Affectibility in Educational Technologies: A Socio-Technical Perspective for Design

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ABSTRACT
Digital artifacts have the potential for augmenting the interest of students and the quality of learning environments. However, it is still common to find technology being inserted in learning settings without a closer connection to the learners’ contemporary world. In this paper we report on results of a qualitative research conducted to address questions such as: How could a new technology be introduced in schools in a way that it makes sense to the users? Could it contribute to more integrated learning scenarios? The study took place at an elementary public school in the city of Campinas, in São Paulo, Brazil, and involved more than 500 people. Data were collected from participatory Workshops, informal interviews and pictographic questionnaire. The results suggest that it is possible to combine school’s formal and informal practices into meaningful learning by using the XO educational laptop. The activities helped teachers and students realize that the use of technology can be recreated, influenced by their own feelings, values and culture. A discussion is conducted towards new perspectives on understanding learning practices mediated by technology and the role of the concept of ‘Affectibility’ in the design of educational systems.

Keywords
Human-Computer Interaction, Design for Children, Laptops in Education

Introduction
There seems to be a common sense – not always agreed – that formal learning refers to learning that takes place inside the school; and informal, outside the school (Eshach, 2007). Non-formal learning is often seen as learning that also takes place outside the school, like in informal learning, but still has the same “deliberate instructional and programmatic emphasis” as in formal learning (La Belle, 1982). Similarly, Looi et al. (2010) define formal learning as the one “which is based on fixed curricula enacted in classroom environments” (p.156). Coombs and Ahmed (apud La Belle, 1982) characterized formal learning as the “institutionalized, chronologically graded and hierarchically structured educational system, spanning lower primary school and the upper reaches of the university” (p.162). Still with the emphasis on the physical space where learning occurs, Looi et al. (2010) define informal learning as the type of learning system “where learners are participating in intentional or unintentional experiences outside school settings” (p.156); and non-formal learning, referring to “learning that happens in formal learning settings but not tested or assessed in traditional ways”.

Other aspects taken into consideration while differentiating formal, informal and non-formal learning include: the control learners have over the learning situation (Mocker & Spear, 1982); and the presence or not of a mediator and his role (Eshach, 2007). Another important aspect refers to the intentionality of learning: in formal and non-formal, the intention of learning seems to always be present, in varied degrees (Eraut, 2000; Schugurensky, 2000). In informal learning, the intention of learning may or may not be present (Schugurensky, 2000).

In spite of divergences that might be found among these definitions, “informal”, “formal” and “non-formal” seemed appropriate to describe learning practices in the traditional educational models so far.

The act of teaching (actually, the act of guiding learning processes) demands reasoning and comprehension of reality, in a dialogical approach. Paulo Freire, one of the most influential educators in Brazil, had always criticized the way educational approaches are often detached from learner’s real life contexts (Freire, 1968). As the digital culture is sculpturing a new reality to which school’s practices need to be adapted, this fact calls for a transformation in schools. In a dialogue about Education and Technology between Paulo Freire and Seymour Papert – the creator of LOGO language, who proposed the Constructionism learning theory (Papert, 1993) – Freire stated that the purpose is not to discontinue the school, but to change it entirely, in a way that it can be reborn into a new, updated being (Freire & Papert, 1996).
In order for the school to catch up with its own time, it needs to incorporate technological advances in a critical and democratic manner. Even though technology is integrated in our lives, the ways it appears in education do not seem to be connected to the contemporary style of life. Moreover, while many children are being born in cultures where technology is naturally part of the environment, in Brazil, part of the population still has limited or no access to it. However, simply bringing a foreign technology inside the walls of a school might not solve the problem, as such technology might seem detached from the school’s reality.

Reviewing the meanings of formal and informal learning might help unraveling the new possibilities presented by digital technology, towards more seamless learning scenarios. Making sense of technology, in the context of children’s education, demands a socio-technical perspective that might contribute to the dialogical approach proposed by Freire (1968). Dialogue involves carefully listening to and understanding one another; it also includes the awareness of each other’s values, emotions and interests. In this paper, we explore the potential of the Affectibility concept (Hayashi & Baranauskas, 2011) in different scenarios throughout the use of low cost educational laptops, considered in the formal, informal and technical perspectives, as proposed by the Organizational Semiotics (Stamper, 1993; Stamper et al., 2000). Through some practical cases we address questions such as: how can a new technology be put into action in schools in a way that it makes sense to the users? Could that technology contribute to more integrated learning scenarios? We speculate on how the school’s practices (school’s values and culture) can point toward a meaningful use of technology.

The paper is organized as follows: in the next section we present the theoretical and methodological references; then we describe our context and research plan; present the results; discuss and conclude.

**The compound layers of societal design**

In today’s digital world, technology breaks barriers of space, time, and of presence or absence of mediators. It let learners and teachers experience out-of-the-school activities while still inside the classroom. While outside the school, learners may watch video or browse through and interact with a multitude of learning contents. With the availability of digital resources, neither physical place nor human mediation seems to mark the limits of learning opportunities. The opportunities for the construction of learning are present anywhere, anytime, as well as the mediators. Also the forms of control vary. For example, there are virtual tours where learners can choose the type of experience and slide presentations that allow learners to choose and go directly to the information needed. Once the divisions demanded by space, time, and presence or not of mediators are broken, then the differentiation of formal, informal and non-formal learning – which were based on those divisions – should be reviewed. As Chen et al. (2010) put it, learning can occur seamlessly across time and places when properly mediated by digital devices. When a digital artifact is used as mere alternative and as a detached element, its potential is wasted. As pointed out by Barab (apud Looi et al., 2010, p.156): “While it is not to say that abstract knowledge and media-replicated experiences are not desirable in learning processes, one of the critical problems in traditional schooling practices is the excessive amount of decontextualized information, indirect and abstract knowledge, and secondhand experiences confined in classroom contexts.”

For technological artifacts to serve its target community of users, as an embedded learning constituent, it is crucial to understand the way that the organization – - in this case, the entire school (Baranauskas, 2009b; Hayashi et al., 2012a) – works. The socio-technical approach enlarges the scope of learning settings, moving from perspectives based on place (i.e. inside and outside the school) to a perspective that considers informal, formal and technical aspects of the school context. We argue that this perspective is needed in the design of educational technology that aims at a seamless integration of technology into the contemporary school. In this approach, cultural aspects are taken into consideration, building a perspective from which the sense made by the use of technology plays a major role.

Cognitive models that used to inform the design of systems are undergoing transformation. As Boehner et al. (2007) suggest, researchers are enhancing the notion of cognition as more than rational thought. “Cognition has been proposed instead as something social and cultural, embedded in our everyday practices of making sense of and interpreting events.” (Boehner et al., 2005, p.60).
Culture is understood here as “the way of life of a people, the sum of their learned behavior patterns, attitudes and material things” (Hall, 1959, p.20) and it can be thought of as a “productive phenomenon” that “shapes individual and collective experience and gives it meaning” (Boehner et al., 2005, p.64). The environment of a community of users (e.g., a school, schools from a city or country) might change – or be changed by – the way technological device(s) are used. Since culture varies from people to people, as well as their language and the sense they make from signs, it is important to consider culture in the design and study of educational systems, as proposed by socio-technical approaches.

Cultural conventions (the way humans operate) can be classified in formal, informal and technical levels (Hall, 1959). The concepts of formal and informal from Hall differ from the definitions previously presented. Apart from semantic differences, the important distinction that can be stressed here is on how Hall’s categorization does not seem to break learning apart. Rather, it contributes to the desired integration; as put by Hall (1959, p.66): “One more generalization that should be kept in mind about formal, informal, and technical integrations is that while one will dominate, all three are present in any given situation.” Analyzing aspects in the three levels helps us be aware of the elements, and together these elements compose the entire organization.

Elaborating from Hall’s informal, formal and technical modes, the Semiotic (or Organizational) Onion (Stamper, 1993) helps us understand how each mode (or layer, referring to the onion metaphor) is embedded into the other, composing more meaningful information systems. Figure 1 illustrates and explains the layers of the Semiotic Onion from Stamper (1993) and how it works as a base for the science of design and participatory activities (Baranauskas, 2009).

![Figure 1. The Semiotic Onion and the science of design adapted from Stamper (1993) and Baranauskas (2009)](image)

In addition to the challenge of designing for digital learning scenarios, there is another factor to be considered. With the advances in technology, computer systems are no longer there for the sole purpose of helping us to complete our tasks. Devices are now part of our lives and are present everywhere. In this context, interaction design faces new challenges. As Abowd & Mynatt (2000) point out, usability techniques were appropriate when users’ tasks were known and system’s evaluation had the objective of verifying whether the interface was suitable for completing that task. Now “it is not at all clear how to apply task-centric evaluation techniques to informal everyday computing situations” (Abowd & Mynatt, 2000, p.51).

Within a socio-technical perspective and building upon less explored faces of usability, we have argued in (Hayashi & Baranauskas, 2011) that Affectibility should be taken into consideration in the context of educational technology. We proposed the concept of Affectibility as a guiding notion from which the design of system-user interaction could be treated. Affectibility refers to the aspects that make the system of good – or bad – affective, emotional and/or hedonic qualities, potentially evoking certain affective responses in the users.
Elements of the technical layer are often seen as deprived of emotion or affect (Hall, 1959), but the Semiotic Onion helps designers of technology to realize such aspects that might be left unnoticed otherwise. At the same time that affective issues can find its elements in each layer of the Onion, the most significant result is in the intermixture. By understanding the informal, formal and technical elements towards the design of technology, one may attain the understanding of the underlying base that is formed by the context of use where affective elements have a role to play.

**Affectibility within the socio-technical scenario**

**Context**

The OLPC (One Laptop Per Child) organization donated 520 laptops to a research Project (XO Project, 2010) being conducted at Padre Emílio Miotti School (Miotti): a public school located in the suburban area of the city of Campinas, in Brazil. The school has around 530 people (among teachers and students). Children’s age range from 6 to 14 years old and they are attending the fundamental level. They are all using the laptop, but it is not every grade that follows the one-to-one model (a few children share the laptops). A research project is being conducted within the school to investigate and construct a situated methodology for the laptops appropriation (Hayashi et al., 2012a).

**Research plan and methodology**

Our main research questions aim at understanding how to insert a technological artifact (the XO laptop), which was built in different context and culture, into the school practices of another country, preserving this country’s own cultural values. What are the main challenges that may emerge during this process? In order to make the technology’s use more meaningful, what are the aspects that should be considered?

![Figure 2. Framework for the study of Affectibility in interaction design of educational digital artifacts](image)

According to Miles and Huberman (1984), a conceptual framework maps the territory being investigated and this map should change over time. It specifies who and what will be studied and identifies relationships. Figure 2 illustrates the scope of this research as it depicts an improved version of our conceptual framework (a preliminary version was presented in Hayashi and Baranauskas, 2011). On the background of the figure lies the Semiotic Onion (Stamper et al., 2000). Figure 2 shows the involved parties in our research: users (school’s community), designers of
educational technology and the technology itself. The figure represents the macro view of our research. The micro
scope of our investigation, presented in this work, involves students and teachers (users – as the unit of analysis) and
their environment (school’s settings and other interested parties, who also took part in our activities).

All teachers, some other employees from the school (e.g. principal, pedagogue, janitor, cook, library attendant) and
the students participated in the activities that we describe in this paper. The data collection took place during
Workshops, where discussions and other activities were conducted. The Semio-participatory Workshops – SpW
(Baranauskas, 2009, 2009b) articulates principles and artifacts from Organizational Semiotics – OS (Stamper, 1993
and Stamper et al., 2000) and Participatory Design – PD (Muller, 1997) into practices that provide rich qualitative
data.

In order to improve the credibility of the data collected during the SpW’s, researchers have also been engaged in
activities at school, actively participating in regular classes for almost one year as Participant Observers (Gold,
1958). During that time, researchers interacted with students and informal interviews took place. Reliability
(audibility) was reinforced by pictures and video, together with researcher’s field notes. Like other results from
qualitative approaches – especially of Action Research (Avi son et al., 1999) –, transferability is recommended over
generalizability (Hayes, 2001). In this sense, the detailed description provided here might inspire other researchers to
apply similar approaches in their contexts, when inserting a new technology at a school.

During the researchers’ prolonged engagement within the school, all participants were aware of the presence of the
researchers and their objectives. The parents signed terms allowing the participation of their children in the research.
Teachers and other adult participants from the school also signed similar terms.

Results

In this section we present cases that illustrate some of the activities that took place at the school. The information
was gathered as results of the SpW and Participant Observations. The cases contribute to the understanding of how a
new technology can be inserted into more meaningful practices.

Case 1. Transforming homework assignments

The resources available at the laptop (e.g. web browser and wireless internet connection) allow students to promptly
perform tasks that would normally require a search in the library or a walk to the computer lab. Such visits are
essential, but the practicality of being able to perform some research in the classroom also has its advantages.

Cooper (1989) compared homework with in-class study and showed that in-class study results were superior. Nonetheless, on another study, Cooper et al. (2006) identified evidences for the positive influence of activities
(performed at home) on students’ achievement. As pointed out by Xu (2005), activities sent to be done at home can
be an emotionally charged event, generally causing negative emotional states on children. That might be an
opportunity for parents and children to develop emotion management strategies (Xu, 2005). With their own laptops
available at hand, students are now capable of performing, in the classroom, some of the activities that used to be
assigned as homework allowing also teachers to take part in these emotional processes.

Activities that involve searching through sources that were not easily reachable when inside the classroom are now at
hand. Doing homework-like activities inside the classroom gives teachers the opportunity to understand some of the
emotional responses their pupils have during the discovery of the assigned topics. Furthermore, teachers are able to
help students in some of the difficulties faced when learners are doing research. Some of these difficulties, according
to Eilam (2001), are related to understanding what they are supposed to do and to making sense of the result of the assignment. It is worth noting that we are not arguing for all homework to be transferred into classroom. As Cooper et al. (2006) highlighted, homework has many benefits such as “greater parental appreciation of and involvement in schooling”, “parental demonstrations of interest in child’s academic progress” (p.7), among others.

At Miotti, a teacher tried to bring to the classroom an activity that she would normally assign as homework. She
asked students to find out the origins and meanings of their names. If the search were made at home, students would
come with the answers ready and she would not have been able to take part in the process and directly observe the affective responses evoked by the discoveries they were making.

The teacher reported about a student who usually displayed low self-esteem behavior as he felt excluded for presenting some degree of learning disability. That student found out that his name (Victor) meant “victorious” or “he who conquers”. He also read about who Victor Hugo was. The teacher was excited when reporting to us about Victor’s attitude towards the result of his task: he was both proud and happy. Certainly, for the teacher, it was also a positive experience to take part on her student’s process of construction of self-image and identity. In this same practice, a girl found out that her name was originally a male name; the teacher took the opportunity to create a relation of trust by discussing this issue with that girl.

With the resources from the laptop, homework assignments – shown by Xu (2005) as an activity that usually evokes rather negative emotional responses – can now not only be brought as an inside-the-classroom activity but also can become something interesting and fun.

Case 2. Integrating the School in Interdisciplinary Activities

Other interesting activities resulted from a collaborative practice that started during the initial SpWs at the school. The objective was to collaboratively create Scenarios of Use for the laptops, in a way that it would make sense to students and teachers.

Scenarios are descriptions that allow us to reason about situations of use, even when the situations are not yet implemented (Carroll, 1999). These descriptions tell stories about people and their activities, including descriptions of places, events, actions, as well as objectives and changes that may happen throughout the stories (Carroll, 1999). As we have confirmed with this activity, scenarios might not only help designers to create systems but also helped in the anticipation of ways of embedding the new technology into their practices.

In order to create scenarios for the use of the laptop at Miotti, researchers, students, teachers and other employees from the school gathered together to propose a different scenario of use for the laptops; most propositions resulted in interdisciplinary activities. One of the resulting scenarios was called “Students and Consumption at Home”. In this scenario, the students used their laptops to take pictures of products (e.g., grocery, pharmacy, clothing) or product advertisements (from newspapers, flyers, magazines) to study different matters. Once the pictures were taken, further work on them would be performed, according to the subject. The activities that emerged from this scenario were related to different disciplines and some of them are described below.

The Science teacher asked students to take the laptop home and take pictures of the ‘nutrition facts’ labels for food products they most usually eat. From the information on the pictures, the teacher initiated a discussion about nutrition and later they built graphics (using the resources from the laptop) regarding food composition. They were able to compare calories and other information among products, constructing knowledge towards the promotion of healthier lifestyles.

From the same pictures of labels taken with the laptop’s webcam, the Portuguese (students’ mother language) teacher asked her teenager students to write diaries about their habits. The presence of the pictures of the labels of products in their diaries directed the content of the texts. This allowed students to be more aware of their consumerist habits. More details on this activity can be found in (Miranda et al., 2011a). For the Math class, the teacher asked students to take pictures from the electricity bills at their homes. From the analysis of those pictures, in the classroom, they studied about kilowatts and electricity consumption. Students also built graphics comparing the use of electricity along the months, and they discussed about ways of reducing the electricity bill. Students were supposed to share this information with their family in an effort to pay less for the bill and promote energy saving. Picture taking and merging them with texts would not have been possible to these students without the XO laptop, as many of them cannot afford digital cameras or cell phones that take pictures.

The English as a Second Language teacher asked them to take pictures from anything that was written in English, from labels in products to newspaper and magazine ads. This activity made students aware of the presence of the English language in their lives and also helped them to understand the meaning of those foreign words (as examples,
we can mention the words: “Dove”, “Ice Tea”, “reach”, etc., which appear either as trademarks or adjectives of/for commercial products).

These are only a few examples of the activities conducted at the school that were derived from that single scenario – out of the eight scenarios created (for more details on the other scenarios, refer to Amiel et al., 2011 and Miranda et al., 2011b). Most of the time, educational contents were discussed, in a collective creation of knowledge, without the students even noticing that.

Teachers frequently used the words “happiness” and “sense of accomplishment” to describe students’ attitudes during the activities. All teachers agreed that students seemed to be more interested and motivated to do the tasks using the laptop, either at home or in the classroom. Some teachers observed that students who used to present indiscipline problems were usually the ones to be more proactive with the use of technology. Instead of disrupting the class, these students, in the task of helping their fellows in the use of the laptop, were rather focused and committed. They were proud of their knowledge and aptitude with the use of the laptop. Furthermore, the interdisciplinary approach brought to learners a sense of engagement.

Case 3. XO inside and outside the school’s walls

All students seemed to be very happy with the use of the laptop in their daily activities, inside or outside the school. On the Independence Day, students went out to the traditional annual parade. The only difference this year was that a group of students were exhibiting their XO laptops. They were proud to show that they were having this opportunity of using the laptop.

In another experience, during a school trip, teachers reported that students were happy to explain about the laptop to bystanders who saw them using it. In this activity, students from the third grades visited a park in the city. Teachers asked them to register the animals they saw, as well as the information about the animals, either by taking notes, making short movies or taking pictures – using their laptops. The interesting point in this activity outside the school was that they were using the same laptop they use inside the school and, sometimes, at home. In similar studies reported in literature, where students experimented the use of technology in activities outside the school, they were usually given specific digital artifacts for each setting outside the school. For example, in Woods et al. (2004), the authors report on examples of educational applications (from different settings: museum, science exhibit, libraries, etc.) in which a different handheld device was necessary. As the device belonged to the place, students were not able to use the same artifact in different contexts (e.g., the handheld from the museum belonged to the museum and users were not allowed to take them to other places). That does not match the relationship that most people develop with technology in the contemporary world: in the same single device, which is to be taken everywhere, one can find their agenda, alarm clock, camera, digital watch, cell phone, word processor, web browser, etc. At Miotti, the children, working with their own XO laptop both inside and outside school, were able to develop values like ownership, responsibility and autonomy.

![Figure 3. Boxplots comparing the results obtained from the three Groups for the three dimensions](image)

(SAM’s pictographic scales are represented in the Y axis. The higher the responses appear in the Y axis, the more positive they are. Refer to (Hayashi et al., 2012b) for more details.)
The demonstrations of happiness and pride mentioned earlier were not only identified by observing students’ actions and expressions during the field observations (Participant Observation) from our qualitative research approach. We have also assessed their affective response to the XO laptop in a quantitative way. For that we applied SAM, the Self-Assessment Manikin (Bradley & Lang, 1994): a pictographic evaluation tool that captures the affective states of the subjects regarding an object or a situation. SAM has been successfully used in researches from different areas, as shown in (Hayashi et al., 2012b). Some results from initial assessments are reported in (Hayashi et al., 2012b) and illustrated in Figure 3. The results confirm the positive responses observed from the students. SAM assesses emotional responses in three dimensions: valence (or pleasure – indicating the positive or negative emotional reactions); arousal (or excitement or activation – indicating the bodily activation from the experience); and dominance (describing the feeling of being controlled or being in control of a situation or object). Figure 3 shows the results from three groups: younger children – from 6 to 10 years old (Group A); older children – from 11 to 14 years old (Group B); and teachers and employees (Group C). The result indicates that, in general, younger children present higher responses than older children (valence and arousal), even though they are not completely sure about how to use it (dominance).

Case 4. Student Volunteers

When the use of the laptops started to increase at Miotti, a new challenge was faced. The technical support team was not enough to respond to all demand from the more than 500 students plus teachers. The school did not have financial resource to hire people for the job. In order to cope with that problem, the school tried to follow the example of other schools that had similar laptop programs and encouraged students to volunteer as assistants. Similar to lab monitors, these students would help the teachers and their peers by giving them technical support for the use of the laptops.

Colvin (2007) calls this kind of activity Peer Tutoring as it “involves those of the same societal group or social standing educating one another when one peer has more expertise or knowledge” (p.166). In the project from Schultes et al. (2004), the responsibilities assigned to the students justify their fancier title: “Student Technology Consultants” instead of simply “lab monitors”. Colvin (2007) also lists the benefits of tutoring programs: elimination of hierarchical structures; increased motivation for students and tutors; and empowerment for tutors. According to Topping (1996), peer tutoring programs may result not only in intellectual or formal academic achievements, but also such projects may have “affective and attitudinal gains, social and emotional gains, self-image and self-concept gains, or any combination” (p.52).

At Miotti, the program was called “Student Monitor” and in its first edition it had as participants: 18 students from sixth to eighth grades, two teachers from the school and four researchers (from the fields of computer science, psychology and pedagogy). Initially, 68 students had signed up to join the program. The selection criteria were not based on the achievements of the candidates, but on their presence in the first meeting. This selection criterion, which was not based on students’ former knowledge or grades, might be a target of criticism from some educators. However, as Topping (1996) points out, even if there might be a traditional premise that tutors should be the ‘best students’, if tutors are average (or even less) students, both tutor and tutee may find cognitive challenges in their joint activities: “Although tutee gain may not be so great, the aggregate gain of both combined may be greater” (p.51). Nonetheless, most of the times the Student Monitors at Miotti were assigned to help younger children. "Supported (or 'scaffolded') exploration through social and cognitive interaction with a more experienced peer in relation to a task of a level of difficulty within the tutee's 'zone of proximal development' remains a theoretical cornerstone of peer assisted learning (Vygotsky)" (Tooping, 1996, p.52).

The Student Monitors had meetings with the researchers every two weeks. In these encounters, the students had the opportunity to share their feelings and understandings about their role. When asked about the most challenging experience in this program, one of the students reported that it was to work with handicap students. She was aware of the fact that the experience helped her to be more patient and to understand other people’s needs. Such kind of experience involve technical (the use of laptop), formal (observation of rules of behavior in social interaction, formal meeting, etc.), and informal (gathering with other monitors) aspects. The emotional and affective responses and outcomes transcend these categories, impacting these students life with valuable learning.
Discussion

The successful cases reported previously were not accomplished without difficulties. Even though the XO laptop had been specifically planned to be used in the context of developing countries, those who idealized the OLPC project probably were not aware of every situated challenges that may emerge in real life settings. Some of the challenges faced are commented here and summarized in Table 1.

Some teachers were reluctant to merge their practices with the new artifact, as it seemed a toilsome task for them to learn to operate the laptop. Even among those who were more familiar with new technologies, there were some more conservative teachers who preferred not to join interdisciplinary activities as they were not part of the official pedagogical plan.

The possibility of taking the computer home provides plenty of new opportunities for students and their families. For example, parents, siblings, neighbors may interact with the laptop, which contributes to the digital inclusion of the community. However, what we experienced in this school was the concern that some teachers and parents had about children’s safety. They feared that their children could be robbed in their way home. The concern of having the laptops stolen by own family members was also mentioned.

As not all children were able to take the laptops home because of the above mentioned problems, other problems arose: how to store those laptops at school? How to transport those laptops back and forth from the storage room to the classrooms? How to recharge the batteries of more than 30 laptops rooms with at most two wall sockets and not enough extension cords? As trivial as the solution might seem, the purchase of extension cords might not be so simple for most of the Brazilian public schools.

Another issue related to the technical layer was internet access. Miotti had broadband internet connection as well as wireless routers, which allowed students to do their jobs. However, the number of routers did not seem to be enough for students’ simultaneous connection: the internet connection was often slow and intermittent. The interruption in the flow of actions or thoughts caused by slow or intermittent internet connections might contribute to lowering the students’ levels of motivation and interest. Moreover, students often credit such failures to the laptop, instead of to the school’s internet network.

<table>
<thead>
<tr>
<th>Table 1. Some issues, related to each layer of the Semiotic Onion</th>
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<tbody>
<tr>
<td><strong>Informal</strong></td>
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<td>• Most parents would not be able to use the laptop and participate in children’s activities;</td>
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<tr>
<td>• Some teachers are not comfortable working with technologies they do not master.</td>
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The way a new technology is inserted in the school and the way the issues that may emerge are handled might influence how users affectively respond to that technology. The approach adopted by Miotti, which allows the school’s culture and practices to influence the use of the new technology, is expected to contribute to more positive responses from students, as indicated by the preliminary results of our investigation (Hayashi et al., 2012a). Activities that promote positive affective responses are important in educational contexts. Some renowned authors like Piaget and Vygotsky had already pointed out the importance of affect in learning processes. For Piaget, affectivity is an energetic source: the fuel that makes the motor of intelligence run, without changing its structure (Devrie, 2006). For Vygotsky, affect and intellect should be considered simultaneously in the process of making sense of things (Oliveira, 1992).

The cases from the previous section were taken from the real and complex scenario of a school’s ecosystem. For each of those cases, positive emotional and affective outcomes were identified. Table 2 summarizes some of the outcomes. They represent just a few of many opportunities that can emerge from such scenarios.
Table 2. Emotional and affective outcomes identified in each case/learning opportunity

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<th>Learning opportunities</th>
<th>Emotional and affective outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework at school</td>
<td>Collaborative learn-to-learn activity → teachers aware of learners’ emotional responses towards homework assignments</td>
</tr>
<tr>
<td>Interdisciplinary activities</td>
<td>Knowledge/information outside the boundaries defined by the label of a discipline → more motivated learners</td>
</tr>
<tr>
<td>Outside the school</td>
<td>Pride as indicative of the delight arising from the possession of the laptops → more motivated learners; impacts on self-esteem</td>
</tr>
<tr>
<td>Student Monitors</td>
<td>Learning about responsibility and social skills → impacts on self-esteem; empathy</td>
</tr>
</tbody>
</table>

Affective and emotional aspects were present in all interactions. Being aware of how affective responses take place as well as of the elements that triggers positive responses might help teachers and students to repeat those positive responses/experiences. That might contribute to more satisfying, productive and integrated learning opportunities. Therefore, we argue that not only the usability of a technological artifact should be considered in the design processes, but also its Affectibility (Hayashi & Baranauskas, 2011).

Conclusion

One of the challenges educational technology faces nowadays is to enrich the formal learning settings while maintaining a closer connection to the learners’ informal contemporary world. In this paper we brought to discussion the understanding of Information Systems’ formal, informal and technical layers of a framework, which may contribute to more holistic view of digital technology use in education.

We presented four different scenarios of XO laptops usage that illustrate how formal and informal learning might happen simultaneously. The cases shed light to the initial question “how can a new technology be implemented in schools in a way that it makes sense to the users?” Moreover, the combination of different practices allowed learning in different places (at home and at school) with different learning intentions (be them explicit or not) to be merged into more interrelated learning scenarios. Therefore, the cases suggest a positive response to the question “Could that technology contribute to more integrated learning scenarios?” The cases were a result of Workshops conducted in the scope of the XO Project (2010), and of Participant Observation on teachers and students daily practices.

Emotional and affective aspects were visible in all case scenarios, suggesting their need to be explicitly accounted during the design of technology for educational purposes.

References


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Eraut, M. Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology*, 70, 113-136.


OLPC. http://one.laptop.org/ (last access: Jan., 2011)


