A Robot in Kindergarten

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Abstract

These thought are the result of work in progress, started in 1999, within the scope of the Trás-os-Montes Digital/SCETAD, project (sub-project: ICEI – Computers in Early Childhood Education Contexts). The work took place in Portuguese kindergarten rooms, with children aged 3, 4, 5 and 6.

The ICEI sub-project aims to promote the use of ICT in a playful but pedagogical way, be it free or directed. This use is intended to occur within the scope of activities developed for the micro-spaces of the kindergarten activity room. Their main aims being: increased awareness of ICT among children; contributing for making children and teachers feel at ease with ICT; contribute for the identification of computer-usage and network-usage methodologies as teaching/learning tools.

We believe that ICT can help promote the use of basic skills for the child's global development.

Within the several available ICT, we will just present here the work developed with the "Roamer" robot (Amethyst Consultancy Ltd., 2003).

Keywords

Roamer, robot, children programming, kindergarten, early childhood, Logo, abstraction

1. Introduction

This paper reflects the work under development at the University of Trás-os-Montes e Alto Douro (UTAD), since 1999, within the scope of the project Trás-os-Montes Digital/SCETAD, subproject ICEI (*Informática em Contextos de Educação de Infância*, Computers in Early Childhood Contexts). This project has conducted computer-related activities in Portuguese kindergarten rooms, with 3-, 4- and 5-year old children.

The ICEI subproject aims to promote the use of New Information and Communication Technologies (NICT) in playful educational ways, freely or assisted/conducted, integrating them with the activities taking place within the micro-spaces of the kindergarten room. Its main goals are to raise children awareness towards NICT; to promote the acquaintance of both children and teachers with computers and communication support; to cooperate on the identification of computer and network usage methodologies, as teaching and learning tools.

We believe that technology can help promote children basic skills towards their global development.

Within the several NICT available, this paper will focus on the work developed with the Roamer robot (Amethyst Consultancy Ltd., 2003; CnotInfor, 2003). We'll present it, how it can be used, what we use it for, and what results have been achieved.

2. The Roamer robot and its use

The Roamer robot was created by Professor Tom Stonier (Goodman, 1999) at the UK. It is an autonomous, programmable toy, 40cm wide (figure 1). Its "shell" can be removed and customized, in effect acting as a "disguise" or Carnival costume. This ability is both motivational and an important element to fulfil the various individual and group projects of kindergarten rooms.

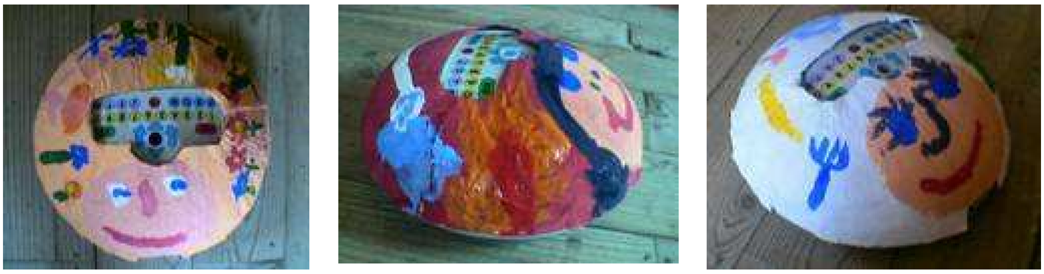

Figure 1 –Roamer robot in disguise: flower seller, firewoman and chef, for the "Professions" room project

The programming is performed on the robot itself, with no need for external computer connections, by using the several command and settings buttons available (figure 2).

We basically used the movement commands (forward, back, rotate clockwise, rotate counter-clockwise), with the same meaning as the identical instructions from the Logo programming language: FORWARD/FD, BACK/BK, RIGHT/RT, LEFT/LT (Logo Foundation, 2000).

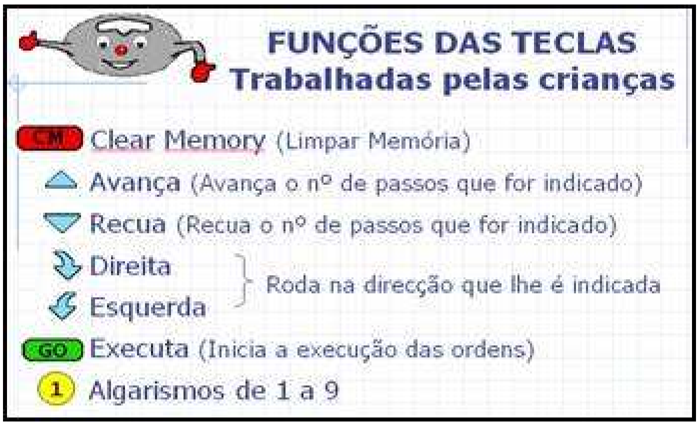

Figure 2 - List of keys used by the children

3. Child-Machine interaction

Children don't have to be force-fed to learn; they are motivated by their own desire to give sense to their own world.

Bringing the robot into a kindergarten rooms is extremely easy. The empathy between it and the children occurs immediately. We feel this is due to its nice looks, together with its ease of use and the simplicity of its programming. Another good thing is that it is easily customized – it can be disguised as whatever the children wish it to be; this allows its integration within the several projects that arise in a kindergarten room.

The robot is programmed in a direct way, following cause-effect guidelines. It can receive just a single instruction, or a short sequence (3 or 4 instructions in a row); however, for pre-school children, we found out that this task had to be segmented. We started by working out with the child which instructions were required to achieve a goal; the child then conveys these instructions to the robot and watches their effect, which is generally amusing. So, in a playful way, the child starts to realize that the machine (object) can be acted upon, and that such actions have direct consequences.

Children see the Roamer robot as a toy that can be ordered around (just like a remote control car), it is the child that decides and sets its destination. It is our role, as educators, to promote these abilities, conferring them an educational intent (as with the examples of activities, further ahead). It should be noted that children, upon realizing that the wrong option was taken, don't usually like to make such an error be noticed. The robot lets them make errors without leaving traces. Its patience in unmatched by any grown-up, and this turns it into a friend that is always there, with whom the process of learning through trial and error is essential for knowledge build-up. For instance, the robot can be ordered to follow a path, only for later on to be realized that it was the wrong one, that it wasn't the fastest one, or that it reaches a dead end; on such a situation, one can backtrack and repeat the process, and thus improving the child's response abilities. With the robot, the children can, in a playful way, turn abstract concepts into reality. Example include: measuring; comparing lengths; moving in a specific space, and drawing a path diagram; expressing these concepts in words.

One must emphasize the positive reinforcement, at the social and emotional level, promoted by the robot, both at the level of personal gains, and at the level of each child's interaction with play partners. *There some activities that a child can't do on her own, but that may be achievable if someone explains them to her, demonstrating how to do it. This possibility of changing a person's performance, due to the interference of someone else, is fundamental under Vygotsky* (Craidy, 2001), who emphasizes the importance of toys and child play in child development. It is the educator's role, as well as the role of older children, to make the child progress in its understanding of the world, building upon consolidated knowledge, having later phases as a goal. The educator and older children act within Vygostky's Zone of Proximal Development, originating progress that wouldn't occur on its own.

4. Activity examples - paths

According to Duhalde and Cuberes (1998), *paths are spatial experiences connected to the motion of the individual in space, that allow the child to understand the difference between near space and remote space*. Their execution and representation is beneficial, for instance, to acquire notions of orientation (right/left, forward/back); of distance (near/far) and of rotation. By being executed or recounted, a path implies an action sequence; the motion of an object gives the child notions regarding its orientation within reference points; the distance between those points and the action sequence form the "path". The resolution of o path requires, for instance, a child to understand that direction changes upon reaching a corner; the exploration of distinct rotations is an exercise for the help child reach the concept of angle.

The graphical record on paper sheets, where the reference points are located and represented, is an exercise allowing the child to move from its spatial existence to the field of space representation. By verbalizing the performed actions, employing their assigned names, the child is being assisted to acquire concepts. The resolution of problem situations, by responding to what is demanded of the child, progressively develops skills where strategy, reason and critical thinking are present.

The children acquire many concepts during informal activities, that don't need any systematic introduction. An educator must promote the application of concepts in a variety of everyday activities. In this sense, working with the Roamer allows an approach of all three content areas defined by the Portuguese Ministry of Education (Ministério da Educação, 1997): Personal and Social Education; Knowledge of the World; Expression and Communication (see also "Other kinds of activities").

We believe that a major aspect is that the child shouldn't learn a concept by repeating drills, where memorizing replaces reasoning. The educator should spur the child into using her intuitive knowledge, as a method to approach more formal learning. The educator should also seek and identify the situation's troubling aspects, creating the potential for the child to find solution proposals.

Within the several experiences that are set for a child, finding the solution to a particular problem isn't the most important thing. What really matters is the reasoning process used for the proposed solutions to a given problem. This reasoning will provide the support upon which the child will build her global development. So, *there is a possibility that the child does a significant learning, defined as a process through which connections can be made between new information and some pre-existing aspect of the cognitive structure.* (Ausubel, 1983). Ausubel further defines this significant learning, *by matching it against repetition-based* [learning], *and emphasizes that only significant learning allows the development of the cognitive skills of human beings* (Bassedas, 1999).

The goal for the curriculum developed throughout a school year is that it is based on projects emerging from the children group, thus exploring children's natural curiosity. The Roamer robot is a valuable resource to achieve this goal. With it, children learn how to interact with each other, developing their relationship skills; they can reproduce real of fictitious situations; propose solutions, testing whether they are adequate to the problem in hands; they take initiatives; they express their opinion; they act both alone or as part of a group; they can use symbols, make choices, determine relations and manipulate physical materials; they can place themselves spatially, move through space, and position themselves in relation to objects; they can make representations of paths; distinguish between front, side, far, near, above, below, ahead, behind, left and right.

5. Activity examples – further activities with paths…

5.1. Little Red Riding Hood's Path – Retell

The children listened to the story of Little Red Riding Hood (expression and communication areas); the major – from the children's viewpoint – events of the story were recorded, performing hand drawings, as shown on figure 3 (plastic expression domain). Afterwards, the robot was disguised as Little Red Riding Hood, result is shown on figure 4 (plastic expression and drama domains).

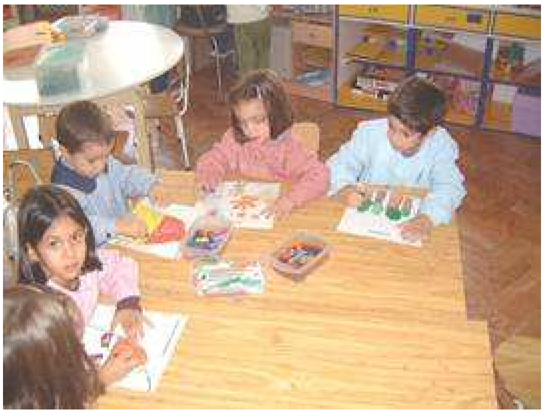

Figure 3 - Drawing the story

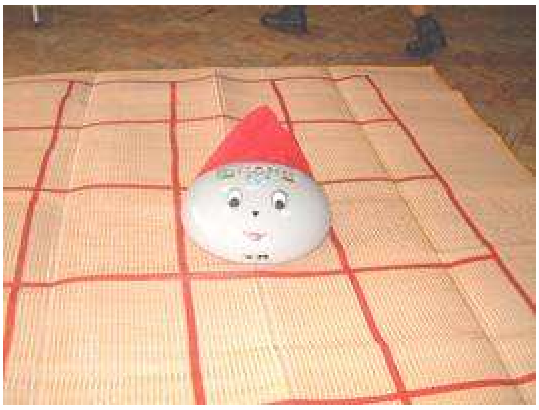

Figure 4 - Little Red Riding Hood

With this setting, Little Red Riding Hood (the Roamer robot) should take the path from its home to grandma's (math domain), going through the story events. During the retelling experience (drama and music domains: the children that wanted to watch a child operating the robot had to sing the Little Red Riding Hood song), by operating the robot, the children had to employ the notions of left/right, direction (forward/back), and quantity, to mention a few. In doing so, they were also developing a strategy to reach their goal (figure 5).

Figure 5 - Children operating the robot

5.2. Logic blocks

The work commonly developed with the logic blocks in kindergartens was the starting point. Employing the computer and the Paint program (figure 6), children built cards (figure 7) where attributes from the logic blocks where symbolically combined.

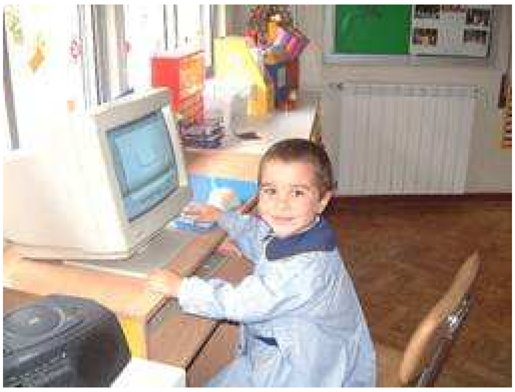

Figure 6 - Child drawing the cards at the computer

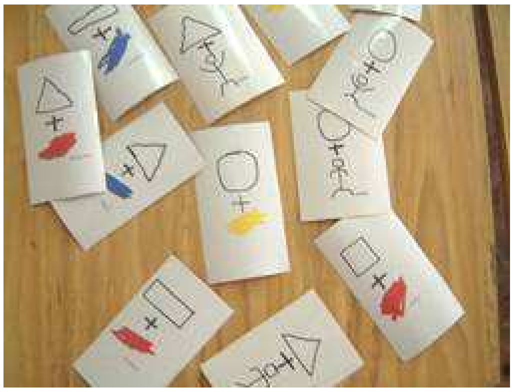

Figure 7 - Final cards

The logic blocks' pieces were scattered over a grid carpet. The children had to interpret the cards' meaning – the attributes had been randomly sampled – and then command the robot, programming it, until the matching piece was found (figure 8).

Figure 8 - Children commanding the robot

6. Other kinds of activities

Using as starting point the activities already taking place in the kindergarten room, the Roamer robot can be used for: other stories, round-robin tales (created by the children themselves); market/field trips (recording real trips, transposing them into a grid built with the children's participation); rigmaroles; songs; game of goose; tic-tac-toe; etc.

7. Abstraction and logical thinking

The period to which Piaget called "preoperational stage" it the second major stage in cognition development. It includes children between ages 2 and 7. In this period, *children become gradually more sophisticated regarding their use of symbolic thinking* (Papalia, 1975). Thus, *the peak of intelligence results in balance between assimilation and accommodation – since imitation prolongs the latter by itself – one can state that child play is basically assimilation, ruling over accommodation* (Negrine, 1994). The child plays according to its life experiences. For instance, when playing "housewife", the child does as she saw; speaks in the same way, acts in the same manner, recreating moments that she experienced or watched. This imitation (attitude pattern), is initially unique and quite simple to match (by imitation) to the child's model; but it progressively assumes the character of interiorization of the social/behaviour pattern, with well-defined values and guidelines.

From the very first years, children spend most of their time playing. *A child's natural job it to play, which to her is something very serious* (Bredekamp, 1987) – something that is not always perceived by adults.

While watching children's behaviour during play, we realize that is it a dynamic activity that places them in situations with motion and action, in which children are active participants.

The entertaining activity of child play, in fictitious situations, is a way to develop abstract thinking.

In this sense, *Piaget warns that the child creates and develops her mental structures through the various child-play activities* (Negrine, 1994) with toys and games, for instance – and also imagination, therefore. In doing so, children increase their conceptual skills. *Cognitive development is therefore the result of interaction of internal processes with the diverse encompassing contexts. Thus, the child goes from dualism to the distinction between subject and object, from centralism to decentralism, In this sense, a game is an activity from which immense learning can result* (Tavares, 1994).

For any child, it is essential that the foundations of abstraction and logical thinking are stimulated from early on. The robot is but one among other working tools that allow this. The child is an active participant: acquiring knowledge of the robot's features and potential, using her will to operate the robot, building scenarios, disguising the shell, laying group-defined rules for playing. The work thus developed encourages the child towards being the actor of her own learning, in ever-more complex challenges. The concept of what a number is (an abstract concept), is rendered – for instance – as the number of "steps" that the robot must perform when commanded by the child, and further on upon its execution.

This interaction with the robot makes the child study her ideas, constructing a strategy by restructuring ideas and making options, such as: "if I choose this/that path, I'll take less/more time". By having to select from a set of options, the quality of the child's problem-solving answers is improved.

8. Final remarks

The work with the Roamer robot is naturally interdisciplinary and all-embracing, and so the content areas defined in the Portuguese Ministry of Education Curriculum Guidelines (Ministério da Educação, 1997) can be approached (see, for instance, the description of the Little Red Riding Hood activity).

By being an active participant, the child builds her own process for learning and knowledge, and the child's pace can be respected.

The Roamer robot is a new way to present and experiment with entertaining activities, and to introduce several concepts, progressively, such as left/right distinction, spatial orientation, counting. It is also an initiation to computer programming practice, since usage rules must be respected and it renders easier to present abstract notions in a concrete fashion. Allows for comprehension of mathematical knowledge through exploration and problem solving; for the creation of learning environments, in which the child learns by trial and error; for group work. These *experiences that the child enjoys, by succeeding in her intent to do several things, and living the emotional experience of joint action* (Craidy, 2001), with people to whom she is emotionally attached, *contribute to her safety and self-esteem. In this way, progress is made in the perceived global development, not just in some of its capacities. This way of being interactive is sometimes explained* (…) *through the "scaffolding" metaphor* (…) *When the site development is over, all scaffolding is removed, but the building couldn't have been built without it* (Craidy, 2001).

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