

Scratch in Kindergarten

A Space and a Place of Communicational, Ludic and Creative Intermediations

M.S. Ana Patrícia Oliveira
University of Aveiro
apoliveira@ua.pt

University of Aveiro
mclopes@ua.pt

Maria Conceição Lopes

This paper describes the research and intervention that are part of the “*Scratch'ando com o sapo na infância*” – “Childhood with Scratch in motion” project developed at SAPO Lab (<http://labs.sapo.pt/ua>). The current study adopts the action research and the Scratch intervention-training-experiencing sessions with the project target groups (children, teachers and parents) occur in real life contexts and take place in the Cooperativa A Torre located in Lisbon. It is used a variety of intervention-training strategies placed in the studies’ horizon where is established the connection between the disciplinary fields of ludicity, communication, creativity, and pedagogy. Thus, through the acquired knowledge during the experiencing with the Scratch application and programming, it is intended to propose new methodologies for learning media literacy, maintaining the creative, ludic and critical flow (which produces alternatives), and finally for the metacommunication practice among preschool children.

1. Introduction

THE ludicity is presented as a new field of (multi) disciplinary studies that aims “to deepen the knowledge about digital artifacts and understand how they are used today, in their plural dimensions, namely in the humanistic, cultural and communicational presuppositions” (Lopes and Teixeira, 2005).

Thus, it is important to understand what are the critical factors that influence the ludicity and learning process during the interaction of children (from six years old) with digital artifacts. Considering the three fundamental criteria for the establishment of interactivity: to listen, to think and to talk (Chris Crawford, 2005), it is assumed the interactivity as a component of the human interaction process.

In addition, it is also essential to involve, increasingly and proactively, children in the construction of their autonomy and in the sociability (reinforcing the inter-cooperation), covering also family and school. Simultaneously, the adults give educational support to children guided by ethical and moral values. Thus, all together co-participate with respect, recognizing the child status, promoting and following his affirmation project, not only as critical individual, but also creative, agile in thinking, in interacting and in cooperating with others on search of common problems resolution.

The interpretation of the possibilities of Scratch application from MIT Lab allowed placing it in this perspective.

Children through the use of Scratch assume the role of authors, while they program, create stories scripts, cooperate and share interactive projects, think creatively, discover (in the ludic experience) mathematical and computational concepts, training logical thinking, develop interpersonal relationships and cooperate: all essential skills for the 21st century (Resnick et al., 2009).

In 2009, the “*Scratch'ando com o sapo*” – “Scratch in motion” project, which was also developed at SAPO Lab, created a set of eleven tutorials in Scratch and for Scratch that are available at <http://kids.sapo.pt/scratch/formacao>, and six characters that guide children during the tutorials tasks. Some of these tutorials are created for children between 4 and 6 years old. Thus, it is in the impact evaluation context of these tutorials, which are experienced by children from 4 to 6 years, that it is being developed the research.

Today, computing devices dominate the daily lives of children in different contexts, whether at school, at home or at free time. The new media are part of their lives and are changing the way they think, interact and learn. In this way, some questions emerge, like: How to motivate children to use new media in learning? Computer programs and applications meet their human condition of ludicity? Children can play and learn in the same time? What are the effects of that interaction? It is believed that Scratch programming may be one of the answers to these questions.

The anthropological view of medium from McLuhan (1964, 1967) inspires this work. The aphorism "Medium is the Message" points out the effects that the medium creates and not the content that are transmitted by it. It should be noted that this study is developed not through a technocratic approach, but using a human approach, emphasizing the effects that derived from the use of new media, specifically of the Scratch programming.

The "Childhood with Scratch in motion" project adopts the action research and various co-participation strategies among researchers, children, kindergarten teachers and parents. This project is developed with the support of several institutional partnerships, namely: PT - Portugal Telecom/SAPO Company and Inforlandia Enterprise Software (that provided and installed the computers needed to develop the study) and Kindergarten of Cooperativa de Educação e Ensino A Torre (that provided study's working place).

2. Theoretical Framework

2.1. Communication-Ludicity-Creativity Triad

Lopes (1998), in this Ph.D. thesis, established the communication-ludicity binomial from the notion of consequentiality stated by Cronen and Sigman (1995) in the context of their communication studies. According to Lopes (1998), the ludicity is, such as communication, a natural condition of the human being, thus the ludicity is a consequential phenomenon to the human being. The communication-ludicity-creativity triad is subsequently developed by Oliveira and Lopes (2005), through the pragmatics approach to the creativity process.

Therefore, communication, ludicity and creativity arise from dynamic processes of interaction and interrelationship that take place in different contexts, being consequential phenomena to humankind and necessarily consequential to each other. As a result, they can be manifested in different ways, producing a multiplicity and diversity of effects.

2.1.1. Approach to the Communication concept

Communication is a phenomenon and a humankind condition, but also an object of study in different disciplines, being itself a word with a broad meaning. The oldest definition of communication came from the Latin verb *communicare*: to make common; to be in relation (assuming a dynamic interaction); the transmission and co-construction of comprehension and the ideal intention of human communication.

According to Paul Watzlawick (1992), communication is a process in which the reality is not pre-determined, but rather a continuous reconstruction performed by the individuals in that process. Watzlawick argues that there is a first-order reality that human sensory receptors capture and a second reality, where significations are attributed to what surrounds us. Finally, "the unifying vision of the world in which humankind is included, corresponds to the third-order reality" (Watzlawick, 1992).

Lopes (1998) argues that the established relationships and interactions between the humans, which are mediated or not by technical or logotechnical devices, indicate that communication is a process of co-construction and co-reconstruction of the reality faced by every one of us. "The communication process is a reality phenomenon of human existence and an interaction system whose limit is the finiteness of death."

According to Cronen (1995), human communication is a process that requires intentionality and in which the consequences are the final results of the process. Recovering this perspective, Lopes (1998)

advocate the consequential nature of communication as a humankind condition. The author says that "the communicational process arises, not only from the verbal language structure or its social structures, but also from the interaction between them".

Finally, and once more according to Lopes (1998), the process of human communication involves the components of time, space and culture. The cultural component situates the communicational interaction, since it includes everything that humankind does. "Communication is learning, and communication and learning are culture".

2.1.2. Approach to the Ludicity concept

Lopes (2003) states that "the word ludicity refers to a unique condition of the humankind, and also to the diversity of its manifestations and their different effects".

According to the author, the concept of ludicity is defined as an essential condition of human that is manifested through the everyday experiences such as play, game, recreation, leisure and making ludic artifacts. These manifestations are dependent on an explicit or implicit contract established between who interacts. From this contract the protagonists of the situation establish an order in social interaction that is the ludicity.

Following this perspective, the ludic manifestations occur in everyday life, being dependent on the intentional choice of the individuals present in the situational context, who decide to interact in this way, even if they are institutionally induced, for example in the ludic manifestation of recreation, considered institutionally as a valuable break for work.

In order to make a semantic demarcation between the terms play, game, toy, recreation and leisure, Lopes (2003) (2008) defined the families of human and social manifestations and the procedural effects of each of the families (Fig. 1), because in spite of their proximity they are distinct.

In this sense, the author used the methodological approach proposed by Wittgenstein (1987), identifying the axes of semantic family and the axes of semantic neighborhood that contribute to emphasize the uniqueness of each one ludicity manifestation.

The ludicity, according to Lopes (2003) is a consequential phenomenon, "the ludic condition is a consequence of the humankind, and furthermore, the ludicity is the place of action where the ludic intentionality is created by each human, who establishes several connections that are conveyed, criticized, changed or abandoned by him, in order to accomplish the agreement that is initially defined".

Lopes (2003) believes that the ludicity phenomenon to be understood, must be studied taking into account three dimensions of analysis, specifically the dimension of the humankind condition, the dimension of its manifestations, and finally, the dimension of their effects.

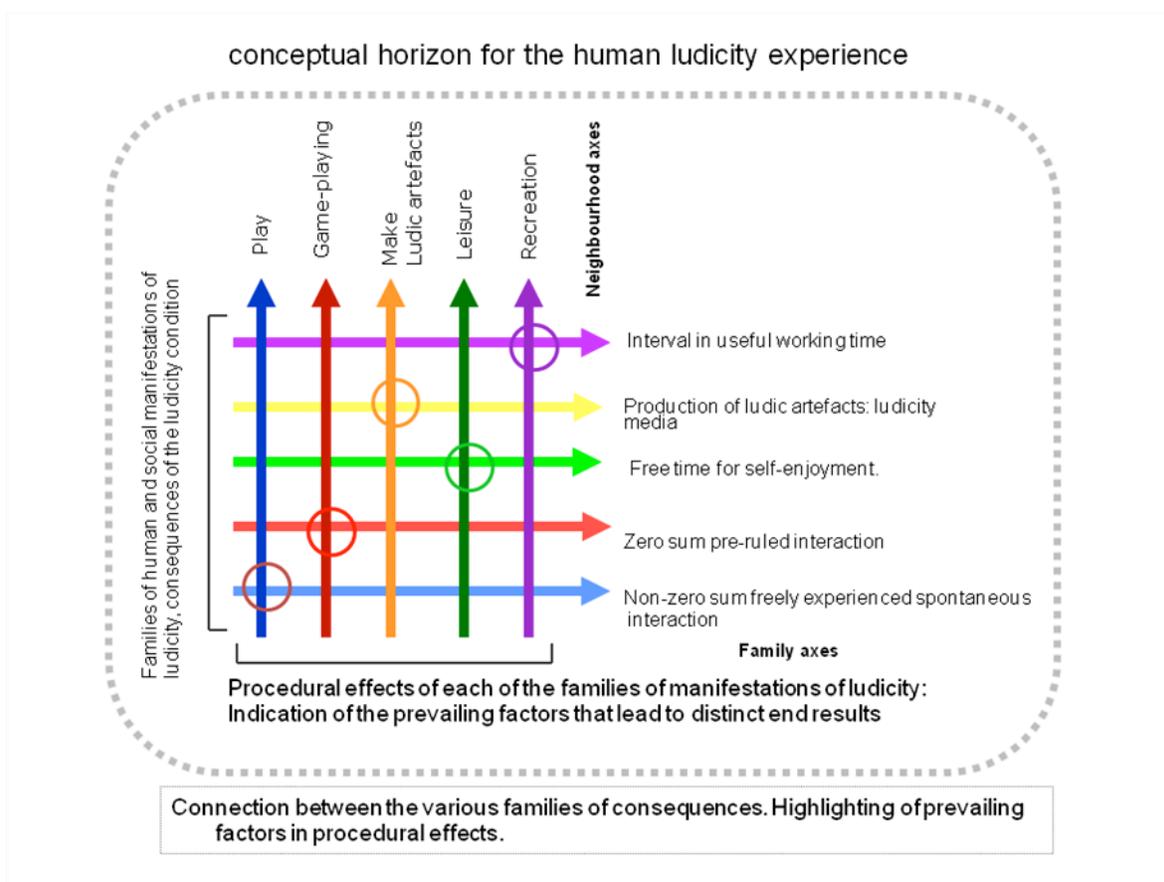


Fig. 1 - Schematic representation of the conceptual horizon for the human ludicity experience (Lopes, 2008)

2.1.3. Approach to Creativity concept

Guilford (1967) advocated, in the 50s, the study of creativity as science. In this sense, the author formulated the factorial theory that starts from the analysis of how the cognitive system works to solve problems, which is based on the interception of three categories, namely, contents, operations and products. When these categories are combined they create several features that define creativity.

In Guilford's view, divergent thinking is the center of the individual's creative production, however the author considers relevant the existence of convergent thinking, since the creative attitude should be seen as a complementary process and not mutually exclusive.

On the other hand, De Masi (2003) recognizes creativity as a mental and practical process by which the individual thinks on new ideas, but also can achieve them. According to the author, creativity is the essence of fantasy and the implementation of manipulated emotions and internal techniques.

Oliveira (2009) defends the pragmatics approach to creativity. The author argues that creativity is a human condition that is manifested in different forms and produces several effects, such as: i) the flexibility of thought, ii) the originality of ideas; iii) the fluidity of expression; iv) communication and personal expression; v) curiosity and critical spirit and vi) appreciation of ludic manifestations.

“The development process of creativity can be manifested when human, in certain situational contexts, perform a meeting with himself and others. Thus, is in a circular process of interaction, feedback and reciprocal interdependencies, conducted among different human, that the process of creative ability is produced.” (Oliveira, 2009).

2.2. Media literacy in the digital age

The term literacy is often associated with the ability to read and write and is a concept established and defined by a set of diverse disciplines. UNESCO – United Nations Educational, Scientific and Cultural Organization (2004) defines that “literacy is the ability to identify, understand, interpret, create, communicate and compute using printed and written materials associated with varying contexts. Literacy involves a continuum of learning in enabling individuals to achieve their goals, to develop their knowledge and potential, and to participate fully in their community and wider society”.

According to Holdaway (1979) the learning of literacy can and must be positive and an intrinsically rewarding experience for children. Holdaway also recognizes literacy as one of the characteristics of its model of social learning; this model is distinguished by the learning acquisition.

On the other hand, the notion of media literacy has been, in general, used since a quarter of a century, although there is some controversy and disagreement over how it is defined.

There are considerable studies and researches about young people and media, dating back to early 30s of the 20th century with the beginning of cinema studies. Most of this work focuses on media effects issues – particularly on prejudicial impacts - and not on what is directly related to media literacy.

Ofcom¹ (2004) defines media literacy as: ‘the ability to access, understand and create communications in a variety of contexts’. The Commission of the European Communities (2007) also contributed to the definition of media literacy, designating it as “the ability to access the media, to understand and to critically evaluate different aspects of the media and media contents and to create communications in a variety of contexts”.

In fact, children develop media literacy, even in the absence of explicit attempts to encourage and promote it. Many researchers and media producers argue that children today are more media literate than the children of past generations, and indeed more media literate than their own parents.

Nevertheless, children are also required to develop a degree of competence in new media management as a result of three factors: their broad level of cognitive development, their great level of emotional and social experience and their specific experience in media (Buckingham, 2003).

Thus, the attempt to identify what children already know about new media seems to be a prerequisite for any effort to promote media literacy.

In this context, taking into account the skills development of children in each areas proposed by Ofcom (2004), will be deconstructed the media literacy concept, in terms of access, understanding and creation of new media.

Access is related to the ability to locate media contents that are suitable for children needs, and the ability to avoid the contents that are not. This involves the hardware and software manipulation as well as the gathering and application of information about what is available.

Understand is related to what users do when they identify the contents. In this area, it is applied “the framework of key concepts that are used in most media education programmes: language, representation, industry and audience” (Buckingham, 2003).

The creative dimension extends the notion of literacy from "reading" to "writing" in new media, however it also involves skills to access to technology and to understand the various forms of media.

The new media present new opportunities and challenges for media literacy, because children manifest themselves as an active audience, having a media competence that enables them to make critical judgments about what they see and create. Thus, children have the opportunity to develop critical media literacy and to participate in media production.

In this way, it is important to promote media literacy in context of formal educational processes as well as in informal context, emphasizing the role of parents as active partners.

¹ *The Office of Communications* (Ofcom) is the independent regulator of telecommunications and competition authority for communications industries in the UK.

2.3. The case of Scratch programming application

In the 80s, through the introduction of personal computers, there was a widespread interest and enthusiasm in engaging children and young people with programming and the basic concepts of logic and mathematics. In this sense, many schools promoted the use of programming languages by children, for example Logo (Papert, 1980) and later Squeak (Maloney et al., 2004) to develop such skills. Meanwhile, in 1993 the MIT Media Lab, in collaboration with The Computer Museum, founded the first Computer Clubhouse (out-of-school learning environment, which promotes creativity and skills development of young people from underserved communities, through the use of technology and with the support of adults). Young people in Computer Clubhouses work on projects based on their interests, but also based on their communities needs.

Nowadays, most people believe that programming is a complex activity that requires a technological specific knowledge and, therefore, is a capability of a highly specialized group of people. However, Papert (1980) argues that programming languages should have a 'low floor', which is translated into an accessible and simple initiation level and a 'high ceiling' that creates opportunities to develop projects, increasingly complex throughout the time. In addition, the author states that programming languages require 'wide walls', to support different types of projects and people with different interests and learning styles. According to the author, the computers transmit innovative and power ideas, assuming a relevant role in the process of cultural change, in which children develop new relationships with the acquired knowledge and describe how computers can improve the way they think and learn.

In this context, appeared the Scratch application (Fig. 2), which is based on programming languages like Logo and Squeak, and it allows, especially children and teenagers, to create and share interactive stories, games, music and web animations, profiting from the participatory spirit of Web 2.0.

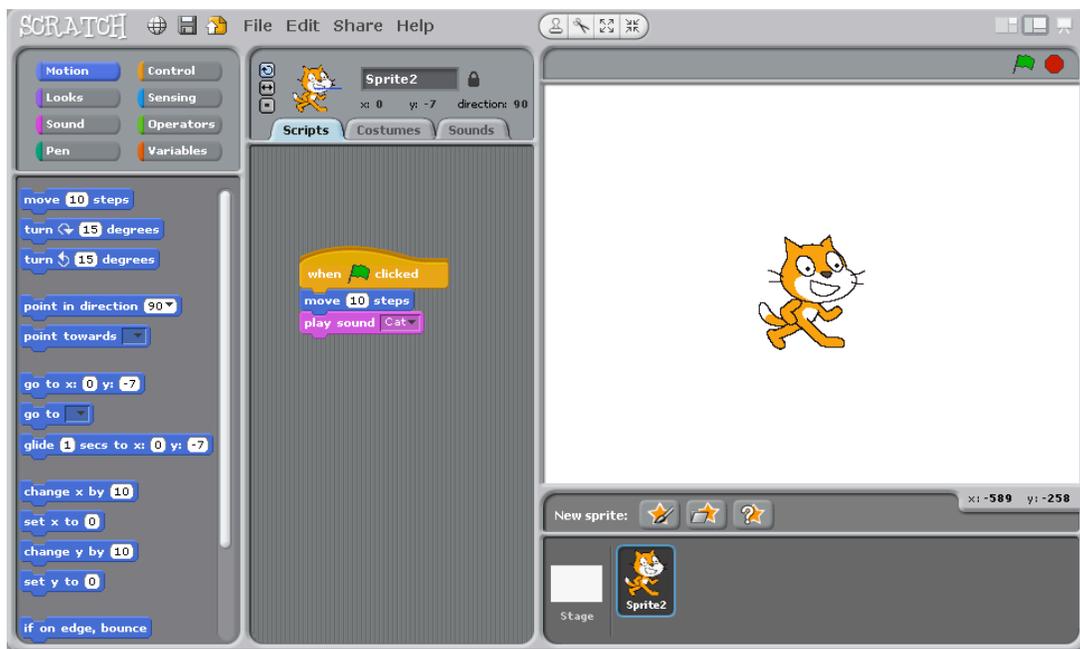


Fig. 2 – Scratch programming environment

The innovation of Scratch is related to the support of new programming paradigms and activities that were not previously possible, providing a better use and intuition in programming, while taking advantage of computers' processing capabilities to expand the different domains in which children create and learn.

In order to achieve these purposes were established design principles, that guided the development of Scratch and the strategies used to make programming an activity more accessible and engaging. These core design principles are essentially three: make Scratch more intuitive, more meaningful and more social compared to other programming environments (Monroy-Hernández et al., 2008).

The MIT Media Lab has been working with the Lego Company, supporting the development of Lego Mindstorms (structures and blocks for technology education). The children's creativity is stimulated from Lego blocks, while they fit them, play and develop projects, and define objectives and strategies that change organically forming structures and stories. Similarly, the Scratch grammar is based on the aggregation of graphic blocks that children fit together to create programs. Into Scratch there is no place for complex syntax or commands from traditional programming languages. Similar to Lego pieces, the blocks connectors suggest how they should be aggregated.

3. Methodological Framework

3.1. Research aims

This research intends to understand how children with 6 years old interact and express themselves using new technologies, specifically when recreate the Scratch tutorials, being supported by the researcher, educators and parents, in order to create new projects that are result of their play.

Therefore, this research aims:

- Promote spontaneous social playing of kindergarten children through the use of Scratch programming;
- Encourage the participation and metacommunication of children in the experiencing;
- Contribute with the outcomes of children experiencing to the Scratch programming improvement;
- Encourage through the development of critical media literacy in children;
- Support the training of kindergarten teachers in order to integrate in the curriculum the use of Scratch;
- Assist the parents' experiencing with Scratch application;
- Promote among parents and educators the discussion on the use of New Technologies and the literacy in 21st century.

Through the final results it is intend, firstly, to contribute for innovation of Scratch programming aiming it towards childhood and, secondly, to promote spontaneous social playing on digital platforms, as well as encourage the active participation of children with suggestions for improving the application and the programming concepts for this age group.

3.2. Action Research Methodology

According to Lewin (1977), the action research methodology is an interactive and spiral research process that focuses a problem. This methodology, as its name suggests, aims to get effects both in the field of action, as in the field of research. It is appropriate for this research because is an in loco procedure (in this particular case in the kindergarten context) in which all participants (including researchers) observe, analyze, ask and readjust certain aspects, providing a continuous and iterative collaborative work.

In order to reveal the inter-mediations carried out by the researcher in the co-participated intervention, Lopes (2003) presents the representative scheme of ludical and social interaction of the researcher co-participation with the developed actions and children children (**¡Error! No se encuentra el origen de la referencia.**Fig. 3²).

² Operating procedure of the interactions and interrelations: 1st circle - Researcher – Mediator: integrates the researcher and kindergarten teachers who mediate children, while they play with Scratch; 2nd circle - Mediatizing:

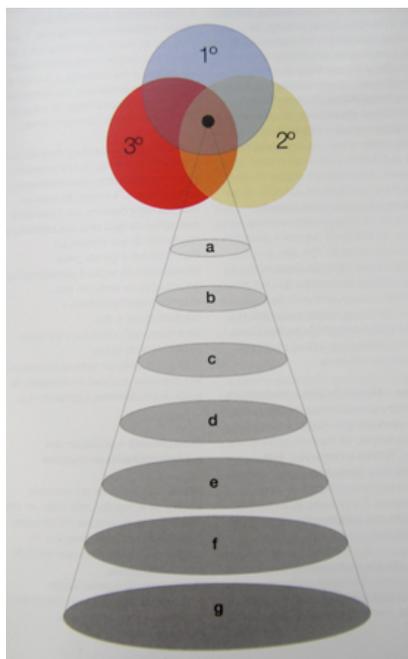


Fig. 3 - System of the inter-mediations carried out by the researcher in the co-participated intervention plan

3.3. Study's sample and its organization

In order to develop the study it was necessary to select an intentional non-probabilistic sample (Ferreira and Carmo, 2008), since the individuals are selected according to criteria determined by the researcher, which are considered relevant for achieving the aims of research work.

Thus, this investigation involves a sample with 62 individuals from Cooperativa A Torre that are organized and distributed as follows:

- 30 children – divided into 2 groups of 15 children (from 5 to 6 years old);
- 30 adults – family members (father or mother of children);
- 2 kindergarten teachers.

3.4. Investigation sequence

The "Childhood with Scratch in motion" project consists of several sequential stages, through which it is intended to promote the spontaneous social playing. The methodology for the promotion of spontaneous social playing consists in improving an iterative way by adults and in developing spontaneous social playing among children. Thus, the iterative process of spontaneous social playing promotion through the Scratch consists of eight development stages :

Stage zero – Defining the basis for inter-institutional cooperation

refers to the communicational, ludical and creative action through the Scratch programming application; 3rd circle - Mediatized: identifies the situations experienced by the project target group. The a, b, c, d, e, f, g, h areas correspond to the promotion stages of spontaneous social playing with Scratch and to the construction stages of co-participated learning and change (co-participatory octagon).

At this stage the partnerships were established, there was the definition of protocols for intervention, training and research, it was determined the calendar, the intervention and evaluation methodologies, and the inter-institutional cooperation modalities in the project.

Stage one – Approach to Scratch and familiarization with participants

1st phase – In the first phase is initiated and established the inter-personal communication with participants. More specifically in relation to intervention with children, this is the moment when stories of Pópio and Pópia characters are told. These characters are the young guardians of “Scratch in motion”, which guide children in the tutorial narrative and help them in the Scratch programming. Finally, in this phase are carried out training sessions about Scratch for educators.

2nd phase – There is the approach to Scratch programming with the introduction to the main application functions and the presentation of its menu bar.

Stage two – Circumscribe (using the “Apresentação do Pópio e Pópia” – “Introducing Pópio and Pópia” tutorials)

1st phase – In this phase are used the “Introducing Pópio and Pópia” tutorials to present and explain the key concepts related to Scratch.

2nd phase – It is made the importation of Pópio and Pópia characters and friends. Children also practiced the zooming function of images.

3rd phase – There is the consolidation of learned concepts and it is introduced other concepts and blocks, such as, to play a sound and change a frame of a character.

Stage three – Friendship (using “Um dia na Quinta”– “A day on the Farm” tutorial)

1st phase – In the first phase is presented and explained the stories animation of the Pópio and Pópia guardians with friends on the farm.

2nd phase – After the introductory phase of the stories is used more complex concepts related to Scratch programming: the block ‘wait some seconds’ and ‘go to x and y position’.

Stage four – Autonomy

1st phase – After the Scratch programming concepts being presented, explained and experienced, children recreate “Introducing Pópio and Pópia” and “A day on the Farm” tutorials.

Stage five – Sharing

1st phase – After the autonomous recreation of tutorials, children create new projects with educators in Scratch and share them.

Stage six – Spontaneous social playing

1st phase – At this phase, children dominate the Scratch programming skills, show an independence from the investigator and have the opportunity to play in Scratch without the intervention of adults.

Stage seven – Divuligation

1st phase – The Scratch projects made by children are printed and exhibited. It is organized a public session of presentation and explanation (given by children and educators) to parents, families and school community.

4. Results of the intervention with children at the kindergarten of Cooperativa A Torre

THE study accomplished at the kindergarten of Cooperativa A Torre in Lisbon, with children, parents and educators, aims to understand how children interact and express themselves using new technologies. Thus, through the acquired knowledge during the experiencing with Scratch programming, it was intended to propose new methodologies in order to teach media literacy, to maintain the creative, ludic and critical flow, and finally, to practice metacommunication among preschool children.

In this way, during May and June 2010, parents, children and kindergarten teachers were motivated to play and create with Scratch. In three sessions per week, children with 5 and 6 years old used the imagination to express themselves with the use of Scratch application available at kids.sapo.pt.

Children were supported by the researcher and the kindergarten teacher, being the Scratch accepted as a support of the educational process. Thus, children were challenged to use the program as a tool to build projects, whose contents were motivated by the stories of the "Scratch in motion" guardians (Pópio and Pópia) and the poetry of Portuguese and Brazilian authors. Children played, created and developed skills that were acquired during the interventions: they programmed and animated in Scratch the stories of the poems (Fig. 5 and Fig. 6) which learned with the kindergarten teacher.

On 30th June there was an opportunity to present these Scratch projects made by children to parents, educators and school community through an exhibition.

On this day, it was also possible to make a session in which children shared with their parents what they have learned during these two months of "Childhood with Scratch in motion", teaching them the basic concepts of the Scratch programming. In addition, were presented to parents the main functionalities of Scratch and how to download the application at kids.sapo.pt.



Fig. 5 – Scratch representation of the poem “Comboio Descendente” by Fernando Pessoa

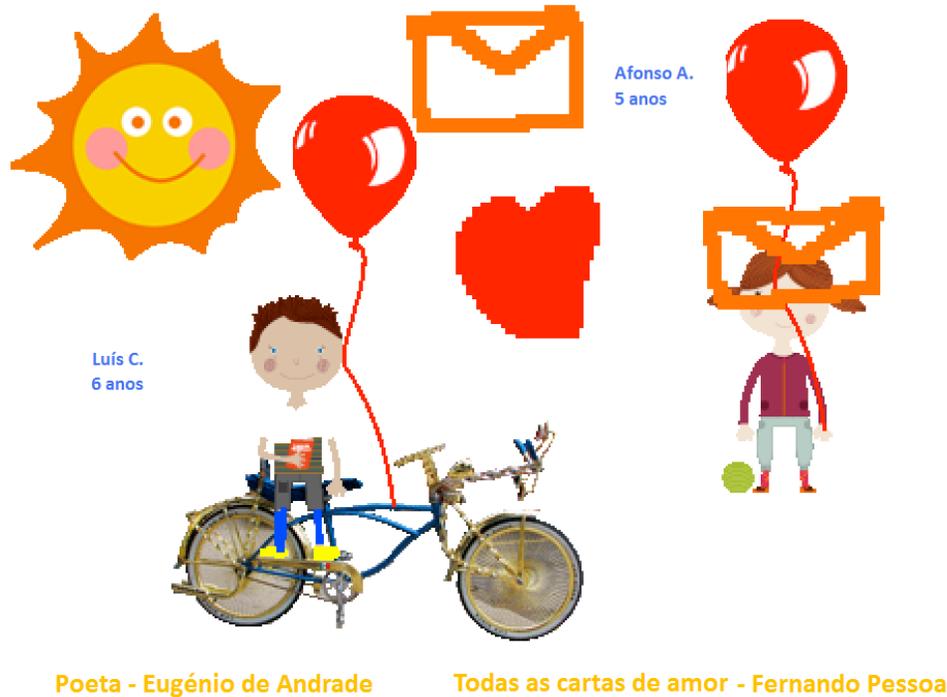


Fig. 6 – Scratch representation of the poems “Poeta” by Eugénio de Andrade and “Todas as cartas de amor” by Fernando Pessoa

5. Final Notes

ANALYZING the results obtained until now, it is believed that the Scratch, as a computer application, is an important toy to early childhood education that allows many games and creations among children and involves several effects like the social learning of 21st century literacy: read-write-count-programming-play-create, enabling the connection between ludicity-work-study-creativity.

In addition, the contents included in the tutorials “Introducing Pópio and Pópia”, and “A day on the Farm”, created in 2009, contain in its narratives human values that can be understood and learned by children through games and creations with Scratch, such as: fraternity, friendship, mutual help, responsibility, autonomy, cultural, social and academic inclusion, active participation in preservation of nature and other civic values of the humankind. All these aspects promote conversations and create complicity among children and among children with their families and kindergarten teachers.

In this context, the spontaneous social play is enhanced, because it is the co-production process of inter-beings sociability learning, giving to child the opportunity to affirm its autonomy in the daily life.

Therefore, this research contributes to the discussion about new media, in the logic of its effects. New media are enriching children’s experiences and inter-generational sociability, and are activators of new communication, ludicity and creativity strategies that are supported by digital platforms.

References

- Buckingham, D. (2003). *Media education: Literacy, learning and contemporary culture*. Cambridge: Polity.
- Carmo, H. e Ferreira, M. (2008). *Metodologia da investigação – Guia para auto-aprendizagem*. 2ª Edição, Universidade Aberta. Lisboa.
- European Commission (2007). Communication from the commission to the european parliament, the council, the european economic and social committee and the committee of the regions, a european approach to media literacy in the digital environment. Brussels.
- Crawford, C. (2005). *Chris Crawford on interactive storytelling*. Indianapolis, Ind.: New Riders.
- Cronen, V. (1995). Coordinating management of meaning: The consequentiality of communication and the recapturing of experience. In *The consequentiality of communication*, Edited by Stuart J. Sigman. Lawrence E. Association.
- De Masi, D. (2003). *Grupos criativos*. Rio de Janeiro: Sextante.
- Guilford, J. P. (1967). *The nature of human intelligence*. New York: McGraw-Hill.
- Holdaway, D. (1979). *The foundations of literacy*. Sydney: Ashton Scholastic.
- Lemish, D (2008). The mediated playground: Media in early childhood. In K. Drotner and S. Livingstone (eds). *The international handbook of children, media and culture*. Sage, Los Angeles. pp. 152–167.
- Lewin, K. (1946). Action research and minority problems. *Journal of social issues*, 2, 34-46.
- Lopes, C. (1998). *Comunicação e Ludicidade*. Tese de Doutoramento em CTC. Universidade de Aveiro.
- Lopes, C. (2003). *Ludicidade*. Edição Universidade de Aveiro e Civitas Aveiro.
- Lopes, C. (2008). Ludicity: A theoretical horizon for understanding the concepts of game, game-playing and play, in Thomas Conolly and Mark Stansfield (eds). University of West of Scotland, Paisley, U.K; published by Academic Publishing International, pp, 275-283.
- Lopes, C. e Teixeira, L. (2005). GT – Comunicação e Ludicidade. Livro de Actas – 4º SOPCOM.
- Maloney, J., Burd, L., Kafai, Y., Rusk, N., Silverman, B., and Resnick, M. (2004). Scratch: A sneak preview. Paper presented at the Second International Conference on Creating, Connecting, and Collaborating through Computing, Kyoto, Japan.
- McLuhan, M. (1964). *Understanding media*. New York: Mentor.
- McLuhan, M. and Fiore, Q. (1967). *The medium is the massage: An inventory of effects*. New York: Bantam Books.
- Monroy-Hernández, A. and Resnick, M. (2008). Empowering kids to create and share programmable media. *Interactions magazine (ACM)*, 15, 2, pp. 50–53.
- Ofcom (2004). *The communications market 2004*. London: Ofcom.
- Oliveira, I. e Lopes, C. (2005). Design de Criatividade: uma abordagem sistémica na análise compreensiva da promoção e desenvolvimento da criatividade no quadro da experiência criativa e da pragmática de aprendizagens e de mudanças contributo teórico da Escola de Pensamento de Palo Alto. Livro de Actas – 4º SOPCOM.
- Oliveira, I. (2009). Tese de Doutoramento. *Criatividade e mudança: promoção da capacidade, competência e atitude criativa*. Universidade de Aveiro.
- Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. Basic Books, New York.
- Prensky, M. (2005). Computer Games and Learning: Digital Game-Based Learning. In Raessens, J. & Goldstein, J. (Eds), *Handbook of computer games studies*, Cambridge: MIT Press.
- Resnick, M., Maloney, J., Monroy-Hernández, A., Rusk, N., Eastmond, E., Brennan, K., Millner, A., Rosenbaum, E., Silver, J., Silverman, B., and Kafai, Y. (2009). Scratch: programming for all. *Commun. ACM* 52, 11, pp. 60-67.
- Sigman, S.J. (1995). *The consequentiality of communication*. Edition Lawrence E. Association. USA.
- Thorn, W (2008). Preschool children and the media. *Communication research trends*. Vol. 27, No. 2: 3–28.

- United Nations Educational, Scientific and Cultural Organization (2004). The plurality of literacy and its implications for policies and programmes. UNESCO Education Sector, Position Paper. Paris.
- Watzlawick, P. (1992). *A realidade é real?*. Lisboa, Relógio d'água.
- Wittgenstein, L. (1987). *Tratado lógico-filosófico*. Lisboa, Ed. FCG.