Exploring the Vine Cycle. Mobile technology in non-formal environmental education settings

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***Abstract*—Mobile and ubiquitous technologies offer unique potentialities to develop environmental education activities. This paper presents the preliminary results of a project developed with children aged between 6 and 12, which explored the vine cycle over one year, visiting farms in the vineyard area of Dão. Mobilizing a framework that integrates the authentic and meaningful learnings and situated cognition, it drew up a set of activities in which children were invited to take the roles of farmer, reporter and researcher. These activities were developed with the help of computers, electronic sensors, action cameras and audio recorders to explore the environment and the farm activities.**

***Keywords*—environmental education; senses; sensors; mobile technologies**

I. Introduction

This paper presents the development of a project for children of Viseu district. The "Dão Kids Academy" is an educational project of the Viseu city and results of a partnership with the School of Education, School of Agriculture and agricultural producers in the Viseu area. The main objective is to connect children with the land cycles relevant to the region.

We began with the vine cycle. The vine is an economically attractive product for the region, since Viseu is integrated in a wine region.

Nature and outdoor learning activities provides opportunities for personal and social development of children, promoting both, a greater knowledge and understanding of the world around them [1]. The activities outside the traditional classroom contexts provide opportunities to explore, inquire and develop creative thinking, becoming aware of the complexity of the real world. These learning experiences are embodied and located and multisensory experiences become part of the knowledge construction.

The design of outdoor learning activities integrated the use of mobile technology in a transparent and ubiquitous way, seeking to help children explore and sense the environment.

II. Literature Review

The constructivist and constructionist theories of learning, as defined by Papert [2] and Resnick et al [3], seems to tackle better education challenges. Children feel more involved and motivated when they learn by doing or when they develop significant products for them and their community.

Authentic learning provides an important reference for the design and implementation of teaching/learning activities. Authentic learning is based on real and complex problems and their possible solutions, mobilizing strategies of case studies, activities based on projects and participation in the community [4]. These teaching learning activities emphasize the importance of the context and of situated cognition [5], and give the children the opportunity to deal with significant, multidisciplinary and ill structured problems.

The evolution of Information and Communication Technologies and its greater transparency and ubiquity allow their real integration in learning scenarios outside the classroom, in non-formal learning contexts. Mobile devices and the use of physical sensors support the easy access to a sophisticated web of information and location-based and context-aware services, translated by the value of obtain the right information at the right time and at the right place [6]. Mobile devices such as smartphones or tablets and the use of physical sensors for the acquisition of environmental data, support and deepen the opportunities for students to explore, to discover and to investigate the environment [7], promoting authentic and meaningful learning.

Several studies have explored the use of the senses and sensors to the development of science education in basic education. In the schoolsenses@internet project [8], the Portuguese primary school children were invited to share multisensory messages about the playgrounds of their schools. Using senses and sensory experiences, children created multimedia messages with mobile phones with GPS to share in a version of GoogleEarth, integrated in the project website. The georeferenced multisensory information created by children integrated multiple representations and appropriations of the playgrounds environment of their schools. Collaborative edition and re(editon) of the multisensory messages on the projet website, allowed children, from schools separated geographically, share and reflect on the environmental quality of

theirschools playgrounds. The Ambient Wood project [9] used mobile devices, such as probes, sensors and GPS for explore, discover and reflect in a forest environment. SOS Abstract project explored the use of the senses and the sensors in environmental education to develop abstract thinking in primary school children [10].

All these studies reveal that children work easily both with mobile technology and sensors and they also reveal their potential to scaffold the development of research, presentation, interpretation and reflection skills about environmental data. On the other hand, as pointed out by Ackermann [11], these studies emphasize that in order to learn from the experiences it is necessary to introduce situation points, to analyze and reflect about them before planning and go back again to experience. In that sense it is important to promote conditions of interconnection between sensory and concrete experiences with learning contexts to explore the data collected, the diversity of views and the data representations with other digital tools.

III. Learning Experiences in "Dão Kids Academy"

A. Project Organization

The project was designed and organized in order to give children the opportunity to explore, in context, the evolution of this land cycle over a year. Children were invited to participate in the "Dão Kids Academy" and the activities took place in non-formal learning settings, in five farms of wine producers of the Viseu region.

Five representative moments of the vine cycle were identified and five visits to the farms, to study each stage of vine development, were programmed.

- Pruning - January
- 1st vegetative stage - March
- 2nd vegetative stage - June
- Harvest – September
- Winemaking- December

The main research questions tried to understand how to design meaningful authentic and learning activities in non-formal contexts integrating mobile technology to explore the environment.

Some aspects were particularly important to design the activities to cope the ages of children and the special contexts where it took place. The activities would occur on the farms in non-formal or informal context. The activities would have a specific nature, five days over one year, which means that the learning situations and opportunities were restricted to those geographical space and time. So it was important to safeguard security issues in visits to farms, and to ensure motivation and involvement of children in the proposed tasks and in the possibility of establishing relations between the various visits to farms and the various times of the vine cycle. Trying to tackle with these issues, children were invited to take on three roles: farmer, researcher and reporter. In the farmer's role, children had the chance to explore and perform agricultural tasks adapted to each phase of the vine cycle, such as to prune the vine, to defoliate, to harvest or to step on the grape. In the researcher's role, children could explore the vine at each stage of the cycle, promoting activities of research and of collection of biological and environmental information. Children were invited to observe and to feel the vine environment, noting the sensations acquired by the senses and using physical sensors to obtain and to record environmental data. In the reporter´s role, children organized short reports about the activities that take place in each stage of the vine cycle, as well as about the activities that they themselves were developing. In order to explore and to represent the activities developed on the farms, children were invited to plan a storyboard before they begin to capture image and sounds and to record. On the other hand, when drawing up reports on their own activities, children reflected and reorganized their own knowledge. To make their reports children used audio recorders and action cameras.

Table I summarizes the design of activities that have been implemented in the 5 visits to the farms.

TABLE I. DESIGN OF THE ACTIVITIES

	Goals	Use of ICT	**5 visits**
Farmer	To experience the farmer's work in the vine		
Researcher	To explore and to investigate biological and physical aspects in the vine To plan measurements and to collect data To compare biological and environmental data	Tablet Computers Physical sensors - anemometer	
Reporter	To represent the work in the vine To represent the experiences and the knowledge developed with the project	Audio recorder Action Camera	

B. Project Development

The "Dão Kids Academy" involved the participation of 50 children of the Viseu region, aged between 6 and 12 years. Fig. 1 shows the distribution of children's ages. Children were divided by the five farms, in groups of three to four elements. The project was developed in an extracurricular context and the activities on farms, for pedagogical and safety reasons required a very close monitoring. Thus, in order to develop the activities, the Schools involved in the project have trained a number of students of agricultural engineering, basic education bachelor and Early Childhood and Primary Education master. The integration of these students as monitors is an educational strategy of the schools promoting meaningful learnings in work contexts. In this particular case, it also allowed us to have the number of trainers required to the development of the various activities with children. Thirty students of both schools were involved in the project.

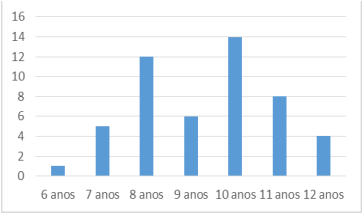

Fig. 1. Children ages

Children made 5 visits to the farms and each visit lasted a day.

In the researcher's role, children explored and observed the vine collecting environmental data. They drew the vines and discussed their characteristics, differences and similarities in 5 times of the cycle, see Fig. 2.

Fig 2. Drawing the vine

Children used their senses to describe the color of the vine, the texture of the vine and its leaves, the sound, the temperature, the humidity and the wind. They used sensors to measure and collect environmental data such as temperature, humidity, wind speed and atmospheric pressure. In this study children worked with anemometers "Pasco" connected to Magellan computers or tablets, see Fig. 3.

Fig. 3. Environmental data recording using the anemometer

In the reporter's role, children prepared a storyboard to develop the audio visual report about both the farms and the activities that were ongoing in the days of visits. Children used action cameras for video recording and portable audio recorders for audio, Fig. 4.

Fig. 4. Children as reporters

In the farmer's role, children observed the workers of farms and learned and experienced with them the various jobs and specific agricultural techniques to care the vine along the cycle.

All these activities were repeated in the five visits to the farms. Each group of children visited five times the same farm to facilitate the analysis of the vine cycle along the year. Besides playing the role of farmer, researcher and reporter, children participated in other activities adapted to the moment of the vine cycle. For instance, on the first visit, they participate in a debate about alcoholism; in the December visit, children had the chance to see the wine bottling process and designed a bottle label for the wine production of the farm visited.

C. Preliminary Results

Children were involved in a very positive way in the activities proposed in the visits to the farms. The great majority of them ensured their presence in the five days throughout the year. Children were motivated on the use of technologies to achieve the proposed tasks, both in the roles of researchers and reporters.

In the researcher's role, children visited several local in the vine, trying to explore and express the information acquired by the various senses. They began by drawing the vine and recording its color, texture and smell. The use of the anemometer added multisensory exploration, allowing the record of the wind speed, the temperature, the relative humidity and the atmospheric pressure. Due to the weather conditions in the months of December and February, children just made these records in March - 1st phase of vegetative development, July - 2nd phase of vegetative development and September - harvest. Fig. 5 shows the vine drawing in the three phases of the cycle, from one plant representation in hibernation phase (only with the stem), going through the budding of the leaves, to the formation and ripening of fruits during the harvest.

Children were able to describe the physical variables using the senses: little mild to describe the wind; very, little, dry, to describe the humidity; very hot, mild, very warm, to describe the temperature; plenty of air, little, low, to describe the atmospheric pressure.

Fig. 5. Draws of three stages of the vine

They used the anemometer to register the same physical quantities. They also revealed easiness in handling the sensor and both the tablet and the computer. Note that the groups of children were formed heterogeneously, safeguarding that older elements could help the younger children in the various tasks. For example, younger children do not know neither the concept of relative humidity nor atmospheric pressure, but the contact with the reading and the recording of these quantities, helped them in a first contact to these concepts.

A group of children explains the atmospheric pressure as "plenty of air" and after the first measurements refers to its value using "little" and "low". Fig. 6 shows a multisensory recording sheet made in the month of June.

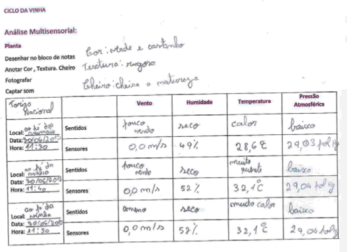

Fig. 6. *Environmental* data sheet

Children built graphs with the values of the environmental data from the registration tables for the months of March, June and September (Fig. 7). These graphics could have been built on the computer, but as we only have one computer or laptop in each farm, it was decided to develop this activity on paper.

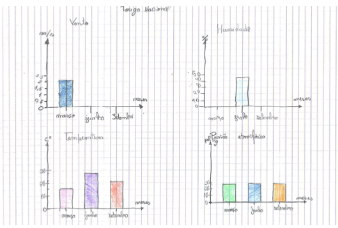

Fig. 7. Graphical representation of environmental data

In the reporter's role children began to develop a storyboard, see Fig. 8, in which they recorded both the topics to work on the report and the questions to the interviewees.

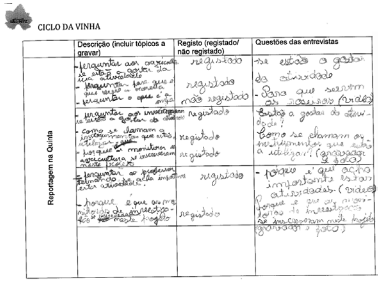

Fig. 8. Example of Storyboard

Children had no difficulty to use the video cameras and audio recorders. In December visit, they were also invited to write a news about the activities on farms, using a word processor. The video reports and the written news revealed children learning about the vine cycle. They explained in an appropriate way the agricultural work on the farms and their work as researchers and reporters. Table II. presents some excerpts from the news written by children.

TABLE II. EXCERPTS FROM NEWS WRITTEN BY CHILDREN

On March 25, children from 6 to 12 years experienced to be farmers, reporters and researchers for a day. We learned about both the physiology of the vine and the vine cycle. We found that grapes are not only used to make wine, but they can also be used to make jelly and dried grapes and serve as a fruit. What also fascinated us were the grape varieties and their names, eg. *muscatel*, *nacional touriga*, *vital* among others.
We not only learned to harvest, but also some terms: "grape must" is the juice that is created after tread of the grapes; "reassembly" is moisturize the mass of grapes, making the wine down up and also "fermentation" when wine is heated and the sugar is transformed into alcohol. The kids visited the vats, where occurs both the reassembly and the fermentation.
The researchers made several air measurements with a multisensor. We measured the temperature, the atmospheric pressure, the relative humidity and the wind speed.
The first activity of the reporters was to think about and plan the questions that we were asking to the farm workers. Afterward we took photographs, recorded and asked. The reporters interviewed the farm owners and the farm workers; they collected information through photographs, videos and interviews.

IV. Conclusions

The early findings about the project "Dão Kids Academy" presented here confirm the potential of mobile technology in environmental education activities in non-formal contexts.

It was possible to organize outdoor activities on farms, integrating, in a transparent approach, the use of technology. The

monitoring role of higher education students was very important for the project development. The use of senses and physical sensors scaffold the exploration of biological and physical aspects of the various vine cycle stages. It is emphasized the complicity of the ways used for children while explore the environment and make their records. Beside the didactic intention of allowing children to explore multiple representations and ways to sound out and represent the environment, it also allowed to work in each farm with just a "kit" of researcher and a "kit" of reporter. Thus, it was significantly reduced the number of devices required to implement the project.

While researchers, students planned the locals where they wanted to record the data. They compare places exposed to the sun with shadow locals or higher locals with more sheltered ones. The continuity of work throughout the year also allowed to compare these data depending on the time of year.

Some environmental data such as air pressure were unknown for most children. We have chosen to maintain this record since the anemometer made these readings. By using the sensors children increased their perception of the vine cycle environment, complementing the information acquired by own senses.

The reports activities about the vine works allowed children to represent their own experiences and the knowledge developed in this project. A first analysis of the documents produced shows that this activity supported the organization and systematization of knowledge.

Having all the activities be developed outdoor on farms, made difficult the creation of spaces for children assess and reflect on their experiences. With regard to the activities as reporters, it is thought to hold a workshop for children edit videos and complete the reports. In future projects it will be important to rethink the organization of some tasks in the classroom, where children can edit the data collected, discuss and analyze the results, looking for opportunities for children to do situation points as pointed out by Ackermann [11].

It is also under development a website for each farm documenting all the work done by children.

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