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ATINER's Conference Paper Series
EDU2014-0915

Discovering the Worlds of Living Things, Objects and Substances in Nursery Schools: Teaching Practices and Training Proposition

Frédéric Charles
Professor
S2HEP
University of Lyon 1
France

Athens Institute for Education and Research
8 Valaoritou Street, Kolonaki, 10671 Athens, Greece
Tel: + 30 210 3634210 Fax: + 30 210 3634209
Email: info@atiner.gr URL: www.atiner.gr
URL Conference Papers Series: www.atiner.gr/papers.htm

ISSN: **2241-2891**
28/5/2014

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This paper should be cited as follows:

Charles F., (2014) **"Discovering the Worlds of Living Things, Objects and Substances in Nursery Schools: Teaching Practices and Training Proposition"** Athens: ATINER'S Conference Paper Series, No: **EDU2014-0915.**

Discovering the Worlds of Living Things, Objects and Substances in Nursery Schools: Teaching Practices and Training Proposition

Frédéric Charles
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University of Lyon 1
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Abstract

In French nursery schools ("*l'école maternelle française*"), primary school teachers take charge of the content organized into teaching areas. The prescribed teaching activity "Discovering the world of living things, objects and substances" refers to biology, physical sciences, chemistry and technology.

The children's learning path concerning these worlds represents the early stages of the *curriculum*. Many research studied these children's learning (e.g. Bisault, 2005; Fleer, 1996; Ravanis & *al*., 2013). This paper focuses on teachers and aims at describing and analyzing the teaching periods dedicated to this particular area of early childhood education.

In a *curriculum* perspective (Dillon, 2009; Martinand, 2003; Ross, 2000), a research about the practices that consisted in reporting information both in teachers' logs and questionnaires, reveals the contents, activities and issues associated with these educational experiences.

The results show that biology is privileged and preferred to technology by teachers. The research also indicates that the scientific and technological *curriculum* is interconnected to other teaching paths, and that science and technology are mostly found, in what we called, "compositional schemes". The discovery of the world, through these compositional schemes, is given more or less importance depending on the priorities of each teacher.

The research at last allows us to discuss the professional training of preschool teachers in order to improve the teaching practices in science and technology.

Keywords: Science and technology education; nursery schools; *curriculum* perspective; professional acts.

Contact Information of Corresponding author:
frederic.charles@univ-lyon1.fr

Background and Issues

In early childhood care facilities, French nursery school ("*l'école maternelle française*") is characterized by a clearly educational direction that has been taken since the fifties (Prost, 1981). Completely integrated into the school structure (Ministry of National Education, 1989), nursery school (NS) must follow programs that define content organized into teaching areas. This *curriculum* structure differs from the structure that characterizes the last years of primary school (PS) or secondary school (SS), where identifiable and compartmentalized disciplines exist.

In the last prescribed *curriculum* (Ministry of National Education, 2008), the teaching area called "Discovering the world of the living things, objects and substances" refers to an introduction of science and technology education (STE). The term "education" is preferred to the term "teaching" of science and technology for the following reasons (Bisault, 2011, p. 9):

- Firstly, the definition of the entity "science" is not obvious in nursery and primary schools.
- Secondly, there are no science or technology teachers in these schools.
- Finally, the *curriculum* cannot be reduced to contents (knowledge or skills): in science and technology, as in other fields besides, many contents are related to educational activities.

Through these educational purposes, NS must ensure a successful entry into the scientific and technical culture (Orange & Plé, 2000), thus contributing to the discovery of both natural and artificial environments. The social and educational issue is fundamental, because NS is the first institution to provide training to almost every three to six year old children, in the current context of development of science and technology.

This training must offer the first experiential capitalization contributing to the establishment of an empirical referent (Coquidé & Lebeaume, 2003). These first experiences have to be in line with the principles set by Pauline Kergomard[1]. Maryline Coquidé (1998) clarifies the meaning of these first experiences: she puts the NS as the place of practical familiarization. These experiences are mainly actions, sometimes real experimentations. In building an empirical referent perspective, these educational experiences can be: planting a garden in the schoolyard, building rolling objects or observing the changing states of water. During the NS years, these life experiences are the first steps into the *curriculum* of science and technology and consist of every encounter the children make with the world of science and technology.

This *curriculum* comes alive when supported by NS's teachers. This contribution aims to describe and analyze their professional acts. In France, these teachers are Master level graduates and professionals in teaching and

[1]Pauline Kergomard (1838-1925) is the founder of the NS in France.

learning. The first part sets out references that allow us to investigate practices in STE. This *curriculum* perspective legitimates the research methodology, presented in the second part. The third part presents the results, including the discovery in what we suggest should be called "compositional schemes" and the preponderance of the interconnectedness, or weaving dimension, that exists in professional actions.

What are the Situations in Science and Technology Curriculum?

Academic Subjects, Subjects and Teaching Areas

Christian Orange and Élisabeth Plé (2000) show researches concerned with PS are not the most frequent in science education studies. Moreover, those researches devoted to early education are restricted (Lasson, 2004; Ledrapier, 2007; Charles, 2012). The panorama of research on preschool shows a strong focus on teaching and learning processes (e.g. Fleer, 1996; Ravanis, Christidou, Hatznikita, 2013) and the projection of SS organization on PS (Charles, 2008). Even if the label prescribed by the *curriculum* refers to academic subjects formed in French SS (Life and Earth Sciences, physics, chemistry and technology), in PS, and therefore in NS, these disciplines are just a distant horizon. STE doesn't have the forms that can be taken by compartmentalized lessons in SS: there is no academic subject in PS, let alone in NS.

Maurice Sachot (2004, p. 23) proposes "to completely avoid the use of the term "academic subject" in primary schools". He shows how the model of discipline, historically constituted in SS, and brought down to PS, is incompatible with the teaching provided in PS and NS. Joël Bisault (2011) joined this position. Analyzing STE in NS and PS, he considers it is necessary to deviate from the disciplinary logic and the projection of the SS organization on PS. Similarly, Joël Lebeaume (2011, p 88) explains that the concept of academic subject is ambiguous in PS for three reasons:

- The first one is pedagogical: "Teaching is not symbolized in NS and PS by well-identified teachers, nor by rooms or specific equipments".
- The second reason is linked to *curriculum*: there is a "progressive differentiation that occurs in the course of education. For example, the teaching area "discovering the world" in NS differenciates in PS with more focused math, science and technology lessons, and also history and geography. The process of disciplining is still partial in PS".
- The third is an epistemological reason and has to do with the distinction between the notions of subject and academic subject: "Subject is an area of study area while academic subject refers to the results of such studies".

Thus, this research combines the disciplines in SS and matters in PS. These matters not yet incorporated in PS, did not exist *a fortiori* in NS, where contents are organized into teaching areas.

This absence of academic subject, here postulated, appears during a day in NS. Indeed, the organization complies with a schedule that takes into account all areas of teaching activities, but the language is the main purpose of many lessons. However, Thérèse Thévenaz-Christen (2005), Bertrand Daunay and Isabelle Delcambre (2007) observe that at the end of NS, French lessons are characterized by the emergence of disciplinarity.

Related Contents, Coherent Practices and Curriculum Perspective

Curriculum's structure directs the organization of the day, the design of learning and teaching as well as the teachers' interventions, which are often related to specific times and locations (eg, rituals in a corner grouping, workshops around small tables): contents are interwoven.

Teachers' interventions constitute a "network of coherent practices" (Lebeaume, 1995, 2000). STE is connected with others educations. Teachers integrate different purposes and teaching areas in one lesson (Bisault, 2011).

Joël Lebeaume (2000, 2008) proves that French lessons and STE are connected by a relation he calls « connectivity ». He develops and expands this concept of connectivity, while distinguishing three levels: teaching, learning and *curriculum*.

By taking into account simultaneously topology, law and sociology, we suggest considering the connectivity as a link between school lessons in interaction. These manifold links form a chain-modeling *curriculum* followed by children and a coherent territory.

According to sociologists, these related contents belong to "the integrated code" (Bernstein, 1971) and to a "process-driven and child centered *curriculum*" (Ross, 2000). This *curriculum* with slightly marked external and internal boundaries would be characterized by strongly interconnected activities. Thus, these activities would be more focused on children's familiar world.

Teaching practices are networks that integrate STE in a complex system of activities and contents with changing priorities.

The STE *curriculum* is thought as a set of lessons related to science and technology, and interconnected by relations of cohesion and coherence (Bisault, 2011). Cohesion ensures continuity between two separate lessons and coherence ensures a set of distinct lessons will contribute to the same target: thus, the STE *curriculum* is interconnected to other *curriculums*.

Investigating the STE *curriculum* and its multiple interconnections implies moving away from the main research direction in science education studies and having a more holistic approach to the entire *curriculum*. In this *curriculum* perspective (Bisault, 2005; Dillon, 2009; Lebeaume, 2000; Martinand, 2003), our research aims at describing and analyzing the implementation of the practices of this early childhood education.

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Methodology

Two Investigations

The ambition to describe interconnected STE *curriculum* determines the choice of methodology used for collecting data. Two investigations about the practices were selected:

- The first investigation used a qualitative approach (Coquidé, Le Tiec & Garel, 2007) based on the analysis of empirical data consisting of logbooks kept by 12 teachers during one year. The research reveals the contents, activities and issues of STE. Indeed, the participating teachers had to relate their practice in these logs, describing reality the way they perceived it. These logbooks are highly personal and have the characteristics of a reflexive and professionnalizing writing (Cros, 2003). These logs allowed us to conduct 3 interviews per teacher (one interview every 8 weeks). Interviews were used to explore the missing parts of STE *curriculum* and their interconnections with other teaching areas.
- The second investigation is based on a quantitative approach using a questionnaire. The analysis of practices reported by 92 teachers allows us to refine the trends identified by the first investigation. These teachers participated in a training congress held in Annecy (France) on July 1-3, 2010. The combination of logs, interviews and questionnaire, whose content were fully transcribed, restores the practices.

Method of Analysis

In a *curriculum* perspective, analysis uses a grid focusing on three aspects:

- The first one, according to Lebeaume (2000), characterizes the lessons of STE, including contents, activities and issues associated with these educational experiences.
- The second aspect, inspired by Lenoir (2008), characterizes the relations between STE and other teaching areas with a synchronic vision. These relations can be dominance, sharing, etc.
- The last aspect captures the position of STE over time, in a diachronic perspective.

This grid is used to reconstruct the STE *curriculum*, its vertical relation in programming and implementation over time, and its horizontal relation with other educational *curriculums*.

Results

Biology Privileged and Preferred to Technology

The research gives quantitatively contents supported by teachers (Table 1).

Table 1. *Worlds supported by teachers*

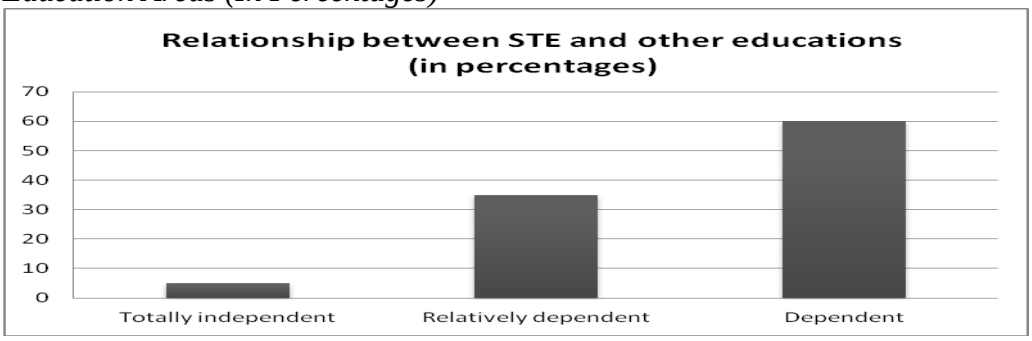
Which world do you take charge of?	Number of teachers (12 followed)
Living things	10
Substances	8
Objects	3

The results show that some parts of the discovery of the world are very present, and others are absent: the living world is preferred by teachers, whereas the world of objects is left in the shadow: biology is privileged and preferred to technology. The world of substances occupies an intermediate position. These results converge with others (Baillat, 2001; Lasson, 2004). They show that technology is minimal in NS and that priority is given to biology by teachers.

A Curriculum in Interrelations

The answers given at one question of the questionnaire[1] show the STE does not form a separate *curriculum* (Figure 1).

Figure 1. *Teachers' Answers on the Relationship between STE and other Education Areas (In Percentages)*



Teaching periods constituting the STE *curriculum* are 95% dependent on other education courses. This connectivity shows that STE is a *curriculum* in multiple interrelations set in what we suggest to call "compositional schemes".

[1] For this question, select the answer that best fits with your practice: when you teach "discovering the worlds of life sciences, objects and material":

- Teaching is completely independent of a project or a topic that you lead.
- Teaching is relatively dependent of a project or a topic that you lead.
- Teaching is related to a project or a topic that you lead.

Conceptual Proposal: Compositional Schemes

These compositional schemes can be observed in the answers provided by 11 of 12 teachers that filled a logbook. The concept of "composition" is developed by using an example. The teacher Sophie implements in her class (3-4 year-old children), one composition labeled "penguins and auks", of which here is a brief *synopsis*:

> From two photographs showing both animals and their differences (from North and South Poles), Sophie develops a composition in which all classroom activities revolve around this theme (counting penguins, making penguin mask, working on letters word P, E, N, G, U, I and N, etc.).
> **(*Synopsis* of « Penguins and auks » composition)**

When teaching "discovering the world", Sophie seeks the designation and recognition of two species, the Penguin and the Auk, by combining their respective polar media.

All teaching activities are present in this compositional scheme: indeed, Sophie relates all activities to these two representatives of the animal world:

> Graphics: Color the letters that form "penguin".
> Scripture: letters A, E, F, a, e, u, and the word "penguin", the phrase "penguins live at the North Pole".
> Oral and written language: find the letters that form the word "penguin".
> Phonology: the sound [o] (as in Penguin[1]) and its various writings.
> Literature: rhymes about penguins.
> Mathematics: Counting penguins; Pasting the amount of penguins required.
> Discovering the world: Distinguishing the North Pole from the South Pole, life sciences at the poles.
> Visual arts: Penguin masks; making a Penguin with milk bottles.
> Sport: related to the penguin's march.
> Music: "A penguin at the North Pole".
> **(Extract from Sophie's log)**

This example highlights that contents are related and practices crosslinked. They give way to "compositional schemes" consisting of a set of different school lessons forming a coherent whole. In addition to these initial characteristics, the composition is characterized by its adaptability. Indeed, starting with a moment of collective language in which Sophie presents two animals pictures, chance happens to determine what comes next: the teacher changes the general organization of the composition because a pupil brings a globe and then a detailed work on the poles is carried on way further than originally planned. The composition is adapted here to make preponderant one aspect of the discovery of the world, which is space orientation:

[1]Pinguin is translated by the world "Manchot" in French.

Sophie: Initially, I thought I would show the children the penguin's physical aspects and characteristics, but I suddenly changed my orientation because a child gave me a globe and… Suddenly, we went to geography, to the North and South Poles. In addition, on this globe, there were animals drawn on different continents, and so we worked on the continents, their animals, and of course the North Pole/South Pole. So we spent two days searching continents, seas and oceans.
(First interview with Sophie)

Therefore, a compositional scheme is a dynamic set, which has an initial structure provided by teachers, from which may arise a set of variations. Composition is like a pattern, a grid, written and thought in advance, and is adaptable: the teacher, as a dancer or a jazz player, can freely improvise.

Different ways to take charge of the STE Curriculum

I can suggest 4 different ways to take charge of the STE *curriculum* with data analysis. Within the compositional schemes, the STE takes various positions according to the priorities assigned by the teachers.

No support for the STE Curriculum

The compositions are marked by a STE placed in an inferior position, with no real scientific target. Teacher's statements indicate confusion, as the label program is included with the idea of an active discovery of the world, without specifying scientific or technological purposes. This is the case for two teachers and in the following example, in a composition called "firemen":

Delphine: I conducted a "firemen" project in May. In "Discovering the world", my targets are:
- Visiting the fire station.
- Discovering the firemen's equipment.
- Identifying, classifying, categorizing, and describing objects, their attributes and their uses: helmets, gloves, lights, ladders and vehicles.
(Extract from Delphine's log)

For these teachers, there is no real STE support. The *curriculum* is marked by ephemeral encounters with the world of science and technology. Periods of STE are often used as a pretext for higher targets such as language or visual arts. Teacher Élise, for example, uses "discovering the world" in an aesthetic perspective: construction games that could allow a technological work are used to carry out artistic activities:

Élise: Meanwhile, children with cubes, they have to make constructions. In relation with books on kings and queens, I told them that we could build castles and towers. The children were building...
Researcher: I think I did not understand everything. What do you call in your logbook "The Castle"? Can you explain to me? What was important in the

construction of these towers: to build higher, bigger? Can you tell me more, please?
Élise: No that was not important. It was not at all important. Here, it was the same; it was a target of visual arts. All this allows me to make visual arts.
(Second interview with Élise)

Cohabitation and Practical Familiarization

The majority of teachers conceive STE within compositional schemes (7 out of the 12 teachers that filled a logbook). These teachers succeed in their professional acts at mixing different targets in different educations. They develop children's practical familiarization with the world of science and technology, through an active discovery of things and phenomena. Thus, teachers contribute to children's experiential enrichment but without a real intellectual development:

Discovering the world of substances:
My target is to make children experiments with water around the following problem: "how to carry water from one object to another?"
(...)
January 5, 2010: pupils experience using the syringe to carry water.
(Extract from Carine's log)

Two types of balancing priorities are observed:

- Within the compositional scheme itself: there is no hierarchy in the priorities given to contents.
- During the time compositions succeed : STE is considered in terms of programming time and then occupies a more or less central position in compositional schemes.

Disciplinary Emergence and Intellectual Development

Teachers implement activities in compositions keeping in mind a disciplinary target. These teachers (4 of them) focus on knowledge or skills specific to scientific or technological academic subjects. Professional acts show that these teachers aim not only at an experience enrichment but also at an acquisition of more formalized knowledge on the scientific and technological world. These teachers both value practical familiarization and intellectual development. This is the case of Amélie's work on the world of the living from farming insects. Amélie aims at developing not only the attitudes of care and respect in relation to life, but also knowledge about the concept of living and specific skills about scientific observation:

Discovering the world of the live sciences: farming stick-insects and butterflies.
My targets are: watching live insects and exploring the life cycle (birth, growth, reproduction, aging and death).
(...)

> For the activity today, I gave the children a magnifying glass and observation containers. Then I asked them to draw to their best possible four kinds of eggs. Some children draw hesitantly: I encourage them by telling them to draw what they see.
> **(Extract from Amélie's log)**

Towards a Separate STE Curriculum

Only one teacher supports STE completely independently from other courses. Jean-Philippe implements STE activities marked not only by the disciplinary emergence described above, but also by a STE *curriculum* completely independent from all other teaching area. The following extract of an interview with Jean-Philippe is particularly interesting: the only man among participating teachers says he does not proceed like his colleagues. While knowing and explaining standards characterizing professional acts in PS, Jean-Philippe rejects deliberately these standards.

> Jean-Philippe: there are many teachers in PS who work… everything is related to the same theme. I don't like this… I don't like working like that. I never work by theme, I don't like it. For example, in October, I won't link all my courses to Halloween: talk about pumpkin, work with the orange color, and count skeletons… So actually, I have my programming time in phonology, mathematics, and science...
> When I'm training with city colleagues, they all practice the same way, with these themes. I know it's a tradition in PS. It's traditional, all my colleagues from university, they all work around these themes. Even in university, trainers made us work like this, with a central theme or project.
> **(Third interview with Jean- Philippe)**

Training Proposition

This research, which aimed at describing and analyzing professional acts, promoted a comprehensive approach to STE *curriculum*. It reveals the contents, activities and issues associated with this *curriculum*. The results indicate an interrelated STE mostly found in compositional schemes. Thus, composition's design and implementation are identifiable events from NS teachers' professional acts and a specific standard from NS culture. These elements fundamentally question the training *curriculum* of teachers who are in charge of the STE in NS.

In keeping with Jean-Louis Martinand's way (1995), we believe that the STE aims both at developing the children's experiential enrichment, and at changing their conceptual view about things and phenomena. The results of this investigation show that the practices generally do not tend to these guidelines.

In France, training takes place in universities and teachers must have a Master's degree to teach in NS. Following Maryline Coquidé (2007), this

research allows us to discuss the professional training of NS teachers in order to improve the teaching practices in science and technology. This training should have to lie in the consideration of the tension between:

- The described reality of professional acts and therefore, compositional schemes' existence.
- And the need for an education with epistemological coherence.

The predominance in professional acts of the weaving dimension (Bucheton & Soulé, 2009) ensures cohesion between STE and other educations but constitutes an obstacle for teachers who have to think about coherence in STE.

We may compile a list of training propositions:

- This course should take account the interrelated nature of STE. This specificity requires a renunciation of a training thought as a multivalency and a downward projection of SS's academic subjects (the different valencies) on PS where they do not exist. The training would aim the development of skills to take charge of a possible STE, that NS teachers would be able to provide.
- Science education studies should take place as a central training subject. *Science education studies* here refer to three dimensions: psychological, pedagogical and epistemological. In keeping with the way of Joël Bisault (2011), we suggest to consider STE not in terms of knowledge but as teachers' practices and children's activities, and not from what pupils should learn but from what they can really do.
- This training should be entrusted to multi-categorial teams, to science education studies' different orientations and incarnations: university trainers, NS trainers and researchers. Thus, the trainers would not juxtapose their skills but should share them: these teams have to work together to define possible access for children to science and technology. Finding ways to get in touch with science and technology are a possible entry for thinking STE. They would not only be an acquisition of knowledge or procedures, but also a way for pupils to interact with objects (natural or artificial, like vacuum, balloon, punch) and phenomena, to change their point of view about them.

But these suggestions, based on the STE *curriculum* can also be extended to other areas of teaching. Thus it may contribute to the training of NS teachers: there is so much happening between 2 and 6 years old that it is necessary to train teachers in early childhood education.

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