Simple, Fast, Cheap:
Success Factors for Interactive Multimedia Tools

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ABSTRACT

This paper discusses key factors contributing to the "success" of interactive multimedia development tools in non ICT professional contexts. We define "success" in terms of acceptability and large scale usage by entities and institutions who may need to build interactive multimedia artifacts but do not have technical competences "in-house" and must cope with very limited financial resources. Schools or museums, for example, may want to exploit interactive multimedia for communication or educational purposes, but are bound to many resource-related constraints. In this perspective, we argue that simplicity, low-cost, and ultra short "time-to-market" are key requirements for interactive multimedia development tools to be accepted and widely adopted by non ICT professionals. To support his claim, we illustrate an exemplary tool that meets these requirements and was developed at our lab within the Policultura Project. The tool was successfully used by cultural heritage experts in Italian small museums and by over 1300 students of 55 schools in Italy, and brought important educational and social benefits to all stakeholders involved.

1. Introduction and Motivation

In this paper, we will discuss the success story of a project that has attempted to make simple, fast, and cheap the process of developing and delivering an interactive multimedia on different interaction channels.

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We describe a toolkit that was developed at our lab and is called 1001stories – a name inspired by "The book of One Thousand and One Nights", the well known collection of tales compiled over thousands of years by various Persian, Arab and Turk authors, translators and scholars since 800-900 A.D.

1001stories enables people to easily shape an interactive multimedia artifact as a "hypermedia story" (a non linear narrative that exploits a variety of media: text, audio, images, videos, animations (Joyce, 1997; Mallowy & Marshall, 1996) and to deliver it on different channels , so that people can enjoy the hyperstory in different physical settings and situations, both on-line and off-line: through the web (e.g., at home, in the office, in the computer rooms at school or in a museum), through a CD-ROM (e.g., on a museum kiosk or in the classroom), and through a mobile device like the iPod^{TM} (for mobile use "on the go", walking, in the metro, on the bus, or in the park).

The 1001stories toolkit was mainly developed within the Policultura project (www.policultura.it) – an initiative supported by Politecnico di Milano that aims at fostering the adoption of ICT technology in Italian schools and promoting a "polycultural" approach to education in which technology and humanities are smoothly and synergistically combined.

1001stories toolkit is composed by two main ingredients: (a) a hyperstory development tool, allowing for an efficient content data entry and the fast generation of the multimedia interactive application; (b) a methodological guidance, which supports an organized development process and provides a "proposed workflow", i.e., a structured collection of activities and content production guidelines to build a hyperstory in an efficient way.

It is important to note that 1001stories has been conceived as a tool for non multimedia professionals. We want to have hyperstory creators focus on the design of "the message" and on the quality of the contents and narratives ("what do I want to say") – which represent the key success factors for the overall quality of the user experience – rather than on technology and implementation ("how do I make it happen"). We want to have them investing the main effort on content decisions, content creation/ production/revision, product evaluation and quality assurance; we want that a professional development team does not have to take any major technological decisions (about software architecture, databases, programming language etc.) and does not have to invest a penny in implementation. Ultimately, we want to foster vision of the hyperstory development process in which the crucial competencies required in

the production team mainly concern domain-knowledge, aural and written communication, rather than technology.

Our thesis is that simplicity, low-cost, and fast development are crucial factors for the success of a toolkit like ours, if we "measure" success in terms of the degree of acceptability and usage by the intended target. In the paper, we will also report some key results of an extensive field study that was carried on to identify the benefits of our approach and that empirically support the above thesis.

2. Scoping "Storytelling" for 1001Stories

The term "story" is quite wide and virtually encompasses any discursive narrative that generates and sustains meaning.

Huge is the literature on storytelling as a paradigm for effective communication to be used in a variety of contexts and domain, from art, literature, entertainment, to business life (Bruner, 2002; Glassner, 2004; Crawford, 2004). Story contents may be fictional or real, may relate to a subjective experience or to more objective facts and events. Some stories are meant to be forms of poetry and art, others to entertain, relax, raise curiosity, inform, advise, warn, provoke, transmit values, preserve traditions, or educate.

Although we are not addressing any specific domain, the hyperstories we mainly support in our project are means of education and learning, information, preservation of culture and traditions, communication of a (cultural, societal, or historical) message, or transmission of values. We do not focus here on the social value of storytelling but rather on supporting efficient technology-enhanced storytelling development by providing a simple technological and editorial framework that allows to shape stories with a predefined, but yet open and very generic structure. The target of the hyper-storytelling development tool discussed in this paper includes anyone who wants to build hyperstories having the above goals, but possesses a very scarce technical know-how, very limited budget and time constraints. This is the typical case, for example, of small cultural heritage institutions (e.g. local museums) or tourism organizations, schools, companies, who may adopt a storytelling approach to communicate events, places, projects, personal or social experiences.

3. The 1001STORIES Toolkit

3.1. The Development Tool

The 1001stories toolkit supports the process of i) translating conceptual narrative structures into a suitable interactive digital format; ii) filling them with multimedia contents, and iii) delivering the resulting hyperstory on different channels. The tool is fast to learn, quick in enabling the delivery of a complete multimedia hyperstory, and easy to use, hiding the complexity of the implementation underlying the tool.

Everything from building the narrative structures to inserting or updating multimedia contents in the narrative units, to page publishing to CD-ROM compilation to podcasting is intuitive and can be done with few clicks.

Our main purpose is to make this overall process as simple, cheap, and fast as possible. We call this approach "instant multimedia" (Di Blas, Bolchini & Paolini, 2007) – a term is inspired by the notion of "instant books", coined in the world of publishers to denote traditional (i.e., paper based) editorial products of good quality that can be put on the market in a very short time (1-2 months) and at low cost. Our belief is that satisfying these requirements is strategic to be successful in the multimedia publishing area today. In a fast evolving market, it might be better for companies or institutions or organizations to produce several low-cost productions in a fast way (in 3-4 weeks), rather than a few expensive ones, perhaps much later (in 8-10 months). Small, lean, low cost, hypermedia products can be targeted to different niches of potential users, and/or can deal with several niches of content. Small, fast productions allow institutions or companies or organizations to react quickly to fresh needs or to catch new opportunities presented by different circumstances and events – e.g., exhibitions for museums, fairs for companies, launch of a brand or new products or service, "just-on-time" promotional tools. Finally, multimedia productions tend to quickly become obsolete (or at least, not tuned to current user expectations); this is a major problem for large productions that can't be easily redone, while is a minor problem for small low-cost productions that can more easily be discarded and redone.

In software engineering terms, the 1001Stories tool can be defined as a web-enabled application framework (Ceri, Florian, Matera, & Facca, 2007; Fayad, 2000; Garzotto & Megale, 2005; Mori, Paternò, & Santoro, 2004; Schwabe, Rossi, Emeraldo, & Lyardet, 1999) (www.webratio.com) for multichannel hypermedia storytelling. An application framework "…provides a reusable solution for a class of software applications that share a common set of requirements. It can be regarded as an application "skeleton",

which captures the essential features of a family of applications and can be customized to produce a specific application in the family" (Garzotto & Megale, 2006; Meyrowitz, 1986). Still, differently from existing software engineering frameworks, which are traditionally conceived as tools for programmers, 1001Stories shifts the perspective from programmers to non-programmers - persons with very limited technological capability. In this respect, 1001stories implements the concept of end-user development, which promotes the idea of "…enabling also non computer professionals…to build new computer based applications without ever seeing the underlying program code" (Sutcliffe & Mehandjiev, 2004).

The tool implements a pattern-based approach, supporting a pre-defined information architecture, a set of built in navigation and interaction patterns, and a set of lay-out templates (Antle, 2003; Garzotto, Paolini, Bolchini, & Valenti, 1999).

According to the 1001Stories pattern, a story is composed by topics, where each topic represents a "step" or a "bit" of a story. Each topic contains sub-topics that represent further details on the topic. Starting from a cover page (or homepage), the user can explore the story in different ways: s/he can access each topic from the homepage, or sequentially visit (through a guided tour pattern) each topic from the first to the last. While in each topic, the user can sequentially or directly visit each subtopic, and then pass to the next topic.

Automatic loop navigation is also offered, to enable the user to just relax and listen and watching to all the story topics and subtopics in sequence without need of further interaction.

The 1001Stories tool enables a non-computing specialist to easily produce a story based on this structural pattern, as s/he is asked to cater "only" for the story content (texts and images), since the information architecture and navigation mechanisms are already built-in.

In essence, the functionality offered by the 1001Stories tool to easily build and publish a story can be summarized in three main features (Figure 1): Data Entry, Preview and Generator.
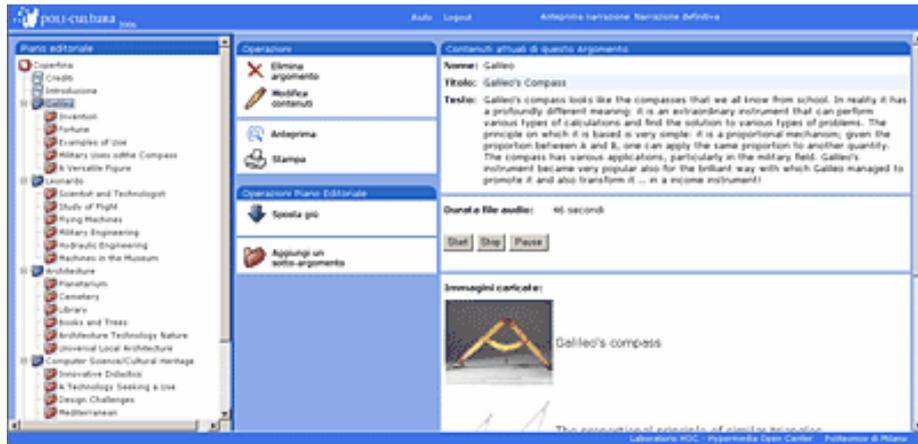
Figure 1. 1001Stories management interface.

The *Data Entry* is a simple control panel enabling the user to edit the editorial plan of the story (i.e. decide the steps of the story), to enter content for each element (i.e. title, text, images with captions and audio file), and to perform all needed changes.

The *Preview* allows to visualize at any moment of the process the preliminary resulting story (as it will appear to the user) of what has been entered so far. In this way, the developer can immediately check the quality of the story (e.g. the impact of the content, of the graphics) and make the wished improvements.

The Generator produces and publishes the final applications (for the different delivery channels), once every element of the story has been set and specified.

Figure 2 shows examples of a multimedia hyperstory that was built using our tool, delivered on a stationary on-line or off line channel and on i-Pod.
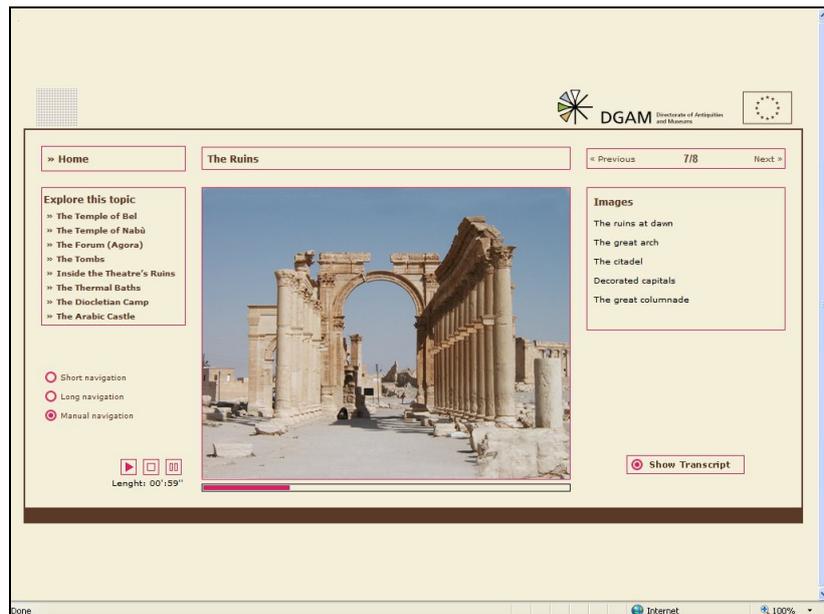
Figure 2. 1001Stories application for stationary channel (web).

3.2. Essential Methodological Guidance

An additional requirement for the 1001Stories project derives from our belief, based on our long standing experience in hypermedia project management, that a good development tool *per se* is not enough to make a development process simple, fast and low-cost. We need to support and guide a development team to answer questions such as: "Which activities are required to design and build a good hyperstory efficiently? How are they organized? How can we build good and engaging content?"

While experienced hypermedia authors and developers may know the answers to these questions based on their professional expertise, the same is typically not true for novices or non hypermedia professionals (e.g., students, teachers, museum experts). To make a development process simple, fast and low-cost for all, a more holistic approach is needed that also addresses wider organizational aspects, complementing the tool with some methodological support. To meet this requirement, we extended the project scope from the mere development of a "good" tool to the creation of a toolkit that includes also a workflow (i.e., a structured collection of activities to build a hyperstory in an efficient way), and a set of content production guidelines for the development team.

An editorial manual has been produced and made available (on www.policultura.it) to support the storytelling developer to produce effective stories using the 1001Stories tool. Note that the manual is not at all a technical manual on "how to use the tool" (there is no need for it, given the high level of usability of the tool), but a guide on the key editorial activities to follow to create good storytelling content and deliver high-quality stories. 10 key editorial activities are the backbone of the methodological support provided by 1001Stories, and are detailed with specific guidelines in (Di Blas, Bolchini, & Paolini, 2007):

1. Gathering the primary material for the stories (1-2 Hours)
2. Defining the Editorial Plan (1-2 Hours)
3. Setting the Visual Communication (3-8 Hours)
4. Writing The Narratives (8-16 Hours)
5. Producing Audio from Texts (4-8 Hours)
6. Producing the First Version (2 Hours)
7. Performing Quality Check (2-4 Hours)
8. Revising Text and Audio (4-8 Hours)
9. Revising Visual Communication (1-4 Hours)
10. Producing the Final Version (2 Hours)

Note that each activity indicates a suggested realistic timeframe to complete it. These guidelines are especially useful for first-time developers, who need not only to quickly publish their story, but also to guarantee a good quality of the delivered application. Since the storytelling author does not have to take any decision concerning the information structure and navigation (1001Stories makes them for her), the author's effort should actually go in choosing the proper content, accurately selecting the pictures, and shaping an engaging and compelling story.

4. The Evaluation Study

4.1. Exploitation Settings

The 1001Stories toolkit has been intensively used by hundreds of people in low-technology contexts (such as small museums and schools), giving us the possibility to experiment its ease of use and its effectiveness. In its early versions, our HOC lab at Politecnico di Milano used it for building 11 hyperstories (as of May 2007), for different clients and purposes: promotion (of HOC activities and of Politecnico activities), cultural tourism for Milanese museums "Pinacoteca Ambrosiana" and "Museo Archeologico", for the ministry of Tourism of Syria, and for 8 cultural ministries of countries in the Mediterranean area. In all these initiatives, the actual project managers and staff who successfully conceived, designed and produced the storytelling applications had mainly a humanistic background (communication, cultural heritage, or literature) and were not skilled in Computer Science or technological disciplines.

As of January 07, 1001Stories has been used for projects delivered for other cultural institutions (e.g. the Herman Hesse Museum near Lugano, Switzerland) and in other national initiatives (in cooperation with the Italian Ministry for Cultural Heritage).

Moreover, it has also been used by 60 students of Communication Sciences at University of Lugano as a basis for content authoring course projects.

A major opportunity for intense evaluation in the school domain happened during school year 2006-2007, when the 1001Stories toolkit has been used as the framework for an Italian national competition involving nearly 3,000 high school students from 10 different Italian regions. The competition was launched among all Italian high schools under the name "Policultura" (www.policultura.it). The initiative was coordinated by our lab at the Politecnico di Milano and sponsored by IBM Italy, Mondadori (the largest publishing company in Italy), Corriere della Sera (the most important Italian

newspaper), the Ministry of Education, the Museum of Science and Technology "Leonardo da Vinci" in Milan, and the Museum of Science History in Florence.

Participants were requested to create, in two months period, a full hyperstory on either the art or the history of their town, using the 1001Stories toolkit.

106 classes from 70 schools located in all Italian regions took part in the competition. A selection of their hyperstories (in Italian) can be visited on the Policultura web site (www.policultura.it).

An additional opportunity for evaluation of 1001Stories in the school domain was offered by a project which involved a primary school in Milan.

4.2. Evaluation Goals

The goal of the evaluation activity was threefold. On the one hand, we aimed at empirically studying the efficacy of the 1001Stories approach, at least in the educational context, and answer to the following questions:

- Is 1001Stories toolkit really usable for our target audience of storytelling developers?
- At which degree does it support fast and low cost hypermedia production?

In addition, we aimed at exploring how ICT inexperienced people – teachers and young students – carry on the development process, identifying patterns of behavior, points of weakness and strength for the overall approach, as well as directions to improve the proposed workflow. Finally, given the specificity of the school context, we wanted to assess the educational benefits that can be achieved by means of a hypermedia production experience like the one carried on for the Policultura Competition.

The evaluation activity was carried on from February 2007 to April 2007. The study involved 70 high-school students from all over Italy, aged 16-18 (i.e., attending the last two years of Italian high school), and an elementary school class of 24 children aged 9-11, from a public institute in Milano. We also involved approximately 2-3 educators per class, for a total of 224 adults. 90% of the schools were non-technical (lyceums) and provided a limited curriculum in informatics. 85% of the classes had no previous experience in multimedia projects. In particular, the class at the elementary school never used the computer lab before for activities other than writing and printing.

4.3. Experimental Design and Methods

In the case of the high-school students of the Policultura project, the task assigned to students was to develop a story from scratch, using 1001Stories toolkit, on a theme at choice (one per class) illustrating an interesting aspect of cultural, artistic, or historical relevance of their town. In the case of the primary school pupils, the task was to develop a story on "*Roman Milan - Milan during the Romans' age*". This topic was selected by the teachers since it was related to a full day class trip – a visit to the Roman ruins in Milan – organized at the beginning of the school year, and the Roman Civilization is a curricular topic in the last year of Italian primary school[1].

As illustrated in the previous sections, the toolkit comprised of the tool (made available as a password protected web application) to be used in class and remotely, and the editorial guidelines. Both technical and editorial assistance from our staff was remotely available throughout the project.

In both evaluation context (high and primary schools), the subjects were asked to form small groups (of 3 or 4) and each group selected a subtopic of the story theme to develop. In the high school, students were totally autonomous, and the teachers' scaffolding was minimal, being limited to a final check of the syntactic correctness of contents.

In the primary school, the structure of the story, i.e., the editorial plan, was built cooperatively in the classroom, using paper and large posters, under the teacher supervision, and was later implemented by the children in the school computer lab using 1001Stories tool. Children retrieved the needed visual material from the Internet, with the guidance of their teachers, or digitalized their own drawings and images from printed books.

We used various evaluation methods and both qualitative and quantitative techniques for data collection and analysis:

Task-based user testing. This method was used to evaluate the usability of the tool (in terms of actual simplicity), and mainly involved the elementary school children using the tool to develop a hyperstory about "Milan in the Roman Times".

Contextual inquiry. We used this method mainly with elementary school children, to understand how students behave and interact with the tool and collaborate among peers during the overall development process. Moreover, we wanted to have a more

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[1] "Roman Milan" is accessible online at http://www.policultura.it/kids.htm following the link "Esplora Milano Romana".

precise sense of the technological competency required to complete a hyperstory using our toolkit.

Questionnaire. We designed an online questionnaire for teachers, combining closed and open-ended questions, and made it available to all educators participating in the Policultura competition after they had completed the hyperstory development with their class (the full questionnaire is available as annex at the end of the paper). The goal of the questionnaire was to get information on the development process by high school students, and to get qualitative and quantitative data on the learning benefits perceived by the expert eyes of the teachers.

4.4. Results and Discussion

Simplicity of the tool

The results of our usability evaluation at the elementary school, indicate that the 1001story tool is indeed very simple and can be used without any preliminary training. All users involved were able to complete all tasks in an average time of 17 minute, with a minimum of 12 minute and a maximum of 26. In 85% of the cases, they did not ask for any assistance to instructors and the observers did not intervene in any way.

Without purposefully not providing any instruction on how to user the tool, the kids basically worked by trial-and-errors but the percentage of "errors", in terms of "wrong" clicks, was quite low (in average, 12% of the overall set of interactions). The empirical tests also confirmed that the only prerequisite for using the tool is the basic capability of using Windows file system, downloading images from the web, text writing, digital audio recording, and importing digital images from a camera.

Simplicity and effectiveness of the process

In Policultura, contextual inquiry and questionnaire results highlight that the overall workflow and the requirements of each activity were easily understood by teachers and students. 98% of questionnaires reported that the availability of a workflow helped to master the complexity of organizing workgroup activities. 95% of participants delivered their hyperstory by the deadline, meaning that the development process of one full-fledged hyperstory in high schools took less than two months.

Patterns of Behavior

An open-ended question in the questionnaire requested teachers to shortly describe how they organized the work, which has helped us identify some common organizational patterns. In summary, in all cases, the process - being a classwork - has been strongly collaborative among students (which is one of the main benefits acknowledged by teachers – see below) and among teachers of different disciplines – technical and humanistic. We could also identify the different criteria that were adopted for allocating development tasks among the students.

Learning benefits

The results of the questionnaire provided the main data to evaluate the learning impact of the hyperstory telling experience. We considered two levels of Bloom's taxonomy of the learning domain (Bloom, Mesia & Krathwohl, 1964): the cognitive level (which involves knowledge and intellectual skills) and the affective level (which involves the manner in which learners deal with things emotionally - feelings, values, appreciation, enthusiasms, motivations, and attitudes).

For learning benefits at the cognitive level, in the questionnaire we focused on two aspects: "getting a deeper understanding of a subject matter" (i.e., the general topic of the hyperstory developed by each class); "improving the teamwork capability"; "improving the capability in informatics". For the educational benefits at the attitude level, we considered: motivation to learning new subjects, willingness and satisfaction in cooperation, enthusiasm for the overall project.

Asked to estimate the overall educational impact of the Policultura experience using a 4 valued scale values scoring [very low, low, good, very good], 66% of teachers scored it very good, and 34% good. We investigated the degree of achievement of each kind of learning benefit with respect to conventional school activities, using a 4 valued scale: -2 ("much lower achievement"), -1 ("much lower achievement"), +1 ("better achievement"), +2 ("much better achievement"). The diagram below reports the aggregated results of teachers' scoring for the various kinds of benefits.
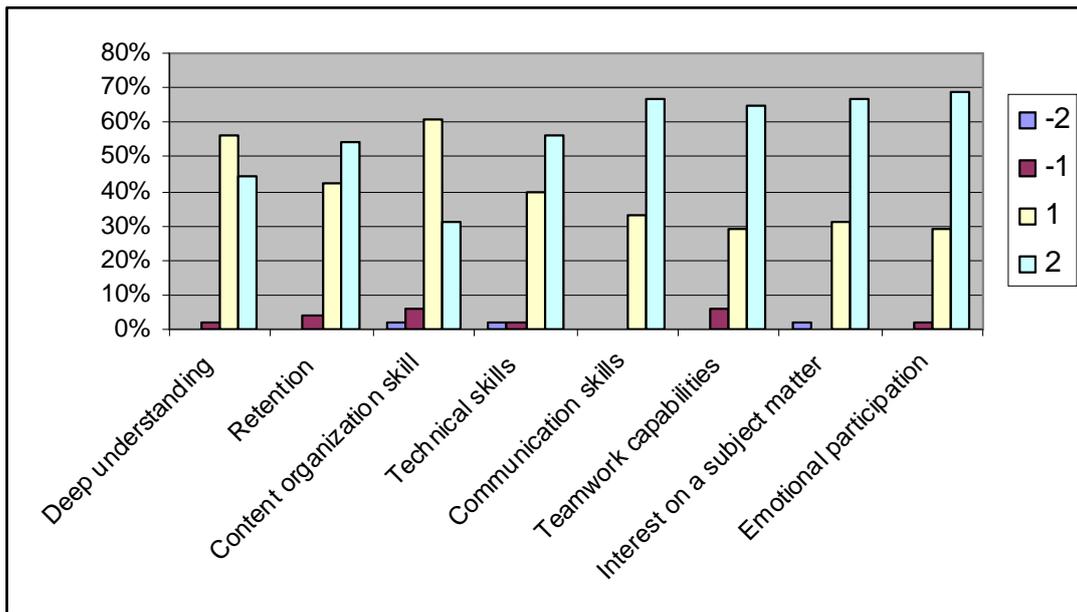
Figure 3. 1001Stories learning benefits as perceived by the teachers in Policultura.

The analysis of the questionnaire data highlights a significant educational impact of the experience. More that 50% of the teachers evaluated that the experience induced a much higher achievement of all learning benefits considered, if compared with conventional activities that are carried out at school to address similar learning goals. Finally, a high majority of respondents (88%) claimed that they will continue using 1001 story in future educational activities.

5. Conclusions

1001Stories is a successful example of "instant multimedia", a lightweight approach to multimedia development which pushes ultra simplicity, speed and low cost as the key driver of the development effort, still ensuring a good quality final application delivered.

The experience of using and evaluating 1001stories toolkit has shown that, by means of simplicity, low cost and short time for product creation, we can achieve a significant degree of acceptability and usage of our "academic" products, and in particular we can foster their adoption in schools – an environment that, at least in Italy, is reluctant to adopt ICT and new educational paradigms.

In particular, the Policultura project has shown that the overall approach implemented in the 1001stories toolkit is very effective in promoting "active" learning (Crocker, 2005)

of narrative and communication skills for young users and to expose them to ICT technology in a playful way. Finally, the experience of 1001stories has also proved its effectiveness in promoting collaborative learning (Benford et al., 2000; Werger, 1999), as it was demonstrated by the "social" mode in which the hyperstory-telling activities have been carried on at schools.

Further improvements to the 1001Stories toolkit are in progress and a wider community of professionals in various industries and educational institutions is increasingly interested in adopting the framework.

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7. ANNEX

POLICULTURA Evaluation Questionnaire

1. How do you agree on the following statements about the learning benefits of Policultura?

- *Deeply understanding the topic*
- *Catch the links and relationships between topics*
- *Memorize longer what has been learned*
- *Raising interest in the topic*
- *Being involved in the class work*
- *Get or refine technical skills*
- *Get or refine communication skills*
- *Get or refine team work skills*

SCALE:

(-2) Much less than usual class activity

(-1) Less than usual class activity

(+1) More than usual class activity

(+2) Much more than usual class activity

2. Provide any comments concerning the learning benefits of Policultura

3. How good do you consider Policultura as a mean to promote that alliance between culture, technology and new learning paradigm that is so much wished for in the Italian school system?

SCALE:

(-2) Not effective at all

(-1) Not very effective

(+1) Quite effective

(+2) Very effective

4. Briefly describe how you have organized the class activity during Policultura.

5. Are you willing to use the toolkit offered by Policultura in further educational initiatives?

YES – NO

6. If yes, how would you imagine to use it?

7. Overall, how do you value the impact on the teaching activity?

SCALE:

(-2) Negative

(-1) Low

(+1) Discrete

(+2) Very good

If you would like to receive the full results of the evaluation questionnaire of Policultura, please contact Franca Garzotto, at garzotto@elet.polimi.it