How the education professionals view the manifold potential of a technological project

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The aim of this paper is to present the Educational professionals view about the variety of opportunities the implementation of projects in the Science and Technology domains may create. The purpose of the Project we had experienced, The Early Technological Education (ETE), was to develop scientific, technological and social competencies in children. In this paper we refer twelve case studies which had been supported by diverse learning and teaching devices which were integrated into curricular scholar projects. These interventions were implemented either in formal and informal education environments and were based on the ETE, an international project on the scope of the Socrates-Comenius, addressed to 3 to 10 years old boys and girls, once we have started from the hypothesis that to experiment science and technology pleasure these are the better ages to children as well as to their teachers and educators. The starting idea for the research team was that: "Early Technical Education sensitises children to scientific and technical phenomena. It creates opportunities to develop and support children's interests in, and their understanding of basic principles of science and technology by promoting experiences and furthering abilities. It is designed for the age range from 3 to 10 and for both sexes and takes place in the context of the social, cultural and emotional world of children. It takes account of a variety of teaching concepts, processes, materials and methods." One of the most important ETE aims has been the building up of some pedagogical materials and the conception of scientific experiences which can be used in different contexts and with different children as well as the building up of a free, on-line manual available on http://www.earlytechnicaleducation.org. Active learning, disciplinary and transversal competencies, collaborative work and linking University and labour context, were some of the guidelines of the pedagogical projects that were the subject of the study we want to present. The analysis of the collected data from interviews applied to 12 professional educators suggests that those projects were an excellent tool for the children, for the University students and for the Educational professionals. Children had had the opportunity to develop technological competencies, as well as reading, writing and social competencies. University students were able to put theory into practice in real situations, thus preparing themselves to the labour market demands. Teachers and educators profited from an up-dating training experience, by the contact with activities in the technological domain, supported by various pedagogical methodologies like team and collaborative work, tutoring, problem solving and project work. These pedagogical experiments provided the opportunity to access ETE potentialities and to reflect upon the ethical issues about technology.

Keywords teacher training; teaching/learning strategies; higher education; science and technology; ethics and technology

1. Introduction

The Project ETE (Early Technical Education), a Sócrates Comenius 2 Project, led to the production of innovative pedagogical materials to teach and to experiment science and technology.

Accepting the idea that science must be learned and technology must be experimented on early years, we decided that the project should be addressed to young people from 3 to 10 years old as well as to their teachers/educators. One of the most important purposes was the production of an *e-handbook* which could content some theoretical thinking about how children learn and how teacher can teach considering

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pupils' age and the aim of the very project itself: to sensitize children (both genres), to sciences, technologies and experimentation, in a way that the rigour and scientific attitudes be always present. The manual we wrote is an *e-book* easily to work with, available for everybody on the "Early Technical Education" site [1].

On the construction of the manual, we had in mind that it should be: a) innovative to motivate teachers and children and to be regarded as an alternative pedagogical proposal; b) scientific and pedagogical correct, rigorous and well founded, from a practical and a theoretical perspective; c) easy to work with and available to any user; d) as flexible as possible so that it might reach a great diversity of contexts (national curricula, ages, genres, teaching and learning styles,…). These requisites were taken into account while designing, describing and presenting the proposed activities, elaborating the explanations and the suggestions of didactical methodologies and procedures [2].

2. Guidelines oft the pedagogical projects

Some of the *ETE* activities have been tested with children in nurseries and basic schools, involving the school teachers, and the students of the Education Faculty, supported by their University teachers. Later on, furthering this experience, a group of teachers had decided to initiate a more ambitious project. Analysing the learning outcomes that can be reached by those activities, comparing them with the curricula of each unit and considering the principles and the structure of the course and the profile of the future Education professional, they had decided to implement an interdisciplinary collaborative work. So, they challenged the students to develop projects, based on the activities of the ETE Project and integrating the dimensions of the 3 disciplines course. The students prepared, designed and developed an intervention with a group of children paying attention to the curriculum, to the teachers' pedagogical plan and to the children knowledge needs. They included some of the activities of the ETE and they set up an investigation plan. [3].

This initiative had implied 12 case studies in real contexts (diversified, formal and no formal contexts but authentic real contexts) and they were been supported by diversified teaching and learning devices., which were integrated in the curricular Project of each educational situation and according to the ETE International Project. Table 1 to 3 informs about the 12 case studies: the educational level of the educational institution; the number of students evolved in the study and their age; the projects and subjects experienced; and, the ETE topics.

Table 1 -Context Situations**:** *Five Basic Schools*

Grade/Children Number / Age		Projects/ Subject(s)	Technical /technological Topics (ETE)
1st 26	10 to 12	*"The Optics and the Light"* Light and Optics	Making: a periscope; a kaleidoscope; a water magnifying glass. How movies work.
2nd 20	8 to 11	*"Little Great Artists"* Cameras and Photos	Taking and making photos; how a camera works; making a pinhole and a real camera.
3rd 21	9 to 11	*"Lighted Lisbon"* Construction; Mechanics; Electricity	Investigating: technology in buildings and vehicles; elementary electricity. Designing and constructing the buildings and vehicles; applying electrical circuits; meaningful use of mathematics. Meaningful use of language; making a construction-technical visual dictionary.
4th 20	9 to 11	*"Master" André's little friends"* Sound	Sound: hear, make and feel tones / noises. Making: plastic cup telephones: water music with glasses; a musical cigar box; weird sounds from the jungle.
5th 27	6 to 7	*"Learning how to listen"* Sound	Making: plastic cup telephone; water music with glasses; a music box.

Table 2 - Context Situations**:** *Three Nurseries*

Children Number / Age		Projects/ Subject(s)	Technical /technological Topics (ETE)
24	3 to 6	*"Sound Water and Colours"* Sound; Water; Light	Sound: hear, make and feel tones / noises; sound can be bundled; Sound is a wave. Water: the art of evaporation. Miracle of colours: how to separate colours.
22	3 to 6	*"Building an ideal neighbourhood"* Construction; Mechanics; Electricity	Planning and designing the buildings and vehicles. Constructing a wood house; finishing the interior of the house; electrifying the house.
15	3 to 6	*"My first experiments"* Water; Electricity and Electromagnetism	Water: shaking glasses-floating and sinking; Sugar and ink – what dissolves faster? Electricity: Manufacture electric hopping manikins, Building an electromagnet.

Table 3 - Context Situations**:** *Four "A.T.L." Centre of free time activities (no formal educational contexts)*

Children Number / Age		Projects/ Subject(s)	Technical /technological Topics (ETE)
16	3 to 5	*"From hearing to vibrating"* Sound	Sound tree: Sounds or noises? acoustics, sound, air resistance. Making: plastic cup telephones; water music with glasses; weird sounds from the jungle.
10	6 to 7	*"The adventure of sound"* Sound	What's sound? - hear, make and feel tones / noises. Making: plastic cup telephones; water music with glasses; a music box.
10	5 to 6	*"Learning how to think"* Water	Water: shaking glasses-floating and sinking; water mix- water taste; Is water hard?; water as a solvent. Sugar and ink – what dissolves faster?
12	6 to 10	*"Span and a half scientists"* Water; Sound; Electricity and Electromagnetism	Water: shaking glasses-floating and sinking; Is water hard? Electricity: Manufacture electric hopping manikins. Sound – making: plastic cup telephones; weird sounds from the jungle.

These 12 projects/experiments were axed on active and self-regulated learning; disciplinary and transversal skills development; tutorial work; collaborative work; problem solving; project work; and, university/experimental context articulation.

As Bronson emphasized (2000:245): "Teachers of young children know that they learn about the world and learn to solve problems when they play and that play is their way of experimenting with new ideas and practising skills [4]. Early childhood educators need to hold fast to these understandings in the face of increasing "academic standards" for early childhood classrooms. It is not that young children cannot or should not learn letters and numbers and concepts in science, because they can and are interested in these concepts if presented appropriately. However, long periods of teacher instruction and longer periods of filling out work sheets at desks or tables are not the most effective means of supporting learning, self-regulated learning, or love for learning at these ages".

Schools ought to encourage children to see knowledge as "cultural tools" by building appropriate choice and individual control into a curriculum that interests and challenges each individual at an appropriate level, emphasizes internal rewards rather than external control, and allows space and time for each child's personal quest.

3. Methods

In the study we carry on we are specially interested to understand how Professional Educators had interpreted the development of each intervention, on the scope of the *interpretative paradigm* once "the events only can be understood if we understand the perception and interpretation done by the individuals that had participated in them" (Tuckman, 2002:508) [5].

Data has been collected by semi-structured interviews (three kindergarten educators; five elementary school teachers; two ATL directors, and two ATL monitors) and it has been analysed according to content analysis technique. Further more, we have used other research instruments such as knowledge diagnostic questionnaires applied to the children; participated observation of the activities; and university students analysis about their own project experiences.

Our interest in carrying on these 12 case studies emerged from our direct contact with the 12 Professional Educators which had worked with our university students. Paying attention to that each one has is own technical culture and point of view about using technology, four questions have been defined and have constituted the starting point to this study outline: ***a)*** What are professional educator opinions about these technological interventions? What are the learning and development opportunities these interventions allow? ***b)*** What ethical problems and situations Professional educators think about as a consequence of the daily use of technology? ***c)*** In what way the teaching and learning devices implemented (tutoring; collaborative work; …) contribute to the development of technological competences and promote their articulation to the development of other ones (reading, writing, social competences)? ***d)*** In what measure the learning identified by Professional educators can be transfer for their pupils, for the participant university students and for themselves?

4. Discussion and results

All the Professional educators had pointed out the potentialities of these technological projects associated to five reasons: **to be integrated on the curriculum project of each teaching/learning context** "*it has been very pertinent, because they were in the Class and School Educational Project and a lot of the subjects were emphasized on other* courses"; **to be well supported in scientific terms** makes projects like ETE more pertinent considering the difficulties of being "scientific" in the treatment of such complex themes for so young individual, emphasizing that "*the objective of these projects is to allow children a first contact to science and to motivate them to the technical-experiment phenomena (…) leading to the development of a research attitude in children and to the use of scientific* vocabulary"; **to have stimulated pupils active participation** "*the students had evolved a lot, with a very positive interaction between them and among them and the educator. Furthermore, they were proud of doing things with their own hands, of knowing from where things come; how get information and how they come to some output; the research needed as well as the team work*"*;* **to lead to learning and to contribute to the competence development on different areas** *once* **"***is possible to perceive in the competences pupils won (…) the growing of scientific competences; scientific knowing tied to the activities done (including the vocabulary); new competences to the self thinking and the intra-individuals appreciation (through the increasing of pupils autonomy and self-esteem)*"; **to be settled upon teaching-learning devices** (tutorial, collaborative work, problem solving and project work) which promote student autonomy; help each other and a scientific attitude "*which allow children to explore their environment, answering to their natural curiosity and their spontaneity in the search for solution*".

It has been largely referred the need of thinking about the impact of the use of technology in children development, and some **ethics questions** came to the debate. For instance, it has been focused the deregulated access to Internet considering that can "*transform our children in individuals who think that for having access to information they are automatically people who know the reality*", fact that justifies "*the need of be with children when they navigate by the* Internet". Questioning social and ethical values cross the interviews. Once of the educators, for instance, claims "*that is urgent that children respect environment, in order to their own survival as well as the common well being. Through experimentation and technical actions children could make acquaintance of the pros of a technological world in the medium and long term*".

The adhesion of the Professionals to the project is tied to the need "*to face technology as a content and as a learning instrument*" and "*to promote mutual respect and responsibility*".

The need for **innovate teaching methods** explained the introduction of new teaching/learning devices. They emphasized their contribution to the development in technological domains and they analysed the possibility to develop other competences, such as reading, writing and social competences. One

of the educators stated that the project "*developed scientific methodology competences, such as observation, attention, focusing, questioning, discuss what is observed, dialog among them and research, namely in Portuguese Language*" and another emphasizes "*the stimulus to children go beyond; to not take the real thing as granted; and to understand the bridge between the experience and the writing; the individual and the team; the thinking about the process*".

Concerning **learning transfer** these interventions allow the **continuity of this work** with other educators we have observed a consensus between educators in terms of the principles, one of them have remarked that "*these projects imply that the teacher wants and be able to modify his routines and teaching habits*". One of the directors stated that "*with these projects pupils stay more motivated (…) and they show how educators may work about a concept in a material way*" and he also remarks that "*sometimes the culture of the schools did not let enter this kind of activities*".

5. Conclusion / final remarks

With this study, which includes 12 different cases, we aim to understand the Professional educators point of view concerning innovation in their classes and courses, as well as about their perceptions respecting the opportunities that the implementation of scientific and technological projects may create and offer to all *players* development: Professional educators; pupils; experimenters (in the present case, the authors' students of Education Sciences).

Carried on at 12 different educational institutions, the study has been settled down on knowledge diagnostic questionnaires applied to the children; participated observation of the activities; university student analysis about their own project experiences, and 12 semi-structured interviews.

The analysis of the interviews witness an important consensus among Professional educators about the important learning and development opportunities that these scientific and technological projects may allow (and that in this specific situation had allowed) to: - ***the experimenters/university students*** (to link theory and practice; to reflect about their own experiences; to discuss one each other; to observe the results of several teaching and learning devices; to work in a collaborative way; to discuss reality with their own university teachers; and to close them to the real world, the work and the market); - ***the pupils aged between 3 and 10 years old*** (to develop technological competences and to articulate them to the development of other ones, such as reading, writing and communicating; to develop a research attitude and the use of scientific vocabulary; to create and to develop solidarities and cooperation attitudes; to increase pupils autonomy and self-esteem); - ***the professional educators*** (to recycle their knowledge; to understand the pertinence of the inclusion of scientific and technological studies in curricula; to think and to discuss about innovative teaching methods as a consequence of the use of technology; to make acquaintance to the advantages of collaborative work; to reflect about ethics related to the use of technology by children; to notice the possibility of experimenters, pupils and themselves in transferring learning, knowledge, experiences and acquired competences to other contexts but the educational ones).

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