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### One Laptop per Child and its Implications for the Process of Written Language Learning: A Case Study in Brazil

### Una computadora por niño y las implicaciones en el proceso de aprendizaje de la lengua escrita: estudio de caso en Brazil

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#### Abstract

This is a case study on the reading and writing practices of six year old children engaged in the daily use of digital technology, conducted in a public school in Porto Alegre (RS/Brazil) and made possible by the One Laptop per Child (OLPC) project. Its aim was to investigate the practices carried out by students and the possibilities and conditions under which the computer can become a tool that enables them to enter the "literate world". The students' practices were examined based on three units of analysis: practices proposed by a teacher, spontaneous practices and representative cases. These practices were categorized into three areas: literacy, fluency of written language and technological fluency. The research began with a theoretical proposal that had to be modified as a result of the study, and emphasizes the importance of pedagogical proposals for children in the initial process of written language learning.

*Keywords:* Literacy, written language, technological fluency, literacy practices, computer.

## Resumen

Estudio de caso sobre las prácticas de lectura y escritura de niños de seis años de una escuela pública de Porto Alegre (RS / Brasil), inmerso en la cotidianidad digital, lo que hace viable el proyecto de una computadora por Niño. El objetivo fue investigar las prácticas realizadas por los estudiantes, así como las posibilidades y condiciones necesarias para que la computadora sea una herramienta para que puedan entrar en el "mundo alfabetizado". Las prácticas de los estudiantes fueron examinadas en tres ejes de análisis: prácticas propuestas por el profesor, las realizadas de manera espontánea y los casos emblemáticos; esas prácticas se clasificaron en tres ejes: alfabetización, fluidez de la lengua escrita y fluidez tecnológica. La investigación inició con una propuesta teórica que tuvo que ser modificada como resultado del estudio, haciendo hincapié en la importancia de las propuestas pedagógicas para los niños en el proceso inicial de aprendizaje de la lengua escrita.

*Palabras clave:* Alfabetización, lengua escrita, prácticas de lectura y escritura, computadora (ordenador).

## I. Introduction

The development of literacy is a historical challenge for most developing countries. Despite the increasing access to schools, countries like Brazil still struggle attaining high levels of functional illiteracy. According to INAF, 72% of the population aged between 15 and 64 years cannot be considered fully literate (INAF, 2007). This is a serious barrier for any society to achieve social and equitable economical growth, especially in a world transformed by digital technologies and driven by knowledge.

In these societies, most students from unprivileged classes learn basic reading and writing skills, but never become fluent in the written language. Fluency here implies a deeper relation with the written language that goes beyond coding and decoding text. It requires a condition of using writing incorporated with one's life in such a way that it expands the possibilities of social participation in all its circles.

Computer technology brings simultaneously new challenges and promises. The challenges include creating new forms of written code and posing new demands on individuals. The promises include making reading and writing more contextualized for children who live in oral cultures, for example.

Considering these promises, many governments invested in projects of computers in schools with a wide range of objectives. Improvements in the quality of education, promotion of equity, development of technological skills, mathematical thinking, and literacy are common goals of these projects. At first the focus was in computer labs but more recently the concept of one laptop per student, the so-called one to one (1:1) model, became a compelling new possibility as costs declined.

Following this trend, in 2007, the Brazilian government created 5 pilot schools to investigate the 1:1 concept. This investigation was under the umbrella of this larger initiative that aimed to understand how computer saturation changes schools' culture of

learning (Laboratório de Estudos Cognitivos, 2010).

The present research's objective is to investigate and analyze how students' reading and writing practices change when they receive full access to a connected laptop. Later it tries to identify the conditions necessary for the computer to help students to participate in the literate world. It also analyzes the impact of such a context to the written language conceptualization.

The study took place in one of the aforementioned pilots, a public school in the city of Porto Alegre, Brazil. It was a case study with a first grade class. In this class all 19 students were 6 years old and were suddenly immersed in a digital life when each one received a laptop connected to Internet, donated by non-profit organization One Laptop per Child (OLPC).

## **II. Theoretical Definitions**

The theory that digital technology changes the practices of reading and writing is not recent. Since the early 1980s Seymour Papert has argued that access to the computer allows children to establish another relationship with knowledge - "learning by doing" - because the machine provides objects that favor the "thinking" of different ways students learn. The computer would be a means by which the child could become familiar with written language and symbols before being literate, creating a triggering element for cognitive conflicts and mobilizing for this learning (Papert, 1994).

In Brazil, studies by Nevado(1989) along with other researchers from LEC/UFRGS, theoretically underpinned by Jean Piaget, Seymour Papert and Emilia Ferreiro, show that an environment rich in symbolic exchanges would present more chances for children to become literate. They propose that the introduction of the computer could enrich school environments by providing stimuli for symbolic exchanges. The results of these studies indicate that children who participate in classes with LOGO, a computer programming language, show greater growth with regard to the conceptualization of the written language, increasing their chances and reaching more complex levels more quickly when compared to those who do not attend the classes or have little effective participation.

More recently, Warschauer (2008), motivated by the belief that new technologies are bringing a shift in literacy practices, investigated in the USA how students' literacy practices in school change when every student has a laptop connected to the Internet. He concludes, in a multisite case study of literacy practices in 10 K-12 schools, that:

The processes, sources, and products of students' literacy activities changed noticeably in the one-to-one laptop classroom. Literacy processes became more public, collaborative, authentic, and iterative, with greater amounts of scaffolding and feedback provided. Literacy sources expanded to include a wealth of online materials, more student-collected data, and digital or audio archives of students' own work. Literacy products extended beyond the essays and PowerPoint presentations that dominate

typical schools to include a greater variety of textual and multimedia genres. (Warschauer, 2008, p.64)

Warschauer points out no improvement in the test scores, neither overcoming the academic gap between students with low and high socioeconomic status, though.

Considering those studies and others, as well many definitions about the same concepts, it is necessary to clarify how they are understood in this research. There are four core theoretical concepts: literacy, written language fluency, technological fluency and written language conceptualization.

The concept of literacy (*alfabetização* in Portuguese) is used here in its narrow definition, as a process of the person to understand the structure and operation of the alphabetic code as well its phonetic consistency. The written language is an object of knowledge and its understanding depends on the child's mental activity. It is associated with the operation of encoding and decoding.

The adopted concept of written language fluency has its roots in the one Soares proposed. She sees written language fluency (*letramento* in Portuguese) as a "state or condition of the one who does reading and writing social practices, participates in events where reading is an integrated part of interaction among people and the interpretation process of such interaction" (Soares, 2002, p. 145). Her definition is adapted by thinking fluency not as a state/condition, but rather as a developmental process of an individual or social group while they do social practices of reading and writing and understand their role. It involves language use with comprehension in a meaningful situation.

The written language conceptualization is understood as a process resulting from the activation of the meaning and logical systems. In this perspective, it is dependent on two other processes: literacy (comprehension about how the code works) and fluency (understanding the purpose of the code and its possibilities of use). In the words of Ferreiro and Teberosky, "conceptualization is the way that children should go to understand the characteristics, the value, and the function of the written language". (1999, p. 17). In the attempt to understand conceptualization, they created a framework with stages of reference in which the child's hypothesis about written language evolves and becomes more complex until it reaches standard writing. The stages are: pre-syllabic, syllabic, syllabic-alphabetic, alphabetic and orthographic (Ferreiro and Teberosky, 1999).

The study also required a concept which denoted the development of the child's ability as a computer user. Technological fluency (Papert and Resnick, 1995 and Cavallo, 2000) was used because it offers a broader definition focused on the uses of technology rather than the knowledge of technology itself. By this definition, being fluent in technology might be compared to be fluent in a language. Fluency is much more than to knowing some words; it is necessary to know how to articulate ideas, tell stories, in other words, do things with language. In the same way, technological fluency implies

not only being able to use the technology, but also knowing how to build meaningful things with it, learning from it, solving problems both concerning the technology and its uses.

### **III. Methodology**

The methodological approach of this investigation was a case study inquiry, as defined by Yin (2009). He defines a case study as “an empirical inquiry that investigates a contemporary phenomenon in depth and within a real-life context, especially when the boundaries between phenomenon and context are not clearly evident”. And adds to this definition:

The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide the data collection and analysis (Yin, 2009, p. 8).

In Yin’s framework, case study is not only a data collection tool, but an all-encompassing methodological approach that covers the logic of design, the data collection, and data analysis strategy. It is particularly suitable for this research because the limits between the investigated phenomenon, the change in the reading and writing practices, and its context, a classroom saturated with laptops, is nebulous. The number of variables that might interfere with the reading and writing practices of children in a classroom environment are very large and very difficult, if not impossible, to control.

To overcome this challenge, case studies, like experiments, are generalizable to theoretical propositions (analytical generalization) and not to populations or universes (statistical generalization). Hence, this investigation started with the definition of a theoretical proposition. This proposition was created prior to the fieldwork, in order to make explicit the researchers’ expectations of the coming events based on the available theoretical references. It guided the data collection and analysis phases. The theoretical proposition was:

The daily use of a laptop by children will allow them to explore the language in real-life situations, thus building a symbolic environment favorable for understanding the purpose and meaning of written language and, as a result, creating the need of understanding its structure and contributing to the conceptualization process (Kist, 2008, p. 58).

The proposition follows a theoretical orientation in which the conceptualization of the written language is the result of two integrated processes: understanding the meaning and functional structure of the language. However, children of unprivileged classes often have little experience with reading and writing social practices beyond school. Although they live in a literate world, language is not an object of interest and they almost do not think about the functions of text. When inside the classroom, they cannot find meaning for such knowledge. In this context, the use of laptops may assist children

to create meaning for the written language, thus facilitating the development of both meaning and logic systems that may allow them to understand the written code (Papert, 1994).

To achieve construct validity/reliability, case studies rely on as many sources of evidence as possible. These sources are triangulated and linked in a chain of evidence that supports or questions the original theoretical proposition. In this study, three sources of evidence were used: (1) participant observation, (2) standard tests for the level of written language conceptualization, and (3) digital artifacts produced by students.

The data collection period followed the first grade class during 5 months, beginning a few days before the students received their laptops. Participant observation was used as first data collection method, generating a field journal and several hours of audio recording. Ferreiro and Teberosky(1999) tests were applied twice to all 19 students to verify their stage of written language conceptualization, once before the laptops were deployed and at the end of the data collection. See Figure1 (this research uses a two letter code to identify students, in order to keep their identities secret).

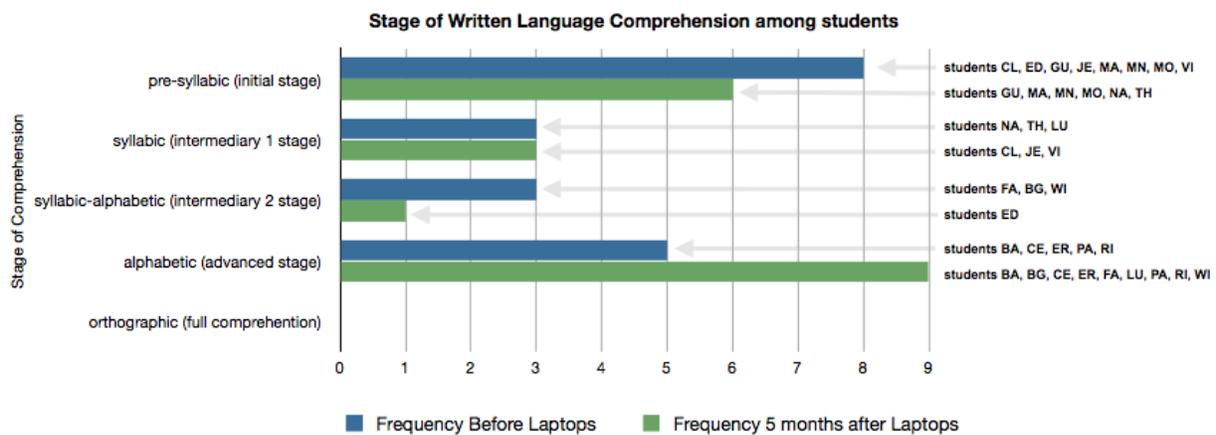


Figure 1. Distribution of the student by stage of written language conceptualization according to Ferreiro and Teberosky's test

Students also created hundreds of digital artifacts consisting of photos, videos, texts, drawings, computer programs, and written productions, all of which were collected and analyzed. The documents from the students' laptops were the major source. However, the school also made available a Virtual Learning Environment (VLE) called AMADIS (Bittencourt *et al.*, 2006), which could be accessed inside and outside school and was used by the students for blog posts and messaging. These written productions were also considered. Figure 2 shows number of artifacts collected by child.

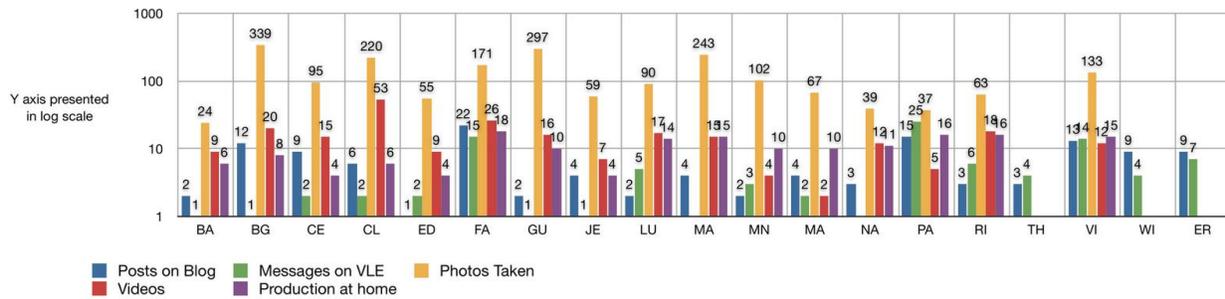


Figure 2. Different digital artifacts created by children. Students TH, WI and ER faced technical problems with their laptops and lost part of their artifacts.

During the analysis data was initially organized chronologically by student. Then, it was aggregated in categories inside two units of analysis: (a) students' practices triggered by a teacher proposal and (b) students spontaneous practices. Each unit shared 3 axes: literacy, written language fluency and digital fluency. Each axis contained its own set of categories (see Figure 3). The analysis pattern-matched the data in each category with the theoretical proposition. A third unit of analysis examined five specific students whose cases didn't match the proposition or were its exemplars.

Case	Unit of analysis	Axes	Categories
19 students (6 years old) from first grade class and their teacher in a public school participant in OLPC Project (2007)  Objective: 1) Understand how students' reading and writing practices change when they receive full access to a connected laptop. 2) Identify the conditions necessary for computer help to students to participate in the literate world. 3) Analyze the impact of such context to the written language conceptualization process.	Students' practices triggered by a teacher proposal	Written language fluency	Inclusion in the virtual literate world Use of the written language to reach a goal Exercise of authorship in writing Communication through written language Exploration of different strategies to read or write
		Literacy	Writing from a model Writing with instrumental function Understanding the mechanism of the written code
		Technological Fluency	Ability to use technology Ability to learn new ways to use technology Ability to build with technology Troubleshooting
	Students' spontaneous practices	Written language fluency	Participation in literacy practices in the digital Focused use of the written language Exercise of authorship in writing Communication through written language Exploration of different strategies to read or write
		Literacy	Understanding the functioning of the written code Writing with instrumental function
		Technological Fluency	Ability to use technology Ability to learn new ways of using technology Ability to build things with technology Troubleshooting Collaboration with classmates in the use of technology
Representative Cases		VI, MN, TH, FA, PA	

Figure 3. Approach synthesis of the case study

## 2.1 Unit of Analysis 1: Students' practices triggered by a teacher proposal

This unit aims to analyze which activities proposed by the teacher to her students changed as a result of the laptop use. The students' practices were grouped according to literacy, written language fluency and digital fluency.

Regarding written language fluency, among the practices proposed by the teacher, a project named "Curiosity Awards" can be highlighted. It has been chosen because it is based on the Learning Project Methodology (Fagundes, 1999). This methodology was the UCA/OLPC project's core orientation for all of Porto Alegre's schools and teachers, in which all of them had received special training. In this project-based work, students are able to express their curiosities and choose some questions to investigate. Students selected: What do dolphins eat? Do dinosaurs become toothless? What do lions do besides attacking and eating? How do elephants drink water? Why do bats suck blood?

This teacher's proposal points out five different categories of practices: Inclusion in the virtual literate world (C1); Use of the written language to reach a goal (C2); Exercise of authorship in writing (C3); Communication through written language (C4); and Exploration of different strategies to read or write (C5).

The students investigated their curiosities in books, on the Internet with the teacher's support, and on television. With laptops, students had many activities that contributed to the project roll out. The first one was to search for pictures of the animals in search engines (C2). Little by little the children became familiar with the steps needed to access the Web, to type Google's address and to do the search. Children in the early stage of literacy used different strategies to write the animals' names. They often copied from support materials like posters on the walls, notes on their notepad or even asked help for their classmates who were familiar with writing (C5). Some students renamed the images something more meaningful to them (C3) as did FA, see Figure 4.



Figure 4. FA searches elephant pictures on Google and customizes their file names before saving them on his laptop.



Figure 5. ER wrote in his VLE diary two posts with lion's pictures: "My work is about lions", "Lions are hairy and beautiful. They attack. They are carnivores. They live in Africa. They eat meat. Lions attack more (than lionesses). Lionesses usually hunt".

In Figure 4 "elefanta na rua" means "elephant on the street", "africaono" means: "from Africa"; "molio" was used for this specific elephant because he is the logo of a tomato sauce brand (sauce stands for "molho" in Portuguese or "molio" in a phonetic pronunciation).

Besides saving the image on their own laptops, they uploaded it to their journal (blog) in the VLE in order to share the project findings with their classmates (C3 and C4) (see figure 5). By using this kind of VLE, the children became part of a literate environment and were able to interact through the written language or symbols with the whole school community (C1). In this way, writing to be read became more meaningful than writing only for the teacher. Every first-grade student had a user name and password to access to the VLE. Everyone created a profile with his picture. They would connect to the virtual environment nearly every day, register their findings about the research questions, and read and comment about what their classmates had posted (C3). However, it is possible to observe in Figure 2 some students had few posts on the VLE.

On the literacy axis just a few of the teacher's proposals during the use of the laptop generated practices regarding mastering the code. Among them, the ones that contributed to the literacy were those related to the projects, i.e. activities that required free writing. They generated situations in which students faced a conflict with their own hypotheses and had an opportunity to advance their understanding about the code. In this process it is usual that they generalize rules that cannot be generalized, as student CE does (see Figure 6). He belongs to the advanced literacy group and throughout his work it was possible to observe his efforts to comprehend the written code applying his own hypothesis.

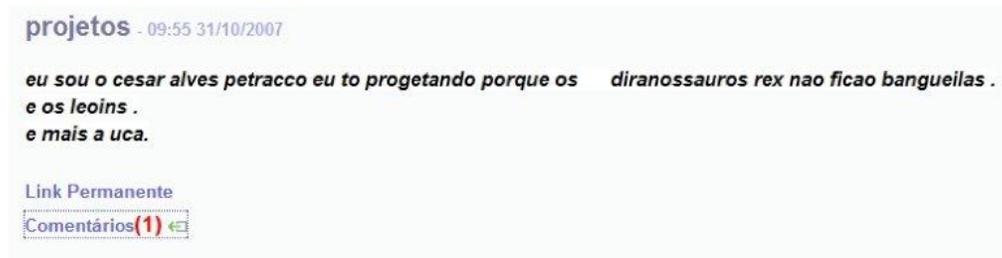


Figure 6. CE writes in his AMADIS blog. - 10/31/2007

In the example above, CE writes he is “projecting” (projetando), thus generalizing the verbal ending as in “I’m writing” (estou escrevendo), “I’m doing” (estou fazendo), “I’m studying” (estou estudando). However, in Portuguese language such construction does not exist for the verb “to project (projetar)”. According to Ferreiro and Teberosky, the child looks for a regularity and consistency in the language that might change it into a more logical system than it actually is. However, these are not mere errors. They could rather be called constructive errors, i.e., answers that are different from the correct ones, but far from stopping children to reach the correct ones, they allow children to get it right in the future (1999, p. 25).

In due course the teacher made interventions with some students aiming at destabilizing their certainties and helping them to refine their hypotheses.

Free writing triggered by a teacher’s proposal was more frequent among students in more advanced levels of written code comprehension, though. Those who had less sophisticated hypotheses did not write much, and thus faced few opportunities that allowed cognitive conflict to emerge and the language to develop. In these situations the laptop did not contribute significantly to the advancement of children’s literacy.

Another fact to be considered is that the laptop software was not developed with literacy as a goal. It is up to the teacher to create activities and observe privileged situations to promote conflict in children’s written language hypotheses, helping their development.

Regarding the digital fluency axis, the teacher proposals opened new possibilities for children to grow technologically fluent, although it was not a determinant for all children to reach the same level. When the work has meaning for the children, they engage in the activity and have better conditions to make powerful uses of technology, developing fluency. In the analyzed class it was the project-based work that created meaning for many proposals of the use of technology. Reciprocally technology empowered the project’s implementation as it enabled the daily access to the Internet, the contact with an open library of pictures, the publishing of the children’s findings in the VLE, the taking of pictures of materials for the projects or situations experienced during the work, as well as the making of its representation through different modalities (sounds, pictures, video, writing, drawing).

Besides the project-based work, Squeak/eToys (Kay, 2005) programming workshops also opened the possibilities for authoring with and exploration of the technology, favoring the development of digital fluency in a way that students could discover as they were stimulated to investigate new possibilities with the tool.

## **2.2 Unit of Analysis 2: Student spontaneous practices**

In this unit the data were gathered from activities developed by students at school without a teacher’s request and from activities developed at home. These data cover different axes: written language fluency, literacy, and technological fluency.

Regarding written language fluency, the 1:1 modality and access to a Virtual Learning Environment provided many opportunities for meaningful use of the written language, opportunities in which written language was demanded as part of interacting mechanisms. Practices observed consisted of posting on blogs about their interests, reading other school's students blog posts and leaving comments. Neither children's lack of literacy nor the teacher's proposal limited the use of laptops, VLE and Internet browsing.

When students did not know how to write something, they created strategies such as copying, taking pictures, and making hypotheses. They wrote with the intention of keeping records, communicating, asking questions, and expressing themselves. They also created strategies to read such as interpreting icons, using indices (like the initial letter), and making a hypertextual reading. They made a meaningful reading to find pictures, classmates and keys to perform particular actions.

The urge of some children to communicate and express themselves through posts in the journal went beyond the limits of the written language. The snippets below (Figure 7 and 8) illustrate categories of the axis Written Language Fluency.

The work of student VI (Figure 7) is representative of the initial stage literacy's group. He did use strategies to express something about himself in a post. In the VLE he wrote: "eu aprendi a mexer no laptop" (*I have learned how to use the laptop*).



Figure 7. Spontaneous message VI wrote at his AMADIS – 9/24/2007

Similarly, the student PA (advanced stage of literacy), who interacts with a student in another class, spontaneously left comments on his journal.

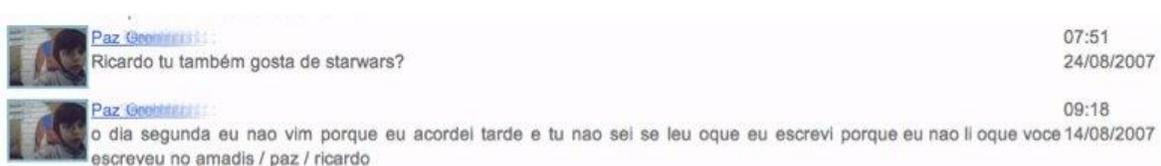


Figure 8. PA sends a message to a child in another class. In 24/08/2007 he wrote: "Ricardo, do you also like Starwars?" In 14/08/2007 he wrote: " The day "Monday" I didn't come because I woke up late and I don't know if you read what I wrote because I didn't read what you wrote at AMADIS." – 8/14/2007 and 8/24/2007.

Relative to the literacy axis, in the spontaneous writing practices, there are situations in which students attempt to understand the code. A practice included in a category from this axis, was held by the student FA, illustrated by the excerpt below:

FA is searching for images on Google Images. He wants a image about Transformers. But he does not know how to spell it. Then he asks how to spell. As the question is returned, he says that he is going to test to see if the word exist. He writes: *Trasãoformes*. Google's engine doesn't show the image and suggests "Transformers". FA realizes that and self-corrects. When saving an image, he writes the correct form. (Registration diary field: 10/12/2007)

"Playing with the writing" was also a spontaneous practice observed. Writing names and previously known words and modifying their writing are practices to help understand the code because they imply a symbolic manipulation. The more the student deals with the written code, the greater are the chances of disturbances, loss of equilibrium, and construction of more stable states of equilibrium. This movement allows the child to reconstruct their hypothesis on a major level.

The development of technological fluency (axis 3) in its multiple aspects was one of the marks of spontaneous practices. The laptop allowed the children to explore the computer in an unfettered way. This happened for both students who have mastered the written code and those who have not. This created a relationship with knowledge different from the dependency situations that are so usual in strict school practices. Solving technical problems on the laptop, exploring new activities, and creating artifacts were all observed practices. Children as laptop owners used technology in real-world situations to solve their own problems, as for example the strategy of taking pictures instead of copying instruction from the blackboard.

However, more advanced students showed more initiative to solve problems, to create and to learn new ways of using technology. Children in an initial process of literacy used the laptop spontaneously, especially at home, to take pictures, make videos and draw, rather than to use written language or programming.

Students' continuous change of roles in the classroom is also worth noting. Even children who did not master the written language were able to become references in laptop use and help their peers. In turn, children who mastered the code were references and sources of help for their classmates in relation to learning to write.

### **2.3 Unit of Analysis 3: Representative Cases**

In order to enhance the understanding of the theoretical proposition, unit of analysis 3 provided five individual students illustrating different situations for literacy practices and laptop use.

VI is representative of the initial stage literacy group, and became a unique case because he was the student who acquired technological fluency although he did not show the same progress in relation to literacy. To use the laptop, he created strategies to use the written language (fluency) in such a way that it was not an obstacle. Despite the 1:1 use of the laptop, the project development and meaningful writing in the VLE, in

a five-month data collection, the student did not reach an alphabetical level, although he was a reference to his peers regarding technology.

MN is also representative of the initial stage literacy group. She is the one who did not show progress in her hypothesis of reading and writing. She is illustrative of the situation of three other students with lower attendance rates, from families who were absent in the child's school development. She was excluded from the reading and writing social practices at home and found this knowledge as something that was not meaningful. In the classroom, she did not show any engagement in spontaneous writing in the projects and the VLE use and faced problems learning the technology.

TH is representative of the intermediary 1 literacy group. His case shows how laptop technical problems associated to a boy's low tolerance to frustration led to a lack of literacy development. Initially he seemed to be a promising case, but in the course of the laptop study he showed no advance in his written language hypothesis. On the contrary, he started using shaky hypotheses. TH's laptop showed serious trackpad problems, which was a usual problem among the students. When the student tried to move the cursor, it behaved in an unexpected way, jumping all across the screen. This difficulty would reach its climax when the student gave up, put the machine away and sought isolation.

FA is representative of the Intermediary 2 group of literacy. This case illustrates how the laptop associated with social practices of writing and reading contributed to the development of the literacy and therefore the boy's written language conceptualization. From the collected data analysis, it was possible to observe that the conditions offered by laptops, VLE and project practices introduced the student to a completely new level of participation in reading and writing social practices. Such conditions allowed him to engage in groups where the use of written language was mandatory, making him use the spontaneous writing to communicate, express feelings and things he learned, and to tell ideas and creations. This created conflicting situations to the development of his written language hypotheses, a fact that boosted them.

PA belongs to the advanced literacy group, and he was a case in which the use of the 1:1 laptop modality associated with Internet access and a Virtual Learning Environment helped to rescue his interest in school and to motivate his continuous writing development. PA, despite the fact of belonging to the advanced literacy group, understood the language operation (literacy), but he did not show any concern with what he was reading (written language fluency). He was considered a student with difficulty since he was not engaged in school activities. When laptops and project-based work activities were introduced, PA started to actively participate in the classes and became a reference in many situations. He had the opportunity to express his ideas through writing, interacting with real-life peers in the VLE and also making progress in written language conceptualization.

### **III. Data Discussion**

The results found in the first unit of analysis, practices based on the teacher's proposals, show how practices supported students and how they were meaningful. The daily laptop use and the connection to the Internet created conditions for the teacher proposed project-based work, UCA/OLPC's project core orientation. This proposal enabled most students to explore language in real situations, building a symbolic environment favorable for the understanding of the written language function and meaning. The project-based work was also especially empowered when associated with proposal on the VLE. On the VLE students had the opportunity to interact with a literate virtual world, experience authorship on the net, exercise real reading and writing practices, express what they had learned, search for information and share knowledge. Moreover, the project-based work enhanced by teacher's proposals favored the development of technological fluency without the need to teach the laptop's technical aspects. It also created situations in which students freely wrote about what they had learned, or just looked for pictures on the Web. Thus, children faced challenges for their current writing hypotheses, which, in particular circumstances provided the development of new and more consistent hypotheses.

The various practices for laptop use for written language demanded the understanding of its structure, favoring the conceptualization process. This happened in particular cases in which children had already participated in literate practices in their family daily life, as well as for children that had already a more sophisticated writing hypothesis. Some children with simpler written language hypotheses did only what the teacher told them, especially when the teacher's proposal did not include free writing, but rather included the copying of models and activities such as how to use the camera and edit images. Despite the furthering of all these cases of symbolic interaction, it is not possible to ignore these children's cases. In order to foster the conceptualization process, teacher intervention needs to be considered as a key element and a tool that may allow for creating situations in which poor hypotheses about the function and operation of written language are challenged. Such an agent is necessary mainly because most children in Brazilian public schools deal with written language only at school. Thus, the theoretical proposition must be adjusted to include the need of various practices (both as teacher's activities and software) that may include literacy learners and those excluded from literate family environments.

The second unit of analysis shows that the 1:1 laptop modality use favored most of the students in spontaneous practices, mainly regarding fluency in technology and fluency in written language. Using laptops on a daily basis, children had opportunities to experience language and laptop operation.

As for written language fluency development, the symbolic interaction through the laptop and, especially in the virtual learning environment, enabled children to participate in spontaneous social reading and writing practices in the virtual literate world. They also used writing with authorship and personal meaning to express ideas, preferences and interests, and to communicate and look for entertainment even without mastering the alphabetic code.

These experiences managed to challenge some children's writing hypotheses, favoring the progress in the literacy process and in the written language conceptualization. According to Ferreiro and Teberosky(1999), sometimes the child is not susceptible to challenges of this kind. Sometimes the child just does not care with the incoherence of his or her hypothesis, and it is necessary to intervene for challenges to occur.

Equally important as the experiences concerning the written language, the laptop in the child's daily life enabled the development of technological fluency and the establishment of a less dependent relation with knowledge. The child's activity (both physical and mental) of understanding the laptop's function (what it is used for) and mechanisms (how it works) can be observed in several of the children's works (sometimes unsuccessful attempts) that were found in the their laptops. The children's availability to learn new functions in the existing software, and share new findings with the classmates, were sound pieces of data found in the spontaneous practices.

The results found in this unit support the theoretical proposition. In this case, children's spontaneous practices showed the need for understanding the language operation and technology. Still, it is not possible to state that this need is enough for written language conceptualization.

The representative cases (unit of analysis 3) are a key tool to deepen the analysis. Students FA and PA helped to reinforce the theoretical proposition as they were cases in which the 1:1 laptop modality enabled children to explore written language in real life, building a symbolic environment appropriate for language fluency development and, therefore, provided the need for understanding its structure (literacy), favoring the conceptualization process. PA already understood the language operation before laptops were introduced, but he did not show any concern with using it (fluency). The laptop work in the classroom, together with the VLE use, provided this meaning for PA to engage in written language social practices and become more fluent.

Starting from his interest in communicating through the VLE and using different software in the laptop, FA showed the need for understanding language operations and, step-by-step, advanced in his reading and writing hypotheses (conceptualization process).

VI's case challenges school timing by showing that the written language conceptualization process is not immediate. Due to his interest and talent in using the laptop, VI created strategies to use language and showed he understood its function. He gave meaning to the act of reading and writing. However, the five-month period of this study was not enough for VI to reach an alphabetic writing hypothesis. He advanced in his hypothesis because at the end of the school year he had a repertory of words that he used as models and he wrote in a syllabic way. However, he remained with the criteria of low rate of letters, which made him add letters to words. According to theories on which this study is based (Ferreiro, 1999; Soares, 2002), his path is part of the process and perhaps this experience contributed for his path toward the written language conceptualization. However, given the limited data collection period this case has not been followed.

MN's case corroborates the conclusions provided in the first unit of analysis, that more appropriate activities and interventions are necessary for young initial literacy learners, as well as for children excluded of reading and writing practices at home. MN carried out the teacher's proposals that did not involve spontaneous writing nor exposed her illiteracy. She was spontaneous only in activities such as using the camera to take pictures and make videos. Seldom did she enter the VLE and she rarely interacted on there. She finished the school year still with her initial hypothesis of written language. The lack of meaning of the VLE for pre-syllabic children suggests the demand for new laptop software and environments that, on the one hand, are less dependent on the written code, and, on the other, stimulate the use of it.

#### **IV. Conclusions**

In the two units of analysis, students' practices triggered by a teacher proposal and students' spontaneous practices, it is possible to show how students' reading and writing practices change when they receive full access to a connected laptop, the first goal of this investigation. The laptop creates conditions for proposals and practices that would not be possible without it, as illustrated by the project-based work, programming and the VLE use. Those practices enhanced by teacher's proposals favor children's literacy, written language fluency and technological fluency development. It also improves situations in which students write to communicate their learning, to express themselves, to be part of a virtual literacy environment. Children experience challenges to their current writing hypothesis, leading them to search for more consistent hypotheses. The use of the laptop in the child's daily life enables technological fluency development and a lower dependence on a teacher's knowledge and guidance.

The second goal for this investigation is related to the conditions for the change of practices for reading and writing. The 1:1 modality for laptop use is indispensable for certain practices to occur, especially with regard to spontaneous practices that happen out of school. However, it is important to weigh these other elements constituting the changes in practice. Among them are the differentiated pedagogical proposal, in this case the project-based work as well as the use of a Virtual Learning Environment. Besides that, the connection to the Internet, the full saturation of the school, which allows students from their first year to learn and teach their siblings, cousins or friends in other classes were important elements. Without these conditions, the laptop would lose much of its value in the observed practices.

The third goal, about the impact of such contexts to written language conceptualization, was related to the initial theoretical proposition. By triangulating the analysis, the initial theoretical proposition has to be adjusted. It is necessary to add a condition about the necessity of proposals and laptop activities more appropriate for children in early literacy. The research has lead to a new following theoretical proposition:

"The daily use of a connected laptop allows children to explore the language in real-life situations. Thus, the laptop usage builds a symbolic environment appropriate for

understanding the purpose and meaning of the written language (fluency), and, as a result, it creates the need for understanding its structure (literacy) and it contributes to the conceptualization process, provided that it is integrated with pedagogical proposals, interventions and laptop activities adequate for the children's needs and possibilities".

In order for the 1:1 modality of laptop use to be effective, teacher's proposals and laptop software should be designed for children in early stages of written language development. Robustness and quality of the hardware and software solutions also appears as a central issue in the data in 1:1 projects for early childhood. Children have to look for and find out meaning in learning to read and write towards understanding the language code operation.

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