Fiabot! Design and Evaluation of a Mobile Storytelling Application for Schools

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ABSTRACT
This paper contributes to the ongoing debate about how digital technology can be integrated into the formal education system. Within a longitudinal research study, which lasted four years, we conducted an investigation on how mobile technology can support educational activities as defined by a school curriculum. Among the topics included in the school curriculum, we focused on the literary field and developed a Digital StoryTelling (DST) application, Fiabot!, to support this activity. Here, we describe the design of the application and how we evaluated its impact on educational activities. The application was designed and evaluated in two primary schools. The study had the objectives of exploring whether Fiabot! supports children in achieving educational objectives defined by the curriculum, how this effectively supports teachers, and to what extent children like using it for the creation and sharing of their stories. Our findings show that the application has a positive impact on curriculum enactment and effectively supports the related educational activities. Overall, Fiabot! was demonstrated to be very effective in stimulating children's discussion of a story's plot and characters. Thus, Fiabot! supported children not only in being creative but also in organizing their work and exploring a digital media opportunity. This resulted in the development of new skills and the better grounding of previously acquired knowledge, while teachers also had the opportunity to expand their teaching skills and get a taste of ICT's potential in education.

Categories and Subject Descriptors
H.5.2 [Information interfaces and presentation]: User interfaces – *Prototyping*

Keywords
Child-Computer Interaction; Formal Learning; Mobile Learning; , Digital Storytelling .

1. INTRODUCTION
The last decade has seen growth in the use of digital technology in educational contexts. Digital media and artifacts change the nature of learning and teaching by substantially modifying the ways in which pupils and teachers access and manipulate information. This phenomenon has raised the interest of several communities; now, it can be studied from different perspectives, including learning science and interaction design. Therefore, being a relatively recent field of study, many issues still need to be explored. We are contributing to this debate by carrying out a research project where we explored the extent to which digital technology can support primary school curriculum enactment and have investigated how to introduce it into existing practices. In order to address these issues, we organized a series of case studies in two primary schools. We focused on a specific area of the curriculum, such as the Local/First Language, and the subarea of literature and narrative genre. Among other linguistic competences, children have to learn how to write a narrative in different literary genres. Teachers train children by asking them to read and write stories that correspond to a specific genre in order to teach them its specific elements and structure. Often the creation of stories is done in groups since the development of social skills is an aspect included in the curriculum. In addition, this activity comprises the training of additional abilities included in the official program such as social skills, creativity, and media literacy. The study as a whole has produced several outcomes, including: a set of guidelines for the design of Digital StoryTelling (DST) intervention in schools [17], a model for illustrating the teacher's role—as the main curriculum implementer—in using digital media/devices in school [18], and a prototype of the DST application Fiabot!.

In this paper, we describe Fiabot! and the results of its evaluation in real educational contexts. In the next section, we present the background of our research project.

2. BACKGROUND
The interest that researchers and educators increasingly manifest in the introduction of digital storytelling in education is primarily linked to its potential for fostering educational benefits, thus complementing the role held traditionally by storytelling as a teaching and learning tool. According to Bruner [2], the narrative is a primitive function of human psychology and a fundamental aspect in the construction of meaning. In these perspectives, narrative is a way of mediating the construction of meaning and a child's organization of knowledge to express creativity and use the imagination. Indeed, human creativity rests upon real experience of the world. Considering the theory of imagination routed in the Cultural-Historical approach [22], each creation is founded on elements taken from reality that are already present in an individual's past experience. In addition, creative activities that are carried out in groups produce great benefits [13] in regard to teaching social skills [12]. Designing technology for a formal environment such as a primary school requires particular attention to the integration of the technological artifacts in the school curriculum. This does not imply an exclusive concern with the resulting artifact but does cover educational activities as well.

As argued by Lewis et al. [11], the design of educational technology is not limited to the system being developed; it includes the range of activities that the system can support and the learning benefits that students gain from completing them successfully. Some systems have been designed purposefully to encourage children's collaboration and foster the development of collaborative skills. For instance, Benford et al. [1] report an approach called "encouraging collaboration," which motivates children to work together and see the benefits of cooperative work. From this approach, systems such as *KidPad* and *Klump* [1] have been developed. Other systems have been designed to enhance the development of particular sets of attitudes, knowledge, and skills. For instance, some tools can assist the development of specific knowledge such as programming, e.g. *Storytelling Alice* [7]. Some interesting attempts have been made in the direction of mixing analog and digital content to create digital storytelling, as seen in the work of Halloran et al. [8] and the POGO Story World [4]. More recently there has been the CASTOR (Context Aware STORytelling) project [14], which is a mobile-based authoring system that allows children to collect and modify material on a single device, in this case, a tablet. These projects are multifaceted; they are also quite complex and can hardly be efficiently integrated into a school environment with respect to the timing and scope of an educational curriculum. Besides research prototypes, there are a variety of applications available on the market that allow children to produce interactive stories, e.g. StoryKit, Story Dice, YouFable, etc. However, these are entertainment-oriented and do not have the goal of supporting formal learning activities.

Our system, grounded in the curriculum and stakeholders' requirements, is focused on solving a specific issue. Indeed, we aimed to develop a feasible application that could support a specific activity and be harmonically integrated with other school activities.

3. THE RESEARCH PROJECT

The overall research project lasted four years and had the purpose of exploring **two main research aspects**:

i) understanding how technology can support school curriculum,
ii) investigating how to introduce that technology in the existing teaching/learning practices.

Indeed, the research started in 2009 and ended in 2013 with the evaluation of the prototype. We conducted the overall project by involving two primary schools in Lugano, Ticino region (the Italian-speaking area in Switzerland): the Leonardo da Vinci (LDV) and the Istituto Elvetico (IE). During the four-year study, we actively engaged the schools' stakeholders in the process: approx. 130 pupils (ages 6 to 11), 4 teachers, and 2 school directors. Overall the project consisted of three main stages:

1. Analysis of how storytelling activities are usually done in class, without the support of any digital technology;
2. Introduction of applications and digital devices in class for DST production; and
3. Design of a new DST tool and its evaluation in context.

In this paper we report on the work done and the findings obtained in stage 3 and we provide a brief overlook of stages 1 and 2: for more details on the first two phases the reader may refer to other publications ([17][18][19]).

3.1 The School Curriculum

School curricula are designed to support child development in clearly-outlined stages, with a focus on the sets of abilities and knowledge children are known to acquire throughout their educational trajectory. In addition, it is important to focus on the teacher as the real driver of school curriculum enactment. Thus, the design of any technology and intervention has to be conceptualized and shaped according to the curriculum and those who enable it. The Swiss government defines the primary school national curriculum in an official document [23]. This text specifies: the expected learning outcomes, the resources for each discipline and their organization, the educational strategies to be used, the teaching methods to be employed, the assessment procedures, and the procedures for managing the curriculum. The curriculum includes six main subjects: First Local Language, Second Language, Science-History-Geography, Art and Physical Expression, and Religion. Primary school is divided into five years and children start school in primary one when they are six years old.

As previously mentioned, we focus on a specific area of the curriculum: Local/First Language and, in particular, on the subarea of storytelling. In the creation of a narrative, children also develop other linguistic competences such as phonology, spelling, morph syntax, and lexicon. In accordance with the curriculum, each teacher has to dedicate two hours per week to this activity. The educational goals change according to the ages of the children and the school grade. Involving the school and its various stakeholders—in particular, teachers and students—is essential to effectively achieving the educational benefits defined in the curriculum. In addition, the inclusion of students' and teachers' voices in the design process acknowledges their role in the co-construction of innovations in educational practices and helps to address the research in terms of concrete curriculum needs. We decided to engage these two schools since their official curricula are identical for the part concerning the literary genre topic. Moreover, the teachers and directors were very open and positive about introducing technology in class, and their active participation greatly helped the exploration of new opportunities. One school was involved in all the three phases of the study, while the other took part in the study from the middle of the requirements elicitation until the end—phases two and three. We included a second institution in order to enrich and consolidate the requirements gathered from the study in the first school. Therefore, in this paper we report on the involvement of both schools in the last part of the project. Indeed, for the evaluation phase we selected two classes (grades 4 at IE and 5 at LDV) and carried out the study with children aged 9–11. According to the curriculum this is a particularly interesting group to work with because the children already had experience in using digital technology, and the development of literary genre skills is a priority. Thus, Fiabot! has been evaluated by 43 students and two teachers across two different but comparable institutions.

In the next section, the methodological approach taken within the overall project will be described and then the last phase will be focused upon.

3.2 Whole project methodological approach

From our perspective, the design of technology for improving an educational experience goes beyond the simple use of a digital device to support the learning process. Considering that the artifact has to be introduced into already existing practices, we needed to take a holistic perspective that looks at the overall learning experience, including the interaction between teachers, learners, and educational processes. Throughout the entire project, we applied a qualitative approach, and we used different methods and techniques in order to investigate the activity in detail and

collect as much consistent information as possible, based on a methodological approach inspired by cooperative [6] and participatory design [20]. In the study, we considered students, teachers, school directors, head teachers, and technicians as the main stakeholders. We interviewed all the school stakeholders following the contextual inquiry [16] technique. After a first broad interview, we focused on the in-depth analysis of the activities of the teachers and pupils in class. According to the curriculum, a teacher has to dedicate two hours per week to the writing lab. Thus, we designed our research study according to their schedules in order to avoid any disruption to the class organization caused by our presence during this activity.

In the next section we provide more details on the project phases.

4. PROJECT PHASES

As mentioned above in the third section, the research project was split into three phases. In the following, we describe in brief the project stages in order to give an overview of our work as a whole ([17][18][19]).

4.1 Analysis of how storytelling activities are usually done in class, without the support of any digital technology

The aim of this phase was to elicit user requirements and understand how the teachers enacted the curriculum. In this phase, we analyzed the activity before the introduction of any technology. It was particularly useful to gather findings on how teachers enable the curriculum in a canonical situation. In particular, we investigated the learning styles, teaching strategies, and the children's attitudes when working in groups [20]. Teachers, as curriculum enactors, were interviewed before and after each session of the writing lab. The interviews with the teachers before the writing lab were aimed at understanding their skills and the children's abilities in using digital technology, as well as the pupils' knowledge on this specific topic. After each session, we asked teachers to reflect on the activity run within the lab, and we focused on specific issues: the quality of the stories created, the type of collaboration within the groups, how they used artifacts, and the production of content. Observations were also gathered during the activities and then analyzed to provide us with an insight into the pupils' and teachers' user experience in using the artifacts to achieve their goals. We observed human-artifact and human-human interactions in order to identify possibilities for design. Afterwards, we conducted a focus group with the pupils to explore the breakthroughs and breakdowns of the activity. The focus group findings were based on the children's self-perception of the positive and negative aspects of the story-creation experience. During the writing laboratories, the children worked in small groups of two to four members to create stories. As mentioned above, through the group work, children can also develop their social skills, which are important pedagogical objectives established in the curriculum.

Figure 1. Children create stories using only analogical artifacts, without digital technology.

The stories had to follow a particular structure and content according to the literary genre that the teacher was explaining in that particular instance—e.g. fairy tales, fables, comics, etc. However, regardless of the type of narrative, the stories contained text and images (fig. 1).

4.2 Introduction of DST tools in class.

This phase has the objective of refining the requirements identified in the previous phase by directly introducing digital artifacts and applications into class activities. In the second phase, we used the technology probes [10] approach in order to refine the requirements elicited in the first phase. This approach is based on the use of digital technologies in class to support specific educational activities. During our research, we tested and evaluated many hardware and software solutions, from desktop computers to portable devices, such as the iPad™, and from web-based tools to desktop and mobile applications. We gathered data using the same approach used in phase one, through: a contextual inquiry with the teachers (before and after), a focus group with pupils after, and observation during the sessions.

This phase produced interesting insights in terms of the suitability of software and hardware to support educational benefits within a specific activity. These outcomes informed the research team about the opportunities and limits of the tools in a real context. Moreover, from the data analysis it emerged that the most suitable solutions are based on the use of portable/mobile devices. Thus, we decided to use the iPad™ to create our prototype.

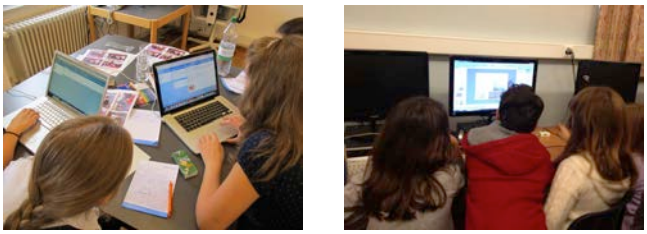

Figure 2. Phase two: children use laptops in class and desktop computers in the informatics lab.

All these findings were elaborated and merged into a set of design recommendations [17] that drove the design of a DST application.

4.3 Design of a new DST tool and its evaluation in the field.

The purpose of this phase is to elaborate the user requirements, and develop and evaluate the application to understand the impact of the tool on curriculum enactment. In phase three, we transformed the requirements into design parameters, and we built the application Fiabot!. Following the Houde and Hill approach [9], we developed low- and high-fidelity prototypes and went through many iterative cycles of design-evaluation-redesign. We will explain how we ran the final evaluation in more depth in section 6.

Considering the curriculum, and according to the teachers, we decided to target the application toward children aged 9–11, grades 4 and 5. At this age, the children have already studied the main features of narrative genres and are more focused on training their linguistic competences. Indeed, teachers asked children at these levels to practice the style, learn the structure (of the narrative type), and be creative in inventing a plot. These are the main educational objectives that have driven the design of the prototype that we present in the following section.

5. THE "FIABOT!" CONCEPT

"Fiabot!" is the name of the mobile application that we designed, prototyped, and tested in phase three. Fiabot! is an iPad application that enables the creation of interactive and multimedia stories. This application fits with class activities; thus, Fiabot! provides children with the opportunity to increase their ability to create a specific story genre. According to the curriculum and the teaching practices, Fiabot! provides indications of the structure and "ingredients" needed for each story type as well as reinterpreting and formalizing the workflow of the story creation.

In Fiabot! we propose for each literary genre a structure and a "list of ingredients" that inspire the children while they are creating the plot of a story and inventing the characters. These elements are well defined by the curriculum and stand as the basis of a teacher's explanation. The other important aspect is the workflow. This is not defined by the curriculum itself but is well established within the teaching practice. It should be noted that the same activity workflow emerged from all of the classes included in the study. Thus, on the basis of this activity process we defined three modules:

I) Definition of story structure and plot;
II) Media creation and editing;
III) Sharing within the class and publication of the story.

Each module corresponds to a specific step that the child, or the group, has to accomplish in order to create an interactive multimedia story. This structure was inspired by the observation of the activity in class, and, in addition, it overlaps with the Narrative Activity Model (NAM) [4]. The NAM articulates the narrative creation process in four stages: exploration, inspiration, production, and sharing.

Considering this model, each Fiabot! module can support a specific stage of the process: the first module supports the *exploration* and *inspiration* stages, the second the *production*, and the third the *sharing*.

The following section explains each module in detail.

I) Definition of story structure and plot.

According to the curriculum, each literary genre has a specific structure, plot, and content architecture. For each type of narrative Fiabot! provides a model of the structure to follow in order to create a complete story. This model is the same as the one used by the teacher during the face-to-face explanation. In addition, in Fiabot!, the ingredients needed to create the story are grouped according to the specific narrative genre. For instance, the fairy tale ingredients are: the antagonist(s), the protagonist(s), the protagonist helper(s), the antagonist helper(s), and the magic object(s). Children can specify detailed features for each of them (fig. 3). The defined ingredients will be shown on the story stage whenever, according to the structure of the story, they should be presented. For instance, a myth is made of a beginning (time, place, and explanation of the facts), development (characters plus a magic event), and a conclusion (the event modifies the reality, bringing things to the way they are at the moment).

This module supports the NAM phases of exploration and inspiration. Therefore, during *exploration*, pupils have a direct or mediated (by social relations or tools) interaction with the environment (e.g. a field trip, a book, or a movie). The input gathered in the experience is later elaborated on in the narrative process, while the *inspiration* phase is the moment in which children can understand the different aspects of their experience and dissociate from it. In this phase, they can analyze and reflect upon what they have experienced by producing new content.

Figure 3. The "list of ingredients" for creating a fairy tale.

Figure 4. Fiabot!'s box with details for each "ingredient".

II) Media creation and editing.

One of the requirements of the curriculum is that children interpret and learn to use different media languages. In this module, children can create, import, and edit different media that can then be used in a story. The story contents can be very heterogeneous, i.e. images, photos, videos, music, audio, and animation. These can be found and created in different ways: using pen and paper, downloaded from the Internet, or produced using the native iPad application. All of these media can then be inserted into the story stage by importing them from the iPad photo gallery. Moreover, using the tablet camera it is possible to digitalize and import handmade drawings. All of this content can be used and mixed within the story in order to convey a unique, clear message (fig. 5).

Figure 5. An example of part of a story that uses drawings imported into the tablet, a sketch done with an iPad app, and the icon of an audio file recorded with an iPad app.

This module enables the *production* phase that corresponds to the association process and allows children to elaborate new content using different expression modalities. In this stage, children externalize the product of their imagination and express their emotions by producing a story. The story can take different forms, e.g. writing, drawing, and speech.

III) Sharing in the class and publication of the story.

As stated in the curriculum, the collaboration and understanding of social rules is quite relevant in the cognitive development of a child. Thus, sharing is an essential moment in this process. Indeed, even in phases one and two, the writing lab included a plenary presentation session during which all the students presented their stories to their classmates. With Fiabot! children can publish and share their stories with their classmates or a wider

audience, such as other schools. Having the potential to show the results of their efforts is important for children, and it helps to improve agency and self-esteem. Stories can be delivered in different formats that are automatically generated by Fiabot!, e.g. website, video, newspaper, etc. The stories in different formats are published on a website accessible through a password; they are organized on a bookshelf and available for the children's families and other people who want to read them.

The third module supports the fourth phase, which is *sharing*. This last phase concludes the cycle that begins with exploration. The expression modality can go from verbal to bodily and be enhanced with other elements such as music.

Fiabot! has been through several iterative cycles, during which a few lo-fidelity prototypes were assessed and refined. As a result, we successfully produced the first version of Fiabot!, which was used for the evaluation of the study; it is presented in the following section.

6. EVALUATION OF FIABOT!

The Swiss primary school national curriculum defines: the expected learning outcomes, the resources for each discipline and their organization, the educational strategies to be used, the teaching methods to be employed, the assessment procedures, and the procedures for managing the curriculum. Teachers have to report whether or not a class has fulfilled the specific requirements. Fiabot!'s features are the explicit answer to the curriculum and users' needs: it is for mobile devices and supports the Swiss educational program's enactment. The evaluation session aimed to answer these questions:

A) To what extent can Fiabot! support children in achieving educational objectives defined by the curriculum?
B) How does Fiabot! effectively support teachers?
C) To what extent do children like using Fiabot! for the creation and sharing of their stories?

Thus, in order to assess the impact of Fiabot! on curriculum enactment, we had to design the evaluation session by looking at these topics as well as the organization of educational activities.

6.1 Methodological Approach

We explored these questions by involving both teachers and students. We applied various methods of data gathering and analysis in order to improve the validity of the study, such as: contextual inquiry, focus group, observation, and story evaluation.

Thus, the collected data covered the following areas of investigation: 1) improvement of curriculum enactment, 2) development of children's educational benefits, and 3) teaching practice enhancement. The contextual inquiry was conducted with the teachers (as in the previous phase) after the evaluation session with the purpose of investigating the perceived impact of Fiabot! on their teaching practices and on the children's activities in class.

The focus group with pupils was aimed at gathering their points of view in a collective discussion. We asked about their overall experience and whether or not they perceived themselves as having improved their skills. Data from the contextual inquiry and focus group were transcribed, coded, and analyzed. Coding and analysis were conducted in the vein of thematic analysis, standing mid-way between an inductive and deductive coding approach [5]. The transcribed data were initially coded in an inductive manner, identifying relevant data patterns that were then associated with themes. In a second wave, the relevant themes were grouped in relation to the three macro-categories mentioned above. Data was reread to refine the emerging themes, and relationships between the themes were drawn in association with each macro-category. The analysis was done to evidence the themes and associations between them. In the final stage, the results were interpreted with regard to the outcomes of the other evaluation methods.

In addition, the observation allowed the researchers to gain an overview of the activities in class, and in particular, to observe interactions within the groups. Notes were transcribed and used to support the other set of data.

Teachers evaluated the stories according to a set of criteria inspired by the curriculum: Creativity, Collaboration, Media Literacy, and Consistency with the narrative genres.

This evaluation was aimed at indicating whether or not the children had achieved the learning targets defined by the current educational program, and how many children had accomplished them. In giving a score, teachers considered the quality of the outcomes (the stories) as well as the process of narrative creation. Moreover, the evaluation score was motivated by articulated feedback in which each teacher compared this result/process with the canonical activity without the support of any digital technology. The researchers assisted the teachers in the process of story evaluation. We observed that the teachers were consistent in their evaluations. Using the same criteria, each story was also evaluated by one researcher and another teacher. The three evaluations were quite homogeneous.

6.2 Evaluation Criteria

6.2.1 Creativity

The teachers specified that they usually evaluate the creativity of a story by looking at the originality of the plot and characters. They agreed on the creativity definition given by Vygotsky [21]: creativity is a process of combining past experience and reality. The teachers gave a high score to the stories that demonstrated an original combination of different elements and their elaboration, while stories that had no original elements or were merely a copy of a movie or book received a low score.

6.2.2 Collaboration

An important goal specified in the primary school curriculum concerns the development of affective and social education. In psychology, the benefit for children of developing collaborative behavior is well known [22]. Children have to develop social skills and learn how human and social organization works. Thus, starting from the first grade, teachers organize class activities to include group work. In our evaluation the score was higher when the children demonstrated the ability to distribute the tasks among themselves with the purpose of successfully achieving the educational objective and involving all the members of the group. When one or more children were not engaged in the activity, the group scored more negatively.

6.2.3 Media literacy

The Swiss curriculum provides a space for training students on media literacy mainly using a word processor and Internet browsing. Young people are considered digital natives [15] because of their natural ability to understand how digital media works and how to access online resources through self-acquired skills and competences. However, recently even Prensky reported on the younger generation's lack of "digital wisdom" [15] and in particular touched upon how poorly children are supported by existing educational curricula. Educating pupils and enhancing their media literacy is concerned not only with computer usage

and Internet browsing but also with the ability to create digital content and use it to communicate effectively.

Teachers gave positive feedback when children used digital content consistently within the story. Media can include voice, music, images, drawings, video, or animation and digitalized handmade drawings. In particular, teachers looked at the harmonization of this content within the narrative. A negative score was given for stories in which media was not a real added value or was used without any purpose.

6.2.4 Consistency with the narrative genres

In the curriculum, it is specified that children have to learn several literary genres: fairy tale, fable, tale, myth, and legend. Each genre has a precise structure and is made of specific "ingredients" that the child has to identify and learn to use in the creation of narratives. In the evaluation session we focused on the fairy tales genre since this was the main topic of focus in grades four and five. The fairy tales follow a structure with a beginning ("Once upon a time . . . ."), a middle, and an ending ("They lived happily ever after."). In addition, a fairy tale has these ingredients: the protagonist/hero, the anti-hero, the hero helper, the anti-hero helper, and the magic object/animal. A good story, worth a high score, had to include all the ingredients and be consistent with that specific structure. Teachers gave low scores to students who did not respect the required structure or omitted ingredients.

6.3 Using the Criteria

The teachers evaluated each story by providing a textual feedback and a score (from very poor (0) to very good (5)) for each of the above-mentioned criteria. In the assessment, both the outcomes (the fairy tales) and the process of creation were considered. The teachers' perspectives enabled us to understand the suitability of Fiabot! for accomplishing the curriculum objectives and to comprehend its impact on teaching practices and the children's learning processes. In addition, the children's viewpoints were useful in order to understand their experience in using Fiabot!.

In the subsequent sections, we present the setting where the evaluation took place and the procedures we followed.

6.4 Participants and Setting

The evaluation of Fiabot! was conducted within two schools. We engaged all of the school staff to design the study while the test was carried out in two classes. That involved two teachers (one in each school) and 43 children, in grades 4 and 5, aged 9–11. We decided to carry out the evaluation with a small number of teachers in order to conduct an in-depth analysis in two specific contexts. Moreover, working closely with the two teachers allowed us to gain their trust and confidence. In each class, we conducted two evaluation sessions—the second took place one month after the first one. Children were grouped in small teams of up to four members each. Each team was built to have a good balance in terms of specific pupils' abilities, covering: digital literacy, social skills, creativity, and knowledge of the curriculum topic. Thus, the teachers assigned children to groups using their deep knowledge of the children's skills, attitudes, and personalities so that the groups would have comparable strengths and abilities.

6.5 Procedure

Each evaluation session lasted for four days and was articulated in three stages:

i) Children's training, 1 hour
ii) Creation and sharing of the stories, 6 hours each day
iii) Focus group and contextual inquiry, 3 hours

i) Children's training.

The researcher trained the class on how to use Fiabot! for one hour, during which they also tried to create a short story. However, children in both classes already had experience in using the tablet as well as some tools for the shooting and editing of video and images, drawings, and audio recordings. Thus, the novelty effect was quite low. In the second session, the training was not replicated since the children already knew how to use Fiabot!.

ii) Creation and sharing of the stories.

The objective of the activity assigned to the children was to create a fairy tale using Fiabot!. The teacher explained to the children the objective and then organized them into groups. In the creation of the plot and the drawings children could use both digital and analog artifacts (pen and paper). Analog texts and drawings were then transformed into digital content by taking a picture of them with the tablet camera or by copying the text using a native text editor app. When all of the stories had been created, each group presented the narrative to their classmates in a plenary session. During the presentations the teachers made the evaluations using the predefined set of criteria.

iii) Focus group and contextual inquiry.

After the presentation of the story we separately conducted a focus group with the children and a contextual inquiry with the teachers.

At the end of the evaluation session the children had produced a total of 17 stories using Fiabot!.

7. FINDINGS

We collected data using different methods and by taking different perspectives. Indeed, we analyzed the experience in the class from the points of view of the teachers, pupils, and researchers. Each perspective contributed to highlighting specific aspects and looking at particular facets. Data gathered through the contextual interview, the focus group, and the observation were treated separately and analyzed according to the specific method—i.e. interviews and notes were transcribed and coded. Afterwards, we looked at the whole corpus of data and organized it in order to answer our research questions. Here, we present the results of the study organized according to our three research questions.

7.1 A) To what extent can Fiabot! support children in achieving educational objectives defined by the curriculum?

As evidence of the impact of Fiabot! on supporting children to achieve educational objectives, we used teachers' assessments of the stories (following the four criteria introduced in 6.2), and their comments and notes. Each teacher evaluated the stories produced by the children in their class. In their assessment, they considered not only the final product, but also the process of production. Overall, the stories met the curriculum indications quite well and fulfilled many of the requirements and even the desiderata set by the teachers, which were in line with the school curriculum, both from the technical and pedagogical points of view. Indeed, as shown in the table (table 1), the scores were quite high. In the upcoming section, we discuss the assessment according to each criterion and quote some of the most relevant teacher comments.

7.1.1 Creativity

The evaluation of creativity was based on the ability of the children to combine elements of past experiences and reality.

Sixty percent of the stories obtained a very high score. Teachers in many cases appreciated the originality of the plot and in the choice of characters. As stated by teacher 1 (T1), "*I really liked how in the plot 'Virginia the vain' children integrated some episodes from one child's family with other elements that were invented. The plot is very consistent and these elements merged perfectly within the economy of the story. Another good example is the 'Luke and the savior' story. Children took inspiration from [The] Hunger Games but they didn't copy the game.*

Table 1. Evaluations of student stories (N = 17)

	Creativity	Collaboration	Media literacy	Narrative genres
Rebecca	4	4	4	2
The past in the future	4	5	2.5	3
The dragons and the family stone	5	5	4.5	4.5
Luke and the savior	2	5	1	5
Clouds and problems	4.5	5	5	5
Jonny and the giants	1.5	5	4	4
Everything happened in one night	5	5	4	5
The crown	4.5	5	5	5
Lucia's savior	3.5	4	4	5
Searching for the gold and silver tree	5	5	5	5
Virginia the vain	4	5	4	3.5
Romea and Giulietto	2.5	4.5	5	4
The adventure of two friends	3	5	2	5
The jewels of the Queen	5	5	4.5	5
Discovering the sweetie world	5	5	5	5
The kidnapped princess	2	3.5	3	3.5
The knight Aghoss	3.5	4.5	5	4.5
Mean of rating	**3.9**	**4.8**	**4**	**4.5**

They used the strategies of the game in the story by creating complex narrative mechanisms that were very intriguing for the audience. I have never seen this kind of connections [sic] *before using Fiabot! In addition, I have noticed that there was an improvement in the level of discussion and engagement of pupils in creating the character of the story and the plot. It was quite surprising!"*. The other teacher (T2) mentioned how module 1 of Fiabot! was useful in conceiving the narrative mechanisms before writing: "*In Fiabot! children are asked to define the characters/ingredients before the creation of the story. This allowed them to discuss about the plot as well as to talk about their experiences that might fit in the story. In addition the way Fiabot! easily allowed them to explore Internet contents let them to* [sic] *find the information they needed for the plot."* As reported by all teachers in the interview, the originality of the plot was sometimes expressed through the unexpected behaviors of the story's characters or imaginative creatures made of a mix of different animals. For instance, in the "*The kidnapped princess*" story we can find both elements. "*Federica, the ant, spits poison from her mouth that dissolved the griffon."* The ant is hero Jack's helper and the griffon is a legendary animal, half lion and half eagle (see fig. 6).

Figure 6. The drawing of the griffon inserted and used in the *The kidnapped princess* story.

7.1.2 Collaboration

This criterion obtained the highest grade: 90% of the stories were valued with a score between 4.5 and 5. Teachers reported that the collaboration among children greatly improved with the use of Fiabot!, especially because it encouraged the organization of work within a group. T1: "*I have noticed that the workflow of Fiabot! imposed on the children to discuss about how to distribute the work within the group. Especially the first module—definition of story structure and plot—helped them to reflect on the type of story they wanted to create. They listed the tasks and then distributed the work according to the abilities of each member."* T2 on the same topic commented that: "*Fiabot! stimulated group discussion on the plot of the story and allowed a reflection of pupils on their abilities and skills. Children demonstrated a great maturity in focusing on the final objective and sometimes in overcoming personal wishes. In some cases, one member led the distribution of tasks. This depends on the children's temperament, and it is perfectly in line with other experiences we* [have] *had in class."* Nonetheless, two stories received a low score (3) because the process of organization was not effective, and one or more members were isolated from the group. Both teachers agreed that in these cases, the story was badly affected by the poor collaboration. Reflecting on the whole experience, teachers also commented that the positive feedback reinforced the children's belief that teamwork is a great asset in supporting educational achievements.

7.1.3 Media literacy

In their assessments, the teachers reported how the opportunity of using different media had a great impact on the quality of the stories as well as on supporting the creativity of the children.

T2 stated that "*In the story 'Everything happened in one night' the use of audio was amazing. Children created a blues ballad to describe the main characters of the story. In addition, the associated images of the characters gave a great added value to the audio and text: listening* [to] *the song while looking at the images had a great impact* [fig. 7]. *The options offered by Fiabot! in module 2—Media creation and editing—encouraged children to use different types of media. Children could experiment in creating, editing, and also merging different contents. They produced a large number of audio files and images and then, with the help of Fiabot!, selected and arranged these on the stage of the story. I found Fiabot! very effective in allowing children to*

edit and integrate media with the purpose of enhancing the communication of the message to the audience."

T1 added, *"The opportunity offered by Fiabot! for creating, editing, and importing different media allowed the children to understand the different features of each of the contents. In addition, looking at the stories, it is evident how children explored the different languages in order to understand which was more suitable and added value to the story*.

Figure 7. A screenshot of "Everything happened in one night."

In addition, I really appreciated how children spatially organized the media and combined handmade and digital images [fig. 7]*, text and sound* [fig. 8]. *This was possible, thanks to the Fiabot! flexibility in arranging contents on the stage of the story."*

Figure 8. An example of the audio and images within the text.

During the interviews, both teachers agreed on how much the children had improved their literacy skills while using the tablet to create text, images, and sound. Many times, they underlined how their literacy had remarkably improved and how Fiabot! had had a positive impact on the development of these skills.

7.1.4 Consistency with the narrative genres

The teachers also gave a very high score to the stories with regard to the consistency of the narrative within the fairy tale genre. Out of all the stories, 70.5% of them received a score higher than 4. Indeed, the teachers reported that they were very satisfied with how the children learned to create stories and how Fiabot! was a useful tool for reinforcing the recall of the content presented in class. T2 explained, *"I can affirm that Fiabot! helped children to consolidate their knowledge in this genre. For instance, when they had to conceive the ingredients in module 1 they discussed a lot about the possible characters and the plot. This module allowed them to brainstorm and then to focalize. In addition, during the discussion they used the appropriate language to indicate the characters and other elements of the story* [in a way that has] *never happened before. This indicates clearly that Fiabot! reinforced the recall of the information provided in the* [initial] *lecture and effectively supported the acquisition of this knowledge."* T1 added, *"I can see the benefit of using Fiabot! from the way they built the plot of the stories. They created correct narratives but they used the elements of the story in a creative and unusual way. For instance, the protagonist of one of the story* [sic] *is the crown, not a person, but a magic object! This choice is quite original and correct at the same time."*

As seen from the data analysis, the teachers were enthusiastic about the application. Fiabot! appears to support children in achieving educational objectives defined by the curriculum. Probably the biggest challenge for the children was to find the right balance between creating a complete fairy tale, being creative, using digital media for a purpose, and conveying the message of the narrative.

7.2 B) How does Fiabot! effectively support teachers?

The contextual inquiry done with the teachers, together with the researchers' observations, allowed us to better understand the role of Fiabot! in supporting the teachers in achieving the educational goals defined in the curriculum as well as in enhancing their teaching practices. Overall, the teachers and school administration really appreciated the way in which we conducted the study from the outset. Indeed, even if the narrative is part of the curriculum, we had to define the activity in terms of time, objectives, and practices. Starting from the initial stage of the study, the team and the school stakeholders worked very hard to refine our intervention in the school and integrate it within other running activities. As a result, the way in which we organized the activity was effective from the project perspective while simultaneously avoiding any disruption to other curriculum-related activities. As reported by T1, "*The integration of digital technology within the training of the first language was particularly useful especially for children who could explore the opportunity given by digital media and artifact on purpose."* T2 states, *"This practical activity well supported the explanation in class. In addition the use of Fiabot! introduced a new challenge such as to learn how to use media language in a coherent and creative way. In addition, it gave the possibility to recall the contents already discussed in class by creating a story."* The use of the tablet and digital media for a specific school activity, part of the curriculum, changed the children's perceptions of using digital artifacts. T1 stated: *"An important message that I tried to convey to the children is that tablets and mobile phones have a value and that* [they] *are not toys. After using Fiabot! children perceived clearly the importance of the tablet that could allow them to learn new things as being author of a multimedia story."* In addition, the use of Fiabot! improved the teachers' awareness of the possibility of using the tablet in other educational scenarios. T1: "*This experience encouraged me to expand the use of digital media in other class activities. For instance, I started to use video to show scientific phenomena in class. I found it very useful and I think that it could change significantly the way I teach."* Moreover, the use of Fiabot! engaged teachers in activities that enhanced their self-esteem. T1 said: *"Now that I understood how to create a multimedia story I feel more confident in using also other technology* [such] *as the smart board.*" T2 reinforces this concept, adding: "*Technology helps us to keep focused and motivated, and enforces a positive attitude towards the use of digital media in class and the storytelling task*."

We asked teachers what their opinions were concerning the other advantages of using Fiabot! and T1 replied: "*Overall, children are more active in the creation of the story using Fiabot! than using other canonical artifacts. The tablet was very attractive, encouraged them to be more active and improved the level of engagement. In particular, the way Fiabot! gave the children the opportunity of being authors of something original and unique that could be shown to their friends and family. This was very satisfying for them."* T2 agreed that Fiabot! stimulated the agency in creating a multimedia story and improved the pupils' self-

esteem: *"Stories in general were very rich and well done. Thus, pupils were satisfied of* [sic] *their work and felt* [themselves] *to be author*[s] *of multimedia contents. This helped me a lot to reinforce their self-esteem which is a fundamental element to which the elementary school is addressed."*

7.3 C) To what extent do children like using Fiabot! for the creation and sharing of their stories?

The focus group after the session helped us explore the experience from the children's points of view, as they could freely reflect on their experiences. The evidence we gathered is based on the children's self-perceptions. During the focus group we asked children to write down on Post-it notes their main issues regarding the different aspects that emerged during the discussion, e.g. their contribution to the activity, the part of the story s/he proposed, their most-liked experiences in using Fiabot!, their level of satisfaction, etc. Very interesting aspects emerged from the thematic coding analyses. Regarding their contribution, the most quoted items were connected either to the practical—e.g. "*writing*," "*drawings*," or "*coordinating the group*"—or to the conceptual activities, e.g. "*creating the characters*," or "*giving tips on the story plot*." Concerning their contribution to the story, the children quoted the "characters" (e.g. "*the evil witch as the antagonist*," or "*the unicorn as the protagonist helper*"), a specific part of the plot (e.g. "*I have proposed the part of the story when the queen discovers her daughter's kidnapping*," or "*the three riddles*"), and elements of story structures (e.g. "*the beginnings and the endings*," or "*the middle part when Romea and Giulietto are in front of the infinite wall*"). Regarding their most-liked aspect of the assignment, children mentioned the plot (e.g. "*when the princess's hairs were* [sic] *covered with green mold*" or "*the part when the witch, the antagonist, has deceived the prince*"), elements of story structures (e.g. "*the beginning and the end*" or "*the conflict in the middle*"), and the practical activities (e.g. "*when I have recorded the character voices*" and "*the part where we wrote our idea on paper*"). In particular, they liked to create audio, images, and videos, and to integrate this content with text in the story (e.g. "*the funniest thing [. . .] was to make the voices of the character*[s]*"*). The children declared that providing a clear list of the elements of the structure—i.e. the beginning, middle, and ending—was one of the most interesting contributions of Fiabot!. In addition, when we asked about the quality of the collaboration within the group, the majority of the children described the group work as "*interesting*" and "*fun*." As suggested by Csikszentmihalyi, "Children can experience pleasure without any investment of psychic energy, whereas enjoyment happens only as a result of unusual investments of attention" [3]. Moreover, considering the richness of the narrative plots and the originality of the characters, it is quite evident how fruitful the children's collaboration was. During the focus group, children expressed their satisfaction with being the authors of a story—e.g. "*me and my classmate created a whole multimedia story as the professional"*—and they asked to show the stories to their parents to demonstrate that they had learned to create "*magic stories*." In general, the children were very enthusiastic and they never mentioned being tired or bored when using Fiabot!.

8. DISCUSSION

The main objective of this study is to contribute to the debate on how digital technology can be introduced in a formal context and support the enactment of educational curriculum. From the analysis of the data it emerged that Fiabot! met the curriculum requirements and improved the teaching and learning of literary genres and other abilities connected to this activity (i.e. media literacy, social skills, and creativity). On the part of the teachers, we gathered positive feedback concerning how Fiabot! improved their awareness of the possibility of using the tablet in other educational scenarios and its effect on their self-esteem. On the children's side, we observed how children developed a combination of literacy skills by using Fiabot!, as well as how they achieved specific educational objectives as defined in the school curriculum. For instance, it was crucial to observe how children were correctly referring to each of the character's roles —e.g. *"I have invented that a bad donut is the antagonist while the sweet old lady is the protagonist"*—and the other elements of the story type as a direct result of Fiabot! reinforcing this terminology. For each of the three modules of Fiabot!, as described in section 5.1, we can recognize their specific contributions. In **Module 1**, the story structure and the ingredients were useful in supporting the children while they conceived the narrative mechanisms before writing. The discussion of the plot and characters allowed them to think about unexpected elements that made the story original. At the same time, the debate stimulated by Module 1 encouraged the pupils to also talk about their skills and to distribute tasks between group members accordingly. In addition, Module 1 supported the teaching strategy via the recall of the information already presented in class, such as the story structure and elements and the narrative mechanism.

Module 2 contributed to the children's media "wisdom." This module allowed for exploration of the opportunity and limits of producing and using digital content, as well as how to use these elements to convey a specific message. The production and editing of digital media and the digital artifact itself raised a high level of interest among the pupils, who were extremely engaged with the activity. The children felt in control of the quality of the final product.

Finally, **Module 3** allowed the sharing of the story, contributing substantially to the children's self-esteem and their satisfaction with being authors. Indeed, the teachers had the opportunity to show other colleagues the results of this educational activity.

Fiabot! has not only helped to confirm and reinforce the theory that the children learned in class, but it has also enabled them to put it into practice and produce stories to be shared with their peers, teachers, and family. This gave them the opportunity to test their skills and have them recognized in a social context, making it a rewarding experience they really enjoyed. The children had previous experience creating stories without any digital device and found that using Fiabot! made it a more exciting challenge. Indeed, they had to learn a new semantic (the media language) and how to use it within a specific purpose, but at the end they were very satisfied. Being the authors of a multimedia story also improved their self-esteem.

9. IMPLICATIONS FOR FUTURE WORK

We are planning to explore other areas of the school curriculum and involve different communities of learners by adapting the methods and techniques we have applied in this project. Our experience shows that in order to effectively integrate technology in schools, it is important to have a holistic approach and respect the ecology of the school. This approach is essential for the design and even more so for the assessment of the impact of the new artifact. It was interesting to notice how using a school-related application on a game-oriented device, such as the available tablet, made both children and parents aware of its intrinsic educational value. This helped in promoting a positive change of attitude towards the adoption of tablets and technology

in education, both in families and at the schools at large. A similar phenomenon took place among the teachers, too, in that those involved in the project felt encouraged to explore more ways and opportunities in which technology could add value to their teaching, starting with scientific subjects. It would be worth further exploring how the various actors in the process have benefited from being part of our study in terms of the development of new skills and changes in attitudes.

One of our main challenges was finding the right criteria for evaluation that would take into account the many facets of the experience and the tool we had designed. In addition, another issue we faced in the project concerned bringing together educational and technological objectives. It proved essential for the success of the project that all members of the research team were sensible to educational themes and contexts. This resulted in a very fruitful collaboration between school stakeholders and researchers, a truly bilateral exchange of ideas.

There remain open issues to be further explored in future projects, but we feel that our experience could provide a good starting point for forthcoming scientific investigations.

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11. REFERENCES

[1] Benford, S., Bederson, B.B. Akesson, K., Bayon, V. Druin, A. Hansson, P., Hourcade, J.P., Ingram, R., Neale, H., O'Malley, C., Simsarian, K., Stanton, D., Sundblad, Y. and G. Taxén (2000) 'Designing storytelling technologies to encourage collaboration between young children', in *CHI 2000, ACM Conference on Human Factors in Computing Systems, CHI Letters*, 2 1 (2000), pp. 556–563

[2] Bruner, J.S. (1996). The culture of education. Cambridge MA: Harvard University Press

[3] Csikszentmihalyi, M. Flow: The Psychology of Optimal Experience. Harper Perennial, 2008

[4] Decortis F. and A. Rizzo (2002) New active tools for supporting narrative structures, in *Personal and Ubiquitous Computing*, 6(5-6), pp.416-429

[5] Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, *5*(1), Article 7.

[6] Greenbaum, J., Kyng, M. Design at Work: Cooperative Design of Computer Systems, Lawrence Erlbaum, Hillsdale, NJ, 1991.

[7] Kelleher, C. and R. Pausch (2007) 'Using storytelling to motivate programming', in *Commun. ACM* 50, 7 (Jul. 2007), pp.58-64

[8] Halloran, J., Hornecker, E., Fitzpatrick, G., Weal, M., Millard, D., Michaelides, D., De Roure, D. (2006, June). The literacy fieldtrip: using UbiComp to support children's creative writing. In *Proceedings of the 2006 conference on Interaction design and children* (pp. 17-24). ACM

[9] Houde, S., & Hill, C. (1997). What do prototypes prototype? In M. Helander, T. Landauer, & P. Prabhu (Eds.), *Handbook of human-computer interaction* (2nd ed., pp. 367-381). Amsterdam: Elsevier Science.

[10] Hutchinson, H., Mackay, W., Westerlund, B., Bederson, B. B., Druin, A., Plaisant, C., et al. (2003). Technology probes: inspiring design for and with families. In *Proceedings of the conference on Human factors in computing systems* (pp. 17-24). Ft. Lauderdale, Florida, USA: ACM Press.

[11] Lewis, T., Petrina, S. & Hill, A. M.: 1998, 'Problem Posing – Adding a Creative Increment to Technological Problem Solving', *Journal of Industrial Teacher Education* **36(1),** 5–35.

[12] Nicolopoulou, A. (1997). Children and narratives: toward an interpretive and sociocultural approach. In M. Bamberg, *Narrative development: six approaches* (pp. 179-216). London: Lawrence Erlbaum

[13] Papert, S. (1991) 'Situating Constructionism', in Idit Harel and Seymour Papert (eds.): *Constructionism.* Norwood, NJ: Ablex Publishing

[14] Pittarello, F., Bertani, L. (2012, June). CASTOR: learning to create context-sensitive and emotionally engaging narrations in-situ. In *Proceedings of the 11th International Conference on Interaction Design and Children* (pp. 1-10). ACM.

[15] Prensky, M. "Digital Wisdom and Homo Sapiens Digital," in Deconstructing Digital Natives: Young People, Technology and the New Literacies, M. Thomas, Ed. London: Routledge, 2011, pp. 15-30.

[16] Raven, M.E., and Flanders, A. (1996). "Using Contextual Inquiry to Learn About Your Audience." ACM SIGDOC Journal of Computer Documentation, Vol. 20, No. 1

[17] Rubegni, E., Colombo, L., Landoni, M., (2013) Supporting child creativity and sense making through Digital Storytelling at school, In: 27th International British Computer Society Human Computer Interaction Conference

[18] Rubegni, E., Landoni, M., (2013) *Modeling the role of teachers in introducing portable technology to the school curriculum,* In proceedings of ECCE '13. ACM, New York, NY, USA, Article 13, 8 pages.

[19] Rubegni, E. and Paolini, P. (2010) *Comparing canonical and digital-based narrative activities in a formal educational setting.* In: International Conference on Interaction Design and Children (IDC 2010). Barcelona, Spain, June 9–12, 2010, pp. 258-261

[20] Schuler, D., Namioka, A. (Eds.), Participatory Design: Principles and Practices, Lawrence Erlbaum, Hillsdale, NJ, 1993.

[21] Vygotsky, L.S. (2004; 1967). Imagination and creativity in childhood. Journal of Russian and east European psychology. Vol 42, no. 1

[22] Vygotsky, L. S. (1978) *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press

[23] http://www4.ti.ch/decs/ds/usc/cosa-facciamo/programmi-ufficial