on by the utilisation of models — namely, the skill to navigate between the real world and a model in order to test the predictions of the latter.

## DISTINGUISHING FACT FROM FICTION

This skill is a key feature of science. Nevertheless, whereas the distinction between fiction (usually simplified models) and reality is obvious enough to remain mostly implicit among scientists, it constitutes a challenge for children. Before it becomes a pattern of thought, it has to be internalized, thus calling for explicit teaching (Etkina & al., 2010; Tiberghien, 2009).

While formal models, often involving mathematical representations, are commonplace in professional science as well as, to a certain extent, in high school, they are obviously irrelevant as far as very young children are concerned. To a lesser extent, the same can be said of analogical models (e.g. a polystyrene ball representing the Earth). Stories being a major tool in kindergarten, literary models, seldom used in more advanced scientific contexts, are in fact likely to constitute the first contact of young children with the concept of modelling.

Biology is a favourite subject (Lamap, 2006), but some stories can also be used to work on elementary physics. Even very young children can detect their most blatant imaginary aspects: real-world animals don't talk and don't wear clothes etc. Literary fictions are identified as special worlds; they can nevertheless be used to generate questions pertaining to science since "the fiction's dominant, albeit unsaid, reference is the real world governed by natural laws" (Bruguière & al., 2007).

But can very young children also acknowledge the fact that special laws, different from real-world natural laws, may govern a given fiction? How do they react to such a dissonance? Do they show ability to switch explicitly from one world to the other?

## **METHODOLOGY**

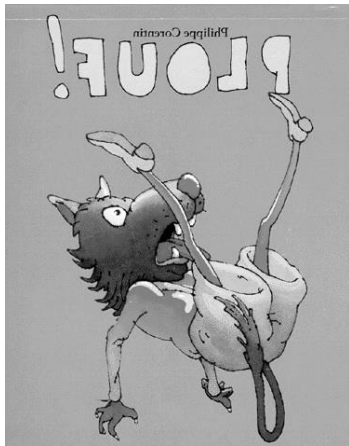
In order to investigate these abilities among 4-6 year old children, we have developed a complete inquiry based sequence around one of the most popular children books in French kindergarten, namely *Plouf!* by Philippe Corentin (Corentin, 2003; Blanquet, 2010; Soudani & al. 2011). Besides the usual literary conventions of such fantasy (talking animals, etc.), the storyline involves an internal contradiction if the diegetic "physics" is to be considered equivalent to real-world physics. During the sequence, the children elaborate a real-world experiment of which the narration can be considered a literary model (Blanquet & Picholle, 2011). They are then brought to compare predictions of the model with observations of a controlled experiment, and to comment on the contradictions.

Eight teachers were specifically prepared to teach this sequence. In France, kindergarten pupils usually work in small groups (4-6 children), the teacher dealing in turn with each group while the others work autonomously. Two devices were used in order to evaluate the appropriation of the sequence by the children. On the first hand, four teachers were involved with their classes in a festive science event (Blanquet, 2009); ten teams of three pupils were directly observed while hosting for other pupils a workshop based on a simpler — but still inquiry based — version of the sequence they had beforehand discovered in the classroom. On the other hand, one senior teacher and three teachers in training and their pupils have been audio- and video-taped (Visa, 2008) while making their way into the sequence. The exchanges between the teacher and small groups were then transcribed and analyzed and the children were later interviewed by pairs.

## **MAINLINE OF THE *PLOUF !* TEACHING SEQUENCE**

The story revolves around a well and a pulley. A hungry wolf falls into a well, thinking there is cheese at the bottom; using a pulley, a pig helps him out, while descending himself down the well; then, a family of rabbits helps the pig out by the same device; ultimately, the wolf helps the rabbits out and gets himself down the well again, still using the pulley. After reading

the story, the teacher verifies the good understanding of its different steps through questions and small-groups activities.



**Fig.1: *Plouf!***



**Fig.2: *Plouf!* well and pulley device**

The sequence then brings children to conceive and build a real-world well-and-pulley device. First, the teacher proposes activities to help pupils to establish the analogy between the book's device and the ones they are going to build. Once it is operational, they are asked to reproduce the different steps of the story, using bottles of various weights with glued images of the imaginary animals on it (Fig. 3). The last step of the story proves impossible to reproduce, since the previous ones imply that the wolf-bottle is lighter than the "rabbits" one [1].

Exchanges among children and with the teacher yield an emphasis on the difference between what happens in the story and with the real-world device. The contradiction is then discussed in the group of children and with the teacher. The children's propositions around it (changing the weight of animals etc.) are implemented. The sequence is eventually re-done and different kind of well-and-pulley devices proposed, with a back and forth alternation between the story and the real-world devices, between prediction of behaviours and their experimental verification.



**Fig. 3: Real-world well-and-pulley device**



**Fig.4: 5 years old hosting a science event: *You try it!***

## APPROPRIATION OF THE TWO-WORLD CONCEPT

While (thoroughly enjoyed) repeated readings and real-world experiments were usually needed in the classroom to bring the children to notice the different behaviours of the fictional and real-world devices, they did not appear to be confused by different laws being involved in the two distinct worlds once these difference had been acknowledged. Although specific to this special story (as opposed to classical fantasy conventions), the fictional laws governing well-and-pulley devices in *Plouf!* were accepted as “non-real”, apparently without any loss of pleasure in subsequent readings, much to the contrary.

The guidance from the teacher during these inquiry-based learning sequences made it difficult to decide whether the children did, or not, understand the relationship between the two worlds, and the interest of navigating between them. It appeared more clearly during the interviews and the scientific manifestation, free from adult interference. Children were using in context the same kind of questions to their young visitors that the teacher had done previously with them. Typically, after their rendition of the story, they were eager to ask “Can you do as in the story?” (*Est-ce que tu peux faire comme dans l’histoire?*) Furthermore, we observed regulation of the sequence by other children-hosts, on the abstract level. As a host would try and omit the question, another would stop him, insisting that “First, you must ask if he can do as in the story” before explaining “what is the well and what is the pulley” (*il faut d’abord lui montrer ce qui est comme le puits et ce qui est la poulie*) before “doing things” and, then only, acknowledging the impossibility of the last step. The exchanges between hosts clearly established their ability to navigate between the real world and a model, and the understanding of its basic utility. (It nevertheless seems dubious that this achievement was transmitted to their young visitors. The basic educational goal of the event was reached just the same, since all children thoroughly enjoyed themselves while “doing science”).

## CONCLUSION

It thus appears that 4-6 y.o. children can easily be brought to cross the gap between a literary fiction and a real-world experiment, and to awarely use the results of the latter to confront the predictions of the former. The nature of this skill is essentially the same that they will later need to confront analogical or mathematical models to scientific experiments. Further studies would be needed to establish whether or not the acquisition and consolidation of this skill in early year science education might improve later performance in learning science.

## NOTE

1. It should be noted that, while many sequences using this album with young children are available on the French Internet, hardly any of them makes any mention of this impossibility. Do teachers notice it? The question remains open, but the author of the book received only a couple of letters addressing the problem, among hundreds over two decades (Corentin, 2011). Teachers don’t usually question the physics of a story.

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