Teacher Interpretation in Programming Software Training for Classroom Application

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***Abstract*— The article describes a PhD research under the glocal socio-educational context focusing on process tracing in a case study. Considering the new digital culture, there is a need for new learning, creative and ethical practices. Therefore, educators' training needs to be revisited. According to the antiessentialist approach of technology, the teacher is asked to interpret the programming software and use it in class as an instrument in addition to digital literacy. This research started with Scratch training, class observation and interviews and search for the causal mechanism. The goal was to search for indications of reader-user-teacher interpretation. This paper presents results in order to expand and contribute to the reflections on insubordinate training in TDIC for teacher.**

Keywords*— *Software programming in education. Antiessentialism of technologies. Process tracing. Continuing education in TDIC.

I. INTRODUCTION

At the heart of this ongoing research is the glocal - global and local socio-educational context, considering digital information and communication technologies (TDICs) as global instruments with particularities and local and personal interpretations. Technologies that bring in themselves new daily needs, relationships and interrelations in socio-cultural-economic situations. And *it is the very intensive use of tools that constitutes humanity* (1, p.21).

However, TDIC, while resizing space, time and availability of information, updating, interaction and connectivity, also excludes, by identifying disparities in their use among urban and rural, young and old, low and high income, educated and not trained (2); (3). This shows that simple provision is not enough.

New digital culture presents itself and determines the need for new learning and new pedagogical practices. Thus, there is a need for invention, creativity, new forms of work, new methodologies and consequently new ways of thinking about human development and society.

In the case of formal education in Brazil, the speed of TDIC, which nowadays presents the development of Internet of Things (IoT), is not achieved in schools. Students and teachers immersed in technologies make a simple primary use of them, not showing great skills or competences (2); (4); (5). Therefore, it is necessary to diversify the look at TDIC in education and even more at educators' training. Training with realistic goals, which brings reflections on praxis and especially understand educator's point of view considering a generation that presents different operational skills. This confirms that it is not enough to insert TDIC in schools and demonstrate how it works. D'Ambrosio and Lopes (2015) wish:

> *a posture of flexible educator before criticism and apprentice before the rethinking. We defend the formation of a professional participant, active, critical and responsible, willing to collaborate with their peers and collectively seek solutions for educational problems that emerge in their pedagogical spaces* (6).

Work with programming languages in basic education has been presented as a strategy for the development of digital literacy beyond simple consumption, but in the search of the capacity to deal with differentiated situations, acting, solving and transforming them (7). In addition this work aims to rethink social needs and problems, their improvements and solutions through programming.

This research is based on personal experience working with educators' training. This experience showed that the presented goals were unknown. The goal is to study teachers' interpretation in programming software training and how they apply it in their classroom. Then it will be possible to analyze TDIC contributions to the teaching process. We believe that teachers' interpretation during training leads them to create their own methodological techniques for teaching-learning through TDIC.

This paper expands research carried out in other events and focuses on the methodological procedures and process tracing technique of the case study.

A. Looking for similarities in Brazilian searches

In order to obtain a mapping about Brazilian researches that have appropriated the antiessentialist approach of the technology proposed in this work, under the methodological process tracing strategy, a search was made in several theses banks and national dissertations – CAPES[1], IBICT[2] e USP[3].

The search for the term anti-essentialism of technology has not brought any correspondence. Already on the methodological strategy process tracing was observed to

[1] CAPES - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior.
[2] IBICT – Instituto Brasileiro de Informação em Ciências e Tecnologia.
[3] USP – Universidade de São Paulo.

be commonly used in the political and social sciences, not in education.

Finally, the antiessentialist approach of technology under the methodological strategy tracing process in mathematical education, was presented in the thesis of Abigail Fregni Lins. The work of Lins (8), defended by the Brazilian educator at the University of Bristol in the United Kingdom, unprecedentedly observes the reading and the use by teachers / readers of software / textbooks Cabri Geométrico and Excel for the teaching of mathematics . Its purpose was to elucidate that Cabri and Excel were being built by mathematics teachers and to what extent they would be linked to the way teachers used and taught with them. The author argues in her research that the use of software for teaching mathematics is not only related to the curriculum but is also strongly linked to what the teacher sees in this software.

Thus, at this paper section 1 presents the glocal context and relevance of the research and a brief review of the literature; section 2 its theoretical basis; section 3 presents the methodology that has been developed; section 4 presents the first results and the study cases. Finally, section 5 describes some considerations.

II. Theoretical Basis

This research is based on the anti-essentialist approach of technology, teacher training of a generation immersed in TDIC in order to be creative, collaborative and ethical; and programming in education as an instrument for problem solving.

A. Anti-essentialist approach

The study of teacher interpretation in programming software training is based on the anti-essentialist approach of technology presented by Grint and Woolgar (1997). These authors describe technology as text, designers as their writers and users as their readers, and by broadening the roles of the latter, consider attitudes to technology, conceptions of what it can and cannot do, perspectives of technological change and their representations in the media and organizations (8); (9).

For Grint and Woolgar (1997) in the anti-essentialist approach, objective reality and social construction are inseparable, in this perspective how the TDIC enter the school and how teachers work with it?

B. Criative insubordinate teacher

For some time researchers and managers understood that it was essential to train teachers in TDIC, as seen by the huge and dynamic network of subjects and specialties in this area presented in various events focused on the quality of education. We must educate the new generation of learners to be better prepared than ours, to be creative, collaborative and to use their talents to solve problems based on ethical values and solidarity. D'Ambrosio and Lopes (2015) question *how are we preparing these teachers for such creativity, courage, confidence and desire to act?* (6).

The relationship between teacher training and digital tools does not, or should not, be in their domain. Technical knowledge and pedagogical knowledge must go hand in hand (10).

The preparation for the development of the teacher's skills should give him a voice and allow reflection on the teaching and learning myths for the benefit of the student. Challenging such myths is what D'Ambrosio and Lopes (2016) conceptualize as *creative insubordination* (6).

Moreover, today digital literacy alone is not enough. It is necessary to be proficient. It is necessary to develop computer thinking with skills to analyze problems, organize and represent data in a logical way, automate solutions, use abstractions and models, communicate processes and results, recognize standards, generalize and transfer. These skills can be acquired through programming (11); (12).

1) The generation immersed in TDIC

Veen and Vrankking (2009) declare that for the generation who is born and lives in this society with rich, informative, various opinions and fast resources, which they call Homo zappiens, school is a part of their life, but not the main part. Thus, new assumptions emerge about the role of the school and its teacher for this generation, which is facing contrast between their life inside and outside the classroom where there is connectivity, media, action, immersion and network (13).

In this context, knowing how, knowing why and knowing where overcomes knowing what. The question is, how does the teacher fit into this situation?

C. Programming software in education

About 40 years ago Seymour Papert had already suggested that a child could learn to program a computer, because

> *educational computing [...] does not refer to one product after another. Its essence is the growth of a culture, and it can be influenced constructively only when we understand and promote current trends in this culture* (14, p.142).

In Brazil, Valente (1993) already pointed out that working with programming in education is based on the principle of a tool for problem-based learning. Solving problems through computational languages provides a logical-mathematical and formal construction, which when executed allows verification, analysis, identification and debugging of concepts and developed ideas, as well as of errors. In addition it helps with the concepts of abstraction, recursion, interaction, permanent and persevering attention (7); (11); (15).

In this study, the solution of the problem developed represented by the programming software Scratch [4] as a software option, is its own construction, carried out

[4] Scratch - graphical programming language available on: http://scratch.mit.edu

individually or collectively, that transforms users-readers into designers, that is, writers of the text.

III. Methodology, Resourses and Techniques

This empirical research in a qualitative approach, under the strategy of Case Study and using the technique of Process Tracing, seeks to elucidate the interpretation made by teachers in Scratch programming initial training and presented by them to their students in the school computer laboratory (LIE).

This case study technique seeks to approach how, according to Beach and Pedersen (2013), *involves the construction of a theory about a causal mechanism, which can be generalized to the population of a given phenomenon, from a situation in which we are in the dark about such a mechanism* (16).

Through the application of questionnaires and comments in virtual meetings (Traz pra Roda - TpR) during initial training, of observations in the classroom, of the records of class scripts and interviews with professors and trainers, we seek to raise indicators and factors that articulate the direction of teacher *interpreting*.

According to Beach (2017) the study of the causal mechanism transfers the analysis of the causes and results for the causal process highlighting why things happened or could be different so:

> *it enables us to understand how parts of the system conspire to produce the result; therefore, it is important to make explicit the causal logic where the activities of one part of the mechanism bind it to the next part in the search for the global mechanism* (17).

This research takes place in three methodological stages of work: the initial training, the search for the manifestations and the causal mechanism survey.

A. Initial training

Initial training on Scratch took place in the second half of 2014. It involved about 100 teachers of the municipal teaching network of São Paulo. It consisted of 16 hours of face-to-face training, 5 hours on line synchronous discussions (Traz pra Roda), online support and the availability of small tutorial videos.

Face-to-face training began with a brief contextual reflection on theme *The city that we want* and the teachers in groups were asked to present solutions to solve problems they identified by programming games, animations or stories. After the face-to-face meetings, back to school they presented Scratch to a group of students and at the end of the semester published their students' projects (Figure 1).

Figure 1: Face-to-face training

At this stage, questionnaires were applied - initial and final, followed by the comments in the virtual meetings, in order to obtain the profile of these teachers.

Interview with the trainers (called hereafter Luz and Som) contributed to the understanding of the Scratch text presented to these teacher.

Working with applied training, application and collective reflection contributed to rethinking of praxis and discovery of paths.

B. The Search for Manifestations

In the second phase, a research with two computer teachers (POIE) and their students was carried out in 2015. Students were carefully selected for the study, using the instruments of observation in class, records of lesson plans and interviews in the schools' computer lab.

This step, added to the first, led to the triangulation of the data in order to investigate Scratch's clues for teachers and Scratch for teachers in their classrooms.

C. Causal Mechanism Survey

The third stage is the application of a survey of the causal mechanism. It consists of the study of the process. For Beach (2017) we cannot have evidence of a process, without actually knowing which process is studied. For this, one must evaluate the evidence left by real and observable activities, seeking to detail the logic that connects each part (17) (Table1).

Table 1: A guiding framework for the hypothesis of the causal mechanism

Continuing training - cause		Evidence (E1)	Evidence (Ex)	Evidence (En)	CASE	Class application - result
	Activities	Raise problem situations	Develop own project	Create content and material for training	Reapply software with students	
		Apply concepts	Respond to questionnaires	Apply content in small doses	Guide in the difficulties with the software	
		Reflect and apply in your project	Apply training to a group of students	Assist the executions of the participant	Respond to students' questions about the software	
		Study support material	Interact with participant and trainers at distance	Accompany distance participant	Trace software on interview	
		-	Expose student projects	-	-	
	Entity	Course	Course participant	Trainer	Teacher	

1 year

The evidence foreseen for the process, considered and established from the proposals of the cause - training and activities of the entities - course, participant and trainer are classified - account, pattern, trace, sequence, mechanics or silentio and then tested and evaluated (Table 2).

Table 2: Classification of the type of evidence for each entity of the causal mechanism

Entity	Expected Evidence		Type / Ratio	
Course Entity (structure)	**E1**	Interactive Information	Trace	Part of the mechanism
	E2	Action-Reflection	Sequential and Account	Chronology and Empirical Materials
	E3	Contextualization	Trace	Part of the mechanism
Cursista Entity (actor)	**E4**	Action-reflection	Sequential and account	Chronology and empirical materials
	E5	Interaction-reflection	Sequential and account	Chronology and empirical materials
	E6	Digital Fluency	Standard	Statistical and empirical materials
	E7	Professional experience	Standard	Statistical and empirical materials
Trainer Entity (actor)	**E8**	Support material-staff	Mechanical	Records
	E9	content pills	Mechanical	Records
	E10	Procreation	Silentio	Absence

From all collected empirical material, theoretical basis and previous knowledge, it is evaluated the existence of plausible explanations to find specific evidences in the cases in study and, thus, to explain the reading and interpretation f Scratch carried out by the teacher in continuous formation.

It is concerned with the occurrences in the empirical register of real activities and, through the evidences and the realization of inferences, it is sought to develop a model on the process instituted by the causal mechanism.

IV. Results and Reflections

A. The course

The face-to-face meetings brought elements about the evidence E1 (interactive information), E2 (reflection-action) and E3 (contextualization).

During the training, we sought to know the target population. The initial questionnaire of the trainees' profile was applied through online instruments, followed by the postings in Traz to Roda and the evaluation questionnaire at the end of the training, which contributed to the evidence E4 (action-reflection) , E5 (interaction-reflection), E6 (digital fluency) and E7 (professional experience).

> *The course opened up a new horizon of possibilities. I was very pleased to meet Scratch and the dynamics of the encounters were very favorable to really appropriate this tool. [...] It would be great to have other courses with similar format: using some days of the July recess, with time to practice with our laptops and the supervision of the speakers. It was also excellent to know the experience of other teachers with the same tool* (Prof. M.P., initial questionnaire).

B. The course participant

The initial stage started analyzing results of the survey applied to the 100 trained teachers. Around 53% of the teachers have taught for more than ten years, demonstrating great professional experience. 82% do not work as computer teachers (POIEs), that is, they work directly with the TDICs with the students, which indicates a certain digital fluency, but half of them have been working for less than five years.

The computer teachers (POIEs) stated that they use text, image and presentation editors, games and the Internet with their students more than twice a month, considering that students have a weekly class in the school computer lab. Nevertheless, they declared they use sound editors, Web page editors, spreadsheets and software programming once a month.

However, the great majority never did, which confirms studies that show that teachers use with the students the same programs they use at home. It makes them feel secure. However, by working Scratch with their students, even if they felt insecure, they learned from them, searching for information on websites and forums.

> *The main contribution is the possibility of creation, I realized how difficult my students presented when placed in situations not pre-defined, the authorship is a great challenge, because they live in a culture of following what was requested, consuming the produced by others.* (Prof. F.G.)

It should be noted that they stated that programming software could be used in all knowledge areas. And by working Scratch with their students, even if they felt insecure, they learned from them searching for information on websites and forums. Some of their answers were: *I had doubts and they explaining to me* (DS, TpR) or *I'm studying at home to know about Scratch* (E.L, TpR). In addition to visualizing *they understood that the movements emerge from commands given by them* (P.A, TpR) or *visualize a completely different classroom, the students propose to help other students. It is also so with each discovery, what one discovers is immediately shared with the others* (P.A, TpR).

The different readings of the interactions in the Traz to Roda and the results of the questionnaires contributed to verify the strength of the evidence E2 (reflection-action), E3 (Contextualization), E4 (reflection-action), E5 (digital fluency) and E7 (professional experience).

That is, the teacher was not the center of the teaching process and there are other movements in the classroom. Did the teachers change their mind on software programing?

C. The trainer

Through an interview conducted after the training with Som Trainer and Luz Trainer seeks to clarify their reading about the software, which they hoped to share the content with the teachers and how they did it. It is contribute to the inference of how the course participant received the information about the Scratch to carry out its own reading.

The trainer Luz explains *that it's no use putting on a thing with a lot of steps, which no one will remember how to do it ... So do little things, like "how to change a character's clothes" and give them an exercise, a moment* (Luz Trainer), complemented by the Som Trainer:

> *in general people are intimidated when you say that you are going to give a programming course [...] only that when you start working with this, I do not remember having experience of someone who remains intimidated for a long time. It is very accessible, people begin to explore, even those who have never had contact and are soon familiar, developing their own programs, modifying a little what the teacher shows, [...] the syntax is much less important than the concepts involved* (Som Trainer).

For both, it was the greater goal to appropriate this content and to understand how language sets and constructs could be applied to solve other problems, other challenges (Luz and Som Trainers).

> *Security to do a different thing using the same things they learned, but without fear, because I saw what they were afraid to do. And if I did something different, I realized that some were afraid of getting lost and could not get back what was before.* (Luz Trainer)

> *He hoped for procreation, because our ultimate goal was to appropriate this content, to understand how those sets and constructs of the programming language could be applied to solve other problems, other challenges.* (Som Trainer)

The various readings of transcripts of the interviews and reflections brought elements for evidence E1 (interactive information), E8 (material-personal support), E9 (content pills) and E10 (Procreation).

D. The Cases Under Study

Two cases were studied, POIE Sol and POIE Mar, two computer teachers without any experience using programming software. Moreover, after the initial training in Scratch and simultaneous application with the students, they continued to use it the following year in their school computer lab.

With the evaluation of the predicted evidence, the presence of specific evidence is verified in the empirical records of the selected cases.

1) The Scratch *of the POIE Sol*

Who is POIE Sol? He is a teacher that graduated in literature, with more than 20 years classroom experience, working more than 5 years as a computer teacher. His knowledge in TDIC for education was gained in continuous education. When he faces some difficulty, he tries to solve it alone or in the network. He initially believes that work with software programming is geared toward mathematics. However, after first using Scratch with students, he pointed out that the projects presented socio-cultural relevance, interdisciplinary connections and contextualization, and were beyond what is expected for the age group he was working with.

For him *in Scratch you are entertained, want to think, create some solution [...] in the course was very difficult, I could not do [...] you have to explore, go beyond what you are going through*.

In addition, working with Scratch in the classroom is a long-term job, *it develops the student for new challenges*. He has help in his computer lab. Monitor students support his during classes. These monitors were oriented to push the students further - *no more movement? A twist? A return movement? A second character? A sound?* While saying *first the students go step-by-step, I can not have them do it all*, referring to a more elaborate project. Finally state *what I learned I passed.*

The POIE Sol develops activities, with student monitors and fellow teachers, which are published on the blog and in the social network of the school, where one can perceive the influence of the E1 (doubly decisive interactive) evidence. It uses technologies with a greater degree of complexity, demonstrates some context for the development of the work in the LIE, with the use of Scratch or others demonstrating the incidence of E3 evidence (contextualization). It points to hoop E2 (reflection-action) and E4 (action-reflection), when it presents clarity about the purposes of Scratch as programming software and wishes for its students. In its activities indicates need for learning steps, which points to evidence hoop E9 (pill capsules). By working closely with monitors, it demonstrates evidence E8 (material-personal support) smoking gun. There is interaction, but no reflection is perceived.

2) The Scratch of the POIE Mar

Who is POIE Mar? A history teacher with specialization. Her experience in the classroom, as well as a computer teacher is less than 5 years. She is self-taught and in the face of difficulties tries to solve problems by herself, in the network or with family. She believes that the work with programming software is aimed at language, however, after first uses of Scratch with students she pointed out that the projects developed presented socio-cultural relevance and interdisciplinary connections and contextualization and states:

> *specifically on the curricular contents, I believe that the development of interpretation has been quite significant. Students think a lot about commands and when the character does not do what they expected, they need to reinterpret the command and its sequence.*

She did not know that Scratch existed, *it's nice to use in a situation where you have a purpose, a goal; it has to be well focused, it has to be organized, not always the command gives what we think it will give [...] so it is good and difficult.*

Scratch in the classroom *is for a longer project, it can link you to other themes; you can use it for another function like working robotics*. She always guides using examples and indications and, in case of doubts or questions, she contributes with questions - *do you want to always have interaction? How about the dialogue blocks? Where is the starting position of the actors?* When asked about remixing in Scratch, she declares *if you teach me I teach them.*

The POIE Mar is a teacher with little professional experience in education and in LIE, he learns by his own effort and by the support of distance. It often uses low complexity technological artifacts and works with them. However, it used video editor after continuing education. Note their concern to contextualize their classes and link them to the Cultural Show of the school or to the content of other disciplines, which points to very strong evidence E3 (contextualization) doubly decisive. It is observed the reflection-action-reflection of POIE Mar on the software itself and on its needs to use it in the LIE. Again, it points to contextualization (E3), when it highlights the difficulty of working freely, without clear objectives, and increases the importance of interaction among students. We can see here the very strong doubly decisive evidence E2 (reflection-action) and E5 (interaction-reflection), as well as the hoop E4 (action-reflection). It uses the strategy of small sequential introductions for any of the software used, which may be related to strong evidence hoop E9 (pills content).

First evidences show that the experience in school and the application of TDIC are the same. They do not interfere in the application or the perception. The preconception of the software is indifferent in the presented result. Both define Scratch as a long-lasting tool, applicable to any area with clear objectives. Teaching stages and resources are evident during the work, while the way to guide and present solutions are different.

The cases present specific evidence and one new evidence. Both POIEs present the evidence of action-reflection, contextualization, action-reflection, and content-sharing, called E11. Only the POIE Sol presents the evidence interactive information and material-personal support and only the POIE Mar, the interaction-reflection evidence (Table 3).

Table 3: Summary of specific evidence verified in each case

E / POIE	E1	E2	E3	E4	E5	E8	E9	E11
Mar		x	x	x	x		x	x
Sol	x	x	x	x		x	x	x

Note the absence of the predicted evidence E10 (procreation) objectified by the trainers. It is observed that the teachers arrived until the moment the classroom training arrived; ignored the material available and the search idea in the Scratch community, which demonstrates the need for a longer application period for introspection of the software, which occurred with some students who said they had previous programming experiences.

E. Generalizable mechanism

According to the methodological technique, is presented proposal the generalizable model, here denominated Insubordinate Formation of Teachers in TDIC (FoIP-TDIC).

The FoIp-TDIC is a model of teacher training organization for the use of TDIC in basic education, in order to broaden the existing ways of thinking about it. It seeks to cover the ideas of the trainers, coming from the foreseen evidences, the speech and the reading of the course participants, coming from the specific evidences, to reach a greater purpose.

It is based on the following assumptions:

• That TDICs are culturally dependent (14).

• In the use of TDIC, the teacher can stimulate creativity, citizen awareness, research and collaboration in solving real and relevant problem situations (6); (19).

• The constant critical elaboration of reflections on his daily life, past and present, regardless (19).

• The search for becoming and making the other digital fluent, that is, authors of their texts (8); (18).

Through the analysis of the strength of the foreseen evidence and the specific evidences of the cases studied, FoIP-TDIC indicates the level of relevance, the necessary and / or essential evidences for the organization and the development of the initial or continued formation of the teachers , regardless of their professional experience or digital fluency. And so, it presents three important circumstances, focused on the model of face-to-face or semi-presence training.

Firstly, the moment of formation of teachers as informative, interactive and contextualized is highlighted, given the great force of such evidence in the causal mechanism. And, therefore, it is essential to reinforce the first two - informative and interactive - because they appear partially in the teacher's reading.

In the second characteristic, it is recalled that the teacher is cautiously and critically stimulated from the perspective of the strong reflection-action and action-reflection evidences of his everyday praxis with the use of TDICs, through small doses of content and sharing among peers and other information bearers, because their immersion in the structure and in the organization of the

classroom does not allow this elaboration of individual form in the moment of the work with the students. Dispensing time for this preparation during training seems necessary.

And, in the third and last one, due to the results of the research, it is essential and urgent the development of training that stimulates procreation, in order to provoke self-learning, the search for relevant information, creation and recreation, research, collaboration and ethical courage. So that, before and with the students, they become both digital fluent, that is, authors of technological texts - and not just readers - for the construction of Education 4.0 and a society of solidarity. The stimulus to procreation is in itself an insubordinate act.

V. CONSIDERATIONS

Being fluent digital today implies being the author and not only reader of the technologies offered, for the sake of a greater good within the schools, the current trivium curriculum.

The research aims, within the antiessentialist approach of technologies, to present evidence of the interpretation carried out by the programming software teacher as an artifact to solve problems, in this case, socio-cultural. For from this interpretation, they found methodological techniques for using it in the classroom.

One sees in computer programming work a means of developing the skills described for the twenty-first century in order to turn current readers into potential authors.

The methodological technique of the process tracing used transfers the analysis of the causes and the results to the causal process, which suggests methodological reflection in the education. It is based on the possibility that the understanding of the mechanism of causal logic and its generalization will become the basis for the production of subsidies for teachers' managers and trainers for the use of technology in education.

Procreation, interactive information and interaction-reflection, for example, are evidences that the study identified as necessary and indispensable to be worked on in a more intensified way.

The hypothesized mechanism presented is not unique, considering the cultural factor, and, consequently, the FoIP-TDIC model is variable. Limited, but interesting, to respect every existing mechanism.

Finally, it is believed to contribute to the real integration of the school into an effective and active digital culture that respects the rhythm and the individual interpretation of its users-readers and future authors of technologies.

REFERENCES

[1] LÉVY, P. *Cibercultura*. São Paulo: Editora 34, 1999.

[2] CGI.br. *Pesquisa sobre o uso das tecnologias da informação e comunicação nas escolas brasileiras* [livro eletrônico] TIC educação 2014 = Survey on the use of information and communication technologies in brazilians schools : ICT education 2014. São Paulo : Comitê Gestor da Internet no Brasil, 2015. Disponível em http://cetic.br/media/docs/publicacoes/2/TIC_Educacao_2014_livro_eletronico.pdf . Acessado em jan/2016.

[3] CHEN, W; WELLMAN, B. *The global digital divide – within and between contries*. University of Toronto IT&SOCIETY, VOLUME 1, ISSUE 7, SPRING/SUMMER 2004, PP. 39-45. http://www.ITandSociety.org .

[4] PASSARELLI, B.; JUNQUEIRA, A. H.; ANGELUCI, A. C. B. Os nativos digitais no Brasil e seus comportamentos diante das telas. *MATRIZes* V. 8 - Nº 1 jan./jun. 2014 São Paulo - Brasil p. 159-178. Disponível http://www.matrizes.usp.br/index.php/matrizes/article/viewFile/404/pdf. Acesso em março/2016

[5] LOPES, R. D.; FICHEMAN, I. K.; MARTINAZZO, A. A. G.; CORREA, A. G. D.; VENANCIO, V.; YIN, H. T.; BIAZON, L. C. O uso dos computadores e da internet em escolas públicas de capitais brasileiras. *ESTUDOS & PESQUISAS EDUCACIONAIS. Fundação Vitor Civita*. Estudos e Pesquisas Educacionais nº1. São Paulo, maio, 2010. Disponível em http://www.fvc.org.br/pdf/artigo-computadores-internet.pdf. Acesso em jan/2016.

[6] D'AMBROSIO, B.S.; LOPES, C.E. Insubordinação Criativa: um convite à reinvenção do educador matemático. *Bolema*, Rio Claro (SP), v. 29, n. 51, p. 1-17, abr. 2015. ISSN 1980-4415

[7] SHIMOHARA, C.; SOBREIRA, E.S.R.; ITO, O. Potencializando a programação de jogos digitais de matemática através do Scratch e da avaliação Game Flow. *V Congresso Brasileiro de Informática na Educação* (CBIE 2016) Anais do XXII Workshop de Informática na Escola (WIE 2016).

[8] LINS, A. *Towards an anti-essentialist view of technology in mathematics education: the case of excel and cabri-gómètre*. Unpublished PhD thesis, degree of Doctor of Philosophy, University of Bristol, october, 2003.

[9] GRINT, K.; WOOLGAR, S. *The machine at work: technology, work and organization*. London: Polity Press, 1997.

[10] BEIRA, D.G.; NAKAMOTO, P.T. A Formação docente inicial e continuada prepara os Professores para o Uso das Tecnologias de Informação e Comunicação (TICs) em sala de aula? *V Congresso Brasileiro de Informática na Educação* (CBIE 2016) Anais do XXII Workshop de Informática na Escola (WIE 2016).

[11] von WANGENHEIM, C.G.; NUNES, V.R.; SANTOS, G.D. Ensino de Computação com SCRATCH no Ensino Fundamental – Um Estudo de Caso. *Revista Brasileira de Informática na Educação*, Volume 22, Número 3, 2014.

[12] RODRIGUES, L.C.; QUEIROGA, A.P.G; OLIVEIRA, M.V.; MORE, A.T. Relato de experiência: curso de introdução à programação para crianças do ensino fundamental no IFSP Votuporanga. *V Congresso Brasileiro de Informática na Educação* (CBIE 2016) Anais do XXII Workshop de Informática na Escola (WIE 2016).

[13] VEEN, W.; VRAKKING, B. *Homo zappiens: educando na era digital*. Porto Alegre, RS: Artmed, 2009.

[14] PAPERT, S. *A máquina das crianças: repensando a escola na era da informática.* Porto Alegre: Artes Médicas, 1994

[15] VALENTE, J.A. "Por que o computador na educação?". In VALENTE, J.A. (Org). *Computadores e conhecimento: repensando a educação*. Campinas, SP: UNICAMP, 1993.

[16] BEACH, D.; PEDERSEN, R. B. *Process-tracing methods: foundations and guidelines*. Michigan, USA. University of Michigan press, 2013.

[17] BEACH, D. *What are we actually tracing? Process tracing and the benefits of conceptualizing causal mechanisms as systems Article*. University of Aarhus, Denmark. January 2017.

Disponível em: https://www.researchgate.net/publication/315905503. Acesso em abril/2017.

[18] RESNICK, M. Reviving Papert's dream. *Educational Technology*, v. 52, n. 4, p. 41-46. Jul./Aug. 2012. Disponível em: https://dam-prod.media.mit.edu/x/files/~mres/papers/educational-technology-2012.pdf. Acesso em: ago. 2017.

[19] MESQUITA, M. (Org.). *Fronteiras urbanas* – Ensaios sobre a humanização do espaço. Editor: Instituto de Educação da Universidade de Lisboa Anonymage: Viseu, 2014. ISBN: 978-989-8753-04-5.

PREVIOUS RESEARCHER'S PAPERS ON THE STUDY

[20] VENANCIO, V.; ABDOUNUR, O. J. A leitura do software de programação Scratch realizada pelo professor: uma pesquisa em ação. *IV Congresso Brasileiro de Informática na Educação* (CBIE 2015), Anais do WalgProg, Maceió, AL.

[21] VENANCIO, V.; ABDOUNUR, O. J. Software de programação em sala de aula por meio da leitura do professor: uma pesquisa em andamento. Anais do *III Congresso Brasileiro de Recursos Digitais na Educação* (CBRDE 2015), São Paulo, SP.

[22] VENANCIO, V.; ABDOUNUR, O. J. Scratch como artefato para solução de problemas: interpretação do professor. Anais da *International Conference Problem-Based Learning and Active Learning Methodologies* (PBL 2016), São Paulo, SP.