A Concise Introduction to Narrative Learning Environments

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Foreword

The expression *Narrative Learning Environments* (NLE[1]) was created in the past decade within the field of Artificial Intelligence (AI), to indicate a particular kind of learning environments which make use of narrative as a way to facilitate learning, and are implemented by means of AI techniques. Since then, thanks to the widespread interest raised by the great potential of narrative, the concept of NLE has widened its boundaries to include learning environments developed within other contexts, which present conceptual similarities with the "original" NLE as concerns their purpose and way to exploit narrative. This concise introduction to NLE reflects this extension of the field, and calls the attention on the essential homogeneity of its conceptual structure beyond the diversity of many environments.

The Special Interest Group *Narrative and Learning Environments*[2] of Kaleidoscope [3] has contributed with its activity to this reshaping operation, helping to spot the characterizing elements of NLE and delineate a uniform framework for the analysis and construction of consistent and effective NLE. This was not a trivial task, since the word *narrative* is widely overloaded in the literature, being used in relation with several applications which differ from NLE as concerns both purpose and operation.

1. Narrative and education

1.1 What is narrative

What is narrative? In the literature we find several narrative theories, mainly developed in the context of narratology, that highlight different aspects as essential features of narrative and aim to characterize it with respect to other representational forms. In the educational framework, a milestone is the definition given by Bruner (1990), which is rather general but well focused on the characterizing elements of narrative. He defines narrative as "*a unique sequence of events, mental states, happenings involving human beings as characters or actors: these are its constituents. But these constituents do not, as it were, have a life or meaning of their own. Their meaning is given by their place in the overall configuration of the sequence as a whole- its plot or fabula*". The main point of this definition is the detection of a sequence of events as the characterizing aspect of narrative, which gives rise to a meaning construction process by the users, based on how they perceive the relation between the various elements and the whole sequence.

This definition is consistent with the characterization of narrative worked out within literary studies. Ricoeur, for instance, highlights the distinction between *a chronological sequence* of episodes and *a configuration;* he points out the need to mentally construct a configuration starting from a sequence of elements in order to build a narrative (1981): "*the activity of narrating does not consist simply in adding episodes to one another; it also constructs meaningful totalities out of scattered events. The art of narrating, as well as the corresponding art of following a story, therefore require that we are able to extract a configuration from a sequence*".
Other definitions of narrative by different authors spot slightly different characterizing aspects (e.g. causal dimension), yet always highlighting the need to fulfil some constraint to give rise to meaningful and consistent narratives. For instance, Aylett (2006) argues: "*…we may see story as the interplay between the two poles of character and causation. From characters come the aspects of personality, emotional state and social standing, linked to causation via motives, intentions, plans and actions. From causation come the aspects of temporality and sequence, linked to characters by events and their outcomes.[…] The extent of this interplay has an effect on how far the result is experienced as story at all: at one end of the spectrum, character disconnected from*

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[1] the acronym NLE will be used in the rest of this report instead of "Narrative Learning Environments", with a plural meaning
[2] http://nle.noe-kaleidoscope.org
[3] http://www-noe-kaleidoscope.org

causation is experienced more as a cocktail party than a story (as in many online chat environments) while at the other, causation disconnected from character is experienced more as a game or puzzle than a story. However, from a perspective centred on learning, one can in any case take a view of story as a process of internal structuring of experience; of sense-making via narrative organisation. Here, story is not so much the novel, play or film as the internal structure that results from reading or watching: the result of what we have termed the storification process through which this internal narrative is constructed".

It is clear from these definitions that narrative can be a powerful cognitive tool thanks to its potential to support the construction of configurations from a set of elements and to start a meaning construction process in people who receive or produce it. It is on this support, which is intrinsic to narrative, that its cognitive value relies.

1.2 Why narrative matters for learning

Following Bruner (1990, 1996), who emphasized that narrative is a fundamental means for meaning construction, as well as a primary way for children to enter the culture and a solid "way of thinking" for everyone, in the past decade the literature in education has witnessed a growing interest in narrative to improve the cognitive aspect of learning. Several authors have underlined the important roles that narrative can play in human understanding, referring to it as: *external knowledge representation* (Porter Abbott, 2002); *cognitive process* (Luckin et al, 2001; Scalise Sugiyama, 2001); *sense-making device*, through the provision of meaningful context (Bednar et al, 1991, from Aylett, 2006); *organizational principle* (Polkinghorne, 1988) and *way to structure human experience*, both individual and collective (Young, 2001, from Aylett, 2006).

Moreover, stories are a natural form of communication used in every culture by children from a very early age as well as adults. For this reason, narrative has always been used in learning, both in school and in informal contexts, as a tool to ease communication, raise learners' interest and support motivation. Stories are related to emotions and hence giving attention to narrative in education helps us understand that learning is not just about knowledge and cognition, but also about motivation, engagement, social interaction, and personal meaningfulness (Aylett, 2006; Gussin Paley, 2004).

1.3 What are NLE

NLE are learning environments where stories are used with the aim to facilitate and improve learning. In general, the use of stories can be realized either by presenting a story somehow connected with the tasks at hand or by providing an environment where stories can be created. Each of these possibilities can in turn be implemented in a variety of different forms.

It is important to reflect on the fact that not any learning environment that includes a story can properly be considered a narrative one. Let us think, for example, of one where a story is given as an appealing background where a number of problem solving tasks are proposed, without a conceptual integration between the given tasks and the narrative fruition process. This is frequently the case with many computer games or drill-and-practice educational software tools. In this case, the *back-story* simply aims to provide a generic motivation encouraging the learner to tackle the assigned tasks. This may appear strategic in disciplines that are scarcely appealing for the students (e.g. mathematics), as a way to put sugar on an unpleasant pill (Aylett, 2006), but it does not characterize those environments as narrative. This does not mean however, that providing a motivating narrative always functions only as sugar on the pill. It may very well be the case that a narrative is used to motivate careful and higher-order analysis of a given situation, so as to deepen understanding or help the construction of personal meaning (e.g., Timchenko, 2006). In fact, the cognitive purpose and the motivational one are often intertwined. When this is the case, the learning environment can properly be considered a narrative one.

Analogously, as concerns the environments where a narrative is created by the learners, the tasks should be formulated and the activities guided so as to lead to the construction of cognitively meaningful narratives, that is, logically consistent configurations of causally connected events.

1.4 NLE and ICT

The development of ICT (Information and Communication Technology) and its increasing use in education has provided a variety of tools and techniques – from 3D graphics and animation to intelligent agents, from communication means to augmented reality – apt to exploit and strengthen the use of stories, giving rise to many different approaches to the use of narrative as a support for learning, as well as to a variety of NLE with different applications and aims.

Are NLE necessarily always technology-based? In principle the answer should be no, since we can think of realizing meaningful narrative activities with traditional educational tools (e.g. drawing, dramatization, etc.). The use of ICT, however, allows the construction of more articulated and ductile NLE set up to carry out a variety of narrative activities. It also allows an easy creation and use of multimedia-narratives, hence leading the students to become familiar with multiple representational modes within an activity – the interaction with stories - which is naturally appealing and not too difficult to understand. Even non-verbal narratives, or with a very limited amount of verbal language, can be easily constructed in technology-based environments, hence allowing even people with some kind of disabilities connected with language to carry out educational activities exploiting the learning potential of narrative (e.g., Faux, 2006). For this reason, the number of technology-enhanced NLE is increasing and the expression "Narrative Learning Environments" is generally used in relation to environments which make a more or less extensive use if ICT.

Acknowledging the presence of a technological component in NLE does not mean that these environments should be fully automated programs. This depends on two reasons. Firstly, the activity allowed within an environment can include a human-led component; this is the case, for instance, when learners are requested to individually create a story or narration and then use a technological tool, such as e-mail or blogs, to exchange it with some other learner, hence building a collaborative activity on story creation, with all the cognitive, affective and motivational advantages that such an activity can entail. Moreover, even with fully automated programs the outcomes are influenced by the mode of use, that is, by the assignment given, its relation with the educational aim and expected learning, the configuration made, the scaffolding possibly provided to the learners. Hence, it is important to remember that when we speak of NLE we always mean learning environments which include both a technological and a human component, in different proportions.

Since both narrative and ICT-based multimedia systems have their own educational potential, one wonders whether their combination produces a positive synergy: is there an added value in using computer technology to realize narrative learning experiences? Addressing this question is a major aim of the research on NLE. The variety of experiences with NLE reported in the literature suggests that the answer to this question should be positive (e.g., Fusai et al, 2003; Dettori et al, 2006). But a final answer has not been reached yet, as illustrated by Gordon and Alexander (2005) who claim that the hypertextual and jumpy nature of computer software undermines narrative sensibility rather than stimulating it. An ever increasing number of studies on technology-enhanced narrative environments, however, has highlighted that the use of different media (Fusai et al, 2003) and technological tools (Aylett, 2006) affects the learning affordances of an environment, so that the use of different ICT tools influences the kind of cognitive activities that can be carried out in a narrative environment, and hence the learning that is expected to take place in it.

1.5 Other applications of narrative in education

Stories can be used in the educational field for different purposes. Not only can they support learning, but also teaching practice and educational research. The field of NLE refers exclusively to the use of stories in learning. Focusing on the use of stories (or narrative) in teaching or in research gives rise to different streams of study, with different aims and issues. Using the same term "narrative" in all these cases without differentiation, though proper in itself, may cause confusion in the inexperienced reader who searches through the literature for material on narrative and learning environments. For this reason, we shortly mention here the streams on the two other

educational applications of narrative, so as to help clarify the extension and boundaries of the NLE field.

In a narrative approach to teaching, the focus and current research effort is on how to create and use meaningful stories to incisively convey knowledge and motivate people to learn it. Stories are frequently used in subjects such as history and literature, but are not limited to these. They are said to inform learners as well as to help them transform learning content into personally meaningful and usable knowledge (e.g., Jackson, 1995; Witherell, 1995). Using stories in teaching can be of interest to school teachers in lower grades (e.g., Champion, 1998; Gussin Paley, 2004), upper grades (e.g., Norris et al, 2005; Wertsch, 1998), and professional trainers (James & Minnis, 2004; Luhman, 2005). Despite the different aims and ways to proceed of this field and that of NLE (understanding how to create effective stories vs. finding ways for the students to meaningfully make use of stories), this application field may have something to offer to NLE, in that knowing how to create good stories might help to build more effective NLE.

The use of narrative for research purposes, on the other hand, is usually called "narrative research". Studies of this kind often claim to make use of a "narrative approach". This consists in using narrative as a way to collect data, by interviewing people and letting them narrate their account of some experience or observed phenomenon. Hence it requires the development of analytical procedures to extract and interpret data from those narratives (Lieblich et al., 1998; McEwan, 1995; Zeller, 1995). It is used, for example, to analyse students' problem solving activity through their account of it, so as to get information allowing teachers to plan for suitable remediation strategies if necessary. This research field differs widely from NLE as concerns both its aim and its operation (collecting data and finding reliable ways to qualitatively analyse them vs. finding meaningful ways to use stories to improve people's learning). It is difficult to see an interaction between these fields.

Since our aim here is to report achievements and open questions on NLE, we will not pay attention to the two above mentioned applications of narrative in education.

2. Getting to know NLE

2.1 Different kinds of NLE

What do narrative learning environments look like? There is not a single answer to this question. They include environments providing different tools for the creation of narrative (from multimedia features to functions checking story consistence), computer games, drama and storytelling, as well as activities of various kinds where story construction is part of an overall task or where a back-story helps to connect different subtasks in meaningful way. How is it possible that such a variety of different environments were created and all are NLE? The point is that the educational potential of narrative has raised the interest of different research fields working with education (and not only), which have considered it from different points of view and hence exploited it in different ways to build effective learning environments. Hence, environments of this kind have been originated independently in different fields, in particular within studies on Artificial intelligence, Multimedia, and Instructional design. Following the varied origin of the different approaches, we can roughly spot three kinds of NLE, corresponding to the 3 above mentioned research fields.

2.1.1 Intelligent NLE

The first group originated from research in the field of Artificial Intelligence (AI). Besides being the most numerous, this group has also been the first to be developed in a systematic way. The expression NLE started to be used in this context and hence it is not surprising that it is sometimes employed to mean only these environments. This group consists of *interactive* NLE, that is, technological environments in which the users interact in not trivial way with the system to generate consistent narrative, thanks to the implementation of *intelligent agents* and other AI techniques. Among them, we find virtual drama and storytelling, as well as a variety of computer games and *augmented reality* environments, where interaction takes place not only by using standard I/O devices but also by manipulating real objects or moving in a physical space equipped *ad hoc* (the name *augmented-reality* means that they are based on a mixture of virtual and real

elements). Several *intelligent* environments have been developed in the past decade within a number of research projects; unfortunately, most of them remained in the form of prototypes and are not commercially available.

The interest of AI for narrative has a long tradition, starting from early studies in natural language and early attempts to make computers understand and generate stories (Mateas & Senger, 1999). The interest for narrative within this research field evolved in various ways over the years, influencing interface and systems design principles. Work on interactive fiction improved during the 90s, leading to the creation of the research field of "interactive storytelling", aiming to allow users to become active participants in computer supported narrative.

Implementing this kind of environments entails working out a solution to a number of technological and conceptual issues. A major issue regards making computers automatically generate consistent and believable narratives. To this end, researchers have been drawing from from narrative theories formulated within narratology studies (Cavazza & Pizzi 2006) in order to spot the main constituent elements of a story, or derive formalism for their implementation. Another important issue concerns granting real interactivity between human and computer on narrative construction. This entails addressing a number of questions to balance user's freedom and system's intended aims. Research in this field has given rise to a number of different approaches (Paiva, 2005), leading to a variety of solutions for the creation of the so-called *emergent narrative*, that is, consistent stories collaboratively created by means of human-computer interaction (Aylett, 1999).

Due to the presence of intelligent functions, turning the use of such environments into real narrative learning experiences (i.e. exploiting the educational potential of narrative) usually does not require much intervention of a teacher or mentor, since interactive environments can be explored by the students rather independently. An overall coordination of the activity is always advisable, however, by an experienced person who can suggest what kind of activity can be suitable in each learning situation considered).

Well known examples are:
- Carmen's Bright Ideas (http://www.isi.edu/isd/carte/proj_parented/)
- FearNot! (http://info.nicve.salford.ac.uk/victec/)
- Ghostwriter (http://www.cogsci.ed.ac.uk/~judyr/ghostwriter)
- POGO (http://www.iku.ulg.ac.be/projets_5_en.htm)
- SAM (http://www.media.mit.edu/gnl/projects/castlemate/)
- Tactical Language Training System (TLTS) (http://www.isi.edu/isd/carte/proj_tactlang/)
- Teatrix (http://gaips.inesc-id.pt/teatrix)

A description and classification of these environments can be found in Kaleidoscope Deliverable D13-03-03: "A first set of case studies on Narrative Learning Environments", by A. Paiva (ed.). available at http://telearn.noe-kaleidoscope.org/read_publi.php?publi=651.

2.1.2   Multimedia and narrative editors

The second group of NLE, which sprang from research in multimedia, includes hypermedia environments with some narrative guidance, and narrative editors, that is, multimedia editors explicitly oriented to the creation of narratives in the form of cartoon strips or short movies (Earp & Giannetti, 2006).

As concerns hypermedia products presenting a narrative, they can properly be considered NLE only if the given story leads the users to consider the variety of elements involved in a complex problem situation, hence helping them to build a (mental) configuration of it and work out a strategy to look for solutions. In this case, the story provided has the role of a container to highlight the elements of the considered problem and help the user relate them with each other in a meaning-creation process which is functional to the construction of a solution. This data-highlighting role in complex situations is not trivial nor irrelevant in relation to learning, in that some research studies underline that problem solving is more often hindered by an incomplete or inaccurate analysis of the data involved than by the lack of a suitable solution strategy (Sutherland, 2002).

As concerns the learning environments based on multimedia and narrative editors, they require a precise didactical guidance in order to really exploit the educational potential of narrative, in that

an inexperienced learner may fail to check the consistency of the stories/mental configurations constructed or to reason on causal constraints if not suitably guided or prompted to do so.

Several narrative authoring tools of good level are currently commercialised, such as:
- Kar2ouche Composer (http://www.mediastage.net/kar2ouche/)
- MediaStage (http://www.mediastage.net/mediastage/)
- Story Maker 2 (http://www.spasoft.co.uk/storymaker.html)

A description and classification of these environments can be found in Kaleidoscope Deliverable D13-03-03: "A first set of case studies on Narrative Learning Environments", by A. Paiva (ed.). available at http://telearn.noe-kaleidoscope.org/read_publi.php?publi=651.

Some simple ones are also available as freeware, e.g. D.Film Moviemaker, (http://www.dfilm.com) or Zimmer Twins (http://www.zimmertwins.com). Commercial multimedia editors can also be used for the same purpose; for instance, Faux (2006) makes use of Textease (http://www.softease.com/textease.htm). Also programs that allow to assemble pictures into movies can be used for the construction of stories; for instance, Kynigos et al, (2006) make use of Camtasia Studio (http://www.techsmith.com/camtasia.asp); Arnedillo and Tangney (2006) make use of Microsoft MovieMaker with images and sounds collected by means of mobile devices. Multimedia editors usually offer analogous, and sometimes better, facilities for multimedia composition, but do not provide choices of characters and story-like backgrounds, as it is the case with narrative ones.

A teacher or mentor can conceptually build an NLE on top of narrative or multimedia editors by proposing meaningful tasks and suitably guiding students' activity.

2.1.3   "Home-made" NLE

Finally, we can find in the literature examples of NLE which make use of general purpose technology and envisage some narrative task within the overall design of a learning activity. An example is provided by De Vries (2006), who reports a case study on a narrative activity realized by exploiting experiential narration and using e-mail as communication tool, with the aim to stimulate reflective thought in the learners. Another example is provided by Dolk & Den Hertog (2006), who challenge student teachers to collaboratively develop narratives of paradigmatic classroom situations in mathematics education.

All such environments are characterized by a strong human component, since human intervention is necessary to plan the activity and include a meaningful phase of narrative construction. Some technological tool is used in connection with the narrative activity, to amplify its impact: in the mentioned cases, it is email for De Vries and a multimedia environment to show videos, named MILE, for Dolk & Den Hertog.

Such "home made" NLE usually do not require any sophisticated technological tool, but require a good knowledge of educational theory and of NLE in order to plan meaningful and consistent narrative activities, well articulated with the overall learning design. They also require care and attention while carrying them out. Due to the scarce amount of specialized software involved in such environments, it is easy, for the inexperienced reader, to mistakenly include in this group educational experiences of other kind, like the use of narratives by teachers to make their lessons more effective, appealing and motivating. Without denying the importance of such uses of narrative, we wish to remind the definition of NLE given in a previous section, which implies a focus on learning, together with some active involvement on the part of the students and the use of some technological tools, in order to support learning by exploiting the intrinsic potential of narrative.

2.2   Towards a taxonomy of NLE

Apart from the use of narrative to support learning, does such a variety of applications have something in common? Is it possible to devise some common elements apt to help prospective users perform conscious and informed choices within such a diverse landscape? Is it possible to shape an overall framework helping the user to understand the structure, the kind of activity entailed and the learning afforded by NLE?

The answer to these questions is positive: as shown in Figure 1, three characterizing dimensions of NLE can be detected, namely the role of the student, the educational approach and the technological means. Each of them is shortly explained below.

- Role of the student.
The student can be given a narrative (story audiencing) or can produce a narrative. Story production, in turn, includes creation, telling and participation. Each of such activities puts into play different abilities. When creating a story, the learner invents it and makes a (usually external) representation of it in some format afforded by the tools available. On the other hand, when carrying out a storytelling activity, the learner tells a (more or less well known) story created by somebody else. In the first case, creativity is stimulated, while in the second case memory and the ability to personalize yet preserving consistency with the original are involved. In both cases the activity can be carried out individually or in cooperation with some (human or virtual) agent, which entails negotiating the overall development of the story.

If in joint story creation each (human or virtual) agent involved handles his/her/its own characters, and hence the narrative raises from the actions individually decided by each of the agents, then we speak of participation in story construction. This entails a different kind of negotiation from the cooperation mentioned above, where the consistence checks are made more complex by the need to control one's character(s) in an overall framework that depends on integrating the ideas of several different participants.

Finally, also receiving a story created and told by others implies a cognitive activity of the student, consisting in the elaboration of a mental representation of the facts narrated as well as of the causal and temporal connections among them.

- Learning approach
We mean by this term the approach to learning and the educational strategies underlying the activity to be carried out within the environment. NLE can be realized following different approaches that aim at supporting cognitive, metacognitive as well as affective levels of learning, such as inquiry or discovery learning, problem-based learning, experiential learning, collaborative and cooperative learning, role play, etc..

- Technological means
Among the variety of technological means that have been used in NLE, some influence the appearance of the environment and user interaction mode, while others determine the environment's structure and kind of narrative experience afforded. The first group includes 2D and 3D graphics, animations, sound, tactile interface. Intelligent agents, natural language processing, multimedia editors and general purpose tools, in particular communication ones like email or blogs, belong to the second group

Technological means
2D and 3D environments, animations, mobile technology, augmented reality, tangible interfaces, intelligent agents, natural language processing, etc.

Learning Approach
game-based and challenge-based, collaborative, situated, case-based, role play, problem solving, discovery learning etc.

Role of the user
story authoring, story telling, participation in story creation, story audiencing
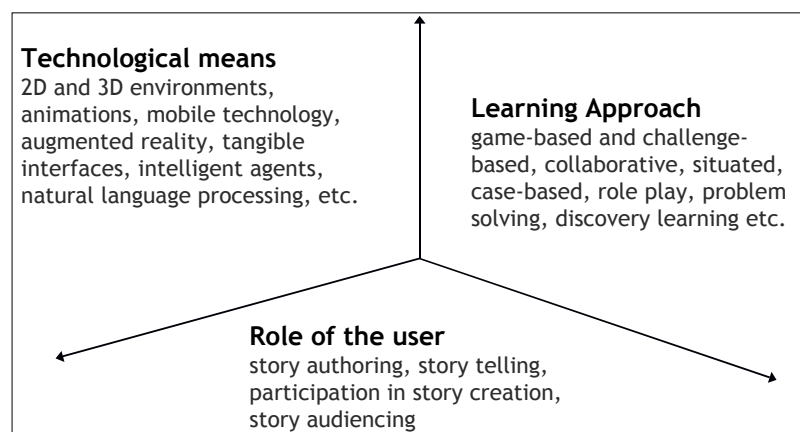
Fig.1. *Dimensions of NLE*

If we consider each environment as the combination of the possible values of these three dimensions, it is not difficult to figure out what great variety of NLE is possible. It is therefore not surprising that the existing NLE often look so different from each other to confuse the users, who may thus fail to recognize their common theoretical ground.

On top of this, NLE also differ in relation to the knowledge domain they address, that is, the content learning that can be acquired by working in the environment. In some cases this can be simply the development of narrative competence, which is a relevant task in itself, especially for children and teenagers. In other cases, narrative is used to induce learning in many different curriculum subjects, (such as linguistic expression in mother tongue or foreign languages, history, and science) or develop social competence and soft skills (such as relational behavior in critical conditions, decision making, etc.). This leads us to broadly distinguish two kinds of NLE as concerns the activity carried out, namely (Decortis, 2005):

- environments which are mediating tools for narrative activities (i.e. *learning to tell stories*);
- environments in which narrative is the mediator for other kinds of activities (i.e. *learning by telling stories*)

Despite the importance of this distinction, this aspect is not included as a fourth dimension in Fig.1, in that often a same environment can be used with different aims (e.g. an authoring tool can be used either to foster narrative ability and to support the practice of a foreign language). Hence the specification of the possible application domains does not appear to be a structurally characterizing feature of NLE.

2.3   NLE and afforded learning

The learning afforded by NLE obviously varies widely, according to the three dimensions described in Section 2.2. As for any other kind of educational software, in order to clearly detect the educational potential of a narrative environment it is necessary to carefully analyse the cognitive tasks implied and the abilities put at play. Let us see, for example, what different applicability and learning can be offered by two environments that an inexperienced user might consider similar in that both aiming to help the creation of stories, namely a narrative editor (MediaStage) and an interactive environment (Teatrix).

In these two environments, the experience of story creation is structured and developed in different ways. In **Teatrix**, the types of character available to build a story are in limited number, but are completed by a description which constrains their possible behaviour. Hence, constructing a narrative in this environment actually results in a role-play activity. The environment includes an intelligent function (the *hot-seating* tool) which aims to detect inconsistencies in characters' behaviour and monitor the overall consistency of the story, thus encouraging the conception of an intentional dimension for the characters. This environment, therefore, strongly supports the development of a narrative competence, in particular as concerns causal reasoning.

Media Stage, on the other hand, is more oriented to the development of communication skills. It pays attention to dialogues formulation, providing archives of sentences and multimedia facilities, like the possibility to record people speaking or produce spoken sentences by means of a text-to-speech tool. It offers a library of backgrounds, props and characters which is much richer than that provided by Teatrix, with more complex animations and a more refined graphics. These features can not only support the creation of more articulated and fancy stories, but also favour the acquisition of a technological literacy in relation with multimedia expressive abilities; these are not irrelevant skills in the current cultural context influenced by an ever increasing diffusion of powerful technological tools.

The two environments share the use of visual elements (backgrounds, props and characters), which encourage creativity and make story creation more concrete and faster than it would be possible in traditional classroom work (i.e. by drawing or dramatization), where often time constraints strongly limit the good development of such activities.

3. Research directions and open issues

3.1 Developing the field

NLE can still be considered an emerging field, since a clear organization of its content is still under development, its diffusion limited and many conceptual and practical issues need to be addressed. Attention to the use of narrative to support learning is rapidly increasing, though, as witnessed by the number of related scientific papers, events and web sites (see a collection of all of these on http://nle.noe-kaleidoscope.org), and therefore we can expect a rapid development of the research in this field and diffusion of its applications. Several issues should be addressed to further develop the field:

- From a conceptual point of view, the taxonomy of NLE presented in Section 2.1 should be deepened and refined, and particular cases of NLE should be explored, so as to define more precisely the limits and structure of the field.
- From a technical point of view, work should be done on building more effective, efficient and interactive environments, and also to integrate the three groups of NLE described in Section 2.3; in this respect, for instance, Dettori & Giannetti (2005) suggest the construction of intelligent narrative editor offering both the cognitive guidance and consistence checks that characterize interactive NLE and the expressive richness of multimedia narrative editors.
- From a pedagogical point of view, the impact of applying NLE in different disciplines, including not traditional ones, like the scientific domain, should be analysed, and their educational potential further explored.

Moreover, particular attention should be given to two important issues that are transversal across the conceptual, the technical and the pedagogical, that is, evaluation and diffusion of NLE.

3.2 Evaluating NLE

Evaluating NLE is a crucial point to take into consideration in order to fully understand how to build better NLE and suitably exploit them in the educational practice. What makes this question difficult, however, is the fact that there are so many aspects and points of view involved that obviously there can not be a single way of evaluating.

Currently the literature offers different approaches to the evaluation of NLE, focusing on the technical features of the environments, on the educational effectiveness of NLE, or on the emotional impact and enjoyment they produce on the user.

A possible kind of evaluation (Decortis & Rizzo, 2005) aims to understand and to describe the interactions taking place in the environments, in order to formulate requirements and specifications for the designers, drawing mainly on the results and criteria adopted in the Human-Computer Interaction research area.

Some other studies on evaluation focus on the NLE potential to stimulate and encourage a narrative activity and mediate learning (Decortis & Rizzo, 2005), with the aim to help develop a narrative ability (Fusai et al. 2003, Rizzo et al. 2003) or improve other competences. This kind of evaluation is based on

- *content criteria*, such as the quality of the narrative produced, the end results of the narrative activities, the achievement of pedagogical objectives;
- *process criteria*, such as the regulation mechanisms and scaffolding provided and the usefulness of features that mediate meaning-making.

In relation with support to learning, Dettori & Giannetti (2006), discuss how to analyse the support to the self-regulation of learning provided by a narrative editors. The same scheme of analysis could be applied to other kinds of NLE.

Last (but nor least!) evaluating NLE entails also evaluating learner's experience from the point of view of emotions and enjoyment, which constitute an essential part of the learning process. An example of this kind of evaluation is proposed by Laaksolahti (2006) in relation to dramatic games. Though his analysis does not explicitly address environments with educational aim, this approach is worth considering for possible extension to the evaluation of NLE, especially since, as already mentioned in Section 1.2, narrative is strictly related with motivation and emotions (Aylett, 2006) and these, in turn, are important components of learning (Schunk & Zimmerman 1998).

3.2 Diffusing application

Diffusing the use of NLE in education depends on the availability of a variety of environments suitable for applications in different disciplines and educational contexts, as well as on educators preparation in this respect.

Aylett (2006) spots the roots of the first of these issues with great precision, in relation to interactive NLE: "*Taking some of the innovative ideas and systems from research prototypes through to delivered systems is what is needed in order to make NLEs a real educational option. This is of course non-trivial since it depends not only on the maturity of the technology but also on the business case convincing educational software producers to move in this direction. ... As against this hopeful development, games companies currently seem very conservative in the development of new genres, with a tendency to updated versions of existing successes rather then the exploitation of autonomous character technology in order to develop new ones. As a result, the narrative aspects of games are nearly universally absent or extremely weak. This conservatism and the baggage that comes with the existing genres needs to be considered very carefully before assuming that 'games-based' education is necessarily always a step forward*".

As concerns "home made" NLE and multimedia authoring tools, which require technological tools often available on the market but entail an amount of human planning, it would be crucial for their diffusion to share within the scientific and educational communities reports of experiences and analyses of case studies, so as to inspire and guide the development of such environments and their application to formal and informal learning.

Finally, as concerns preparing educators to make a meaningful use of NLE, it is necessary to disseminate information on their potential support to learning and on the different ways they can be used, both in informal learning or integrated in school curricula.

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References

Arnedillo Sánchez, I., Tangney, B. (2006) Mobile Technology Towards Overcoming Technology & Time Constrains in Digital Video Production. In P. Isaias, P. Kommers & I. Arnedillo Sánchez (Eds.), *Mobile Learning 2006*. Dublin: International Association for Development of the Information Society Press (pp. 256- 259).

Aylett, R. (1999) Narrative in virtual environments - towards emergent narrative, *Proceedings of AAAI Fall Symposium on Narrative Intelligence,* AAAI Press.

Aylett, R. (2006) And they both lived happily ever after? In G. Dettori, T. Giannetti, A. Paiva & A. Vaz (Eds.), *Technology-mediated narrative environments for learning* (pp.5-25). Rotterdam: Sense Publishers.

Bednar, A.K., Cunningham, D., Duffy, T.M., & Perry, J.D. (1991), Theory into practice: How do we link? In G. Anglin (Ed.), *Instructional Technology: Past, Present and Future.* Englewood Cliffs, CO: Libraries Unlimited, Inc.

Bruner, J. (1990). *Acts of meaning.* Cambridge, Massachusetts: Harvard University Press.

Bruner, J. (1996). *The culture of Education*. Cambridge, Massachusetts: Harvard University Press.

Cavazza M. & Pizzi D. (2006). Narratology for interactive Storytelling: A Critical Introduction. In *Technology for Interactive Digital Storytelling and Entertainment*, S. Gobel, R. Malkevitz & I. Iurgel (eds.), LNCS 4326, Springler Verlag, Berlin Heidelberg, pg. 72-83.

Champion, T.B. (1998). "Tell me somethin' good": A description of narrative structures among African-American children. *Linguistics and Education 9*(3), 251-286.

Craig, C.J. (2003). Characterizing the human experience of reform in an urban middle-school context. *Journal of Curriculum Studies*, 35(5), 627-648.

Decortis, F. & Rizzo, A. (2002). New active tools for supporting narrative structures. *Personal & Ubiquitous Computing*, 6, 416-429.

Decortis, F., Rizzo, A., Saudelli, B. (2003). Mediating effects of active and distributed instruments on narrative activities. *Interacting with Computers*. 15, 6, 801- 830.

Decortis, F. & Rizzo A. (2005). Evaluation of narrative learning environments based on theoretical grounds, *Report of the SIG NLE* (Kaleidoscope deliverable D13.2.3)

Dettori, G., Giannetti, T., Paiva, A.& Vaz, A. (eds.) (2006). *Technology-mediated narrative environments for learning,* Rotterdam: Sense Publishers. (downloadable in non-printable format from http://www.sensepublishers.com/books/otherbooks/90-77874-15-1.htm).

Dettori G. & Giannetti T. (2005). Developing self-regulated learning in ICT-based Narrative Environments, *proc. AIED 2005, 12th International Conference on Artificial Intelligence in Education,* 32-39, Amsterdam

De Vries, B. (2006). Reflective narration with e-mail: Issues concerning its implementation. In G. Dettori, T. Giannetti, A. Paiva & A. Vaz (Eds.), *Technology-mediated narrative environments for learning* (pp.41-54). Rotterdam: Sense Publishers.

Dolk & Den Hertog (2006). Teachers' storied lives: narratives in teacher education, *Proceedings NILE 2006*, P. Brna ed., pg 13-26

Earp, J., & Giannetti, T. (2006). Narrative-oriented software for the learning of a foreign language. In G. Dettori, T. Giannetti, A. Paiva & A. Vaz (Eds.), *Technology-mediated narrative environments for learning* (pp.27-40). Rotterdam: Sense Publishers.

Faux, F. (2006). Speak for yourself! Developing a narrative within a multimedia, multimodal, ICT environment. In G. Dettori, T. Giannetti, A. Paiva & A. Vaz (Eds.), *Technology-mediated narrative environments for learning* (pp.67-78). Rotterdam: Sense Publishers.

Fusai, C., Saudelli, B., Marti, P., Decortis, F., & Rizzo, A. (2003). Media composition and narrative performance at school. *Journal of Computer Assisted Learning, 19*, 177-185.

Gussin Paley, V. (2004). *A child's work. The importance of fantasy play*. Chicago: The University of Chicago Press.

Gordon, D., & Alexander, G. (2005). The education of story lovers: Do computers undermine narrative sensibility? *Curriculum Inquiry,* 35(2), 133-159.

Kynigos, C., Kazazis N. & Makrì K., (2006) On narrative perception and creativity in G. Dettori, T. Giannetti, A. Paiva and A.Vaz (eds.), *Technology-mediated Narrative Environments for Learning*, 91-101.

Jackson, P.W. (1995). On the place of narrative in teaching. In H. McEwan & K. Egan (Eds.), *Narrative in teaching, learning and research* (pp.3-23). New York: Teachers College Press.

James, C., & Minnis, W. (2004) Organizational storytelling: it makes sense. *Business Horizons*, 47 (4), pg. 23–32.

Laaksolahti J. (2006). Methods For Evaluating A Dramatic Game, In G. Dettori, T. Giannetti, A. Paiva & A. Vaz (Eds.), *Technology-mediated narrative environments for learning* (pp.123-132). Rotterdam: Sense Publishers.

Lieblich, A., Tuval-Mashiach, R., & Zilber, T. (1998). *Narrative research: Reading, analysis, and interpretation* (Vol. 47). SAGE Publications.

Luckin, R., Plowman, L., Laurillard, D., Stratford, M., Taylor, J., & Corben, S. (2001), *Narrative evolution: learning from students' talk about species variation*. International Journal of Artificial Intelligence in Education, 12.

Luhman, J. T. (2005). Narrative processes in organizational discourse. *E:CO Special Double Issue: Complexity and Storytelling*, 7 (3–4), pg. 15–22.

Mateas, M., & Senger, P. (1999). Narrative intelligence: An Introduction to the NI Symposium. In M. Mateas & P. Senger (Eds.), Working Notes of the Narrative Intelligence Symposium. AAAI Press.

McEwan, H. (1995). Narrative understanding in the study of teaching. In H. McEwan & K. Egan (Eds.), *Narrative in teaching, learning and research* (pp.166-183). New York: Teachers College Press.

Norris, S.P., Guilbert, S.M., Smith, M.L., Hakimelahi, S., & Phillips, L.M. (2005). A theoretical framework for narrative explanation in science. *Science Education, 89*, 535-563.

Paiva, A., Machado, I., & Martinho, C. (1999) Enriching pedagogical agents with emotional behaviour: The case of Vincent, In *Proceedings of the AIED Workshop on Animated and Personified Pedagogical Agent,* Le Mans.

Paiva, A. (2005) The role of tangibles in interactive storytelling, VS 2005, lecture notes CS 3805, G. Subsol ed., Springler Verlag, Berlin Heidelberg 2005, pg. 225-228

Pokinghorne, D. (1988). *Narrative knowing and the human sciences.* NY: State University of New York Press.

Porter Abbott, H. (2002). *The Cambridge introduction to narrative*. Cambridge University Press.

Propp, V. (1968). *Morphology of the Folk Tale.* 2nd ed., rev. and ed. with pref. by Louis A. Wagner. Introd. by Alan Dundes. Austin: University of Texas. (First Engl. ed. 1958. Translated from Morfologiia skazki. Leningrad: Academia.1928.)

Ricoeur P.(1981) *Hermeneutics and the human sciences*. Cambridge: Cambridge University Press.

Rizzo, A., Marti, P., Decortis, F., Rutgers, J., Thursfield, P. (2003). Building narratives experiences for children through real time media manipulation : POGO world. In M.A. Blythe, A.F. Monk, K. Overbeeke & P.C. Wright (eds). *Funology : from usability to enjoyment*, chapter 15, 1-12, Kluwer Academic Publishers, Amsterdam.

Scalise Sugiyama, M. (2001). Food, foragers, and folklore: the role of narrative in human subsistence, *Evolution and Human Behavior*, 22 (4), pg. 221–240.

Schunk D.H., Zimmerman B.J. (1998), *Self-regulated learning, from teaching to self-reflective practice.* New York: The Guilford Press.

Sutherland, L. (2002). Developing problem solving expertise: the impact of instruction in a question analysis strategy, *Learning and Instruction* n. 12, pg. 155-187

Timchenko, O. (2006). Narrative for motivation and meaning making. In G. Dettori, T. Giannetti, A. Paiva & A. Vaz (Eds.), *Technology-mediated narrative environments for learning* (pp.115-122). Rotterdam: Sense Publishers.

Young, K.M. (2001). The neurology of narrative. *Substance* , Univ. of Wisconsin Press, 30 (1-2), p. 72-84.

Wertsch, J.V. (1998). *Mind as action*. New York/Oxford: Oxford University Press.

Witherell, C.S. (1995). Narrative landscapes and the moral imagination: Taking the story to the heart. In H. McEwan & K. Egan (Eds.), *Narrative in teaching, learning and research* (pp.39-49). New York: Teachers College Press.

Zeller, N. (1995). Narrative rationality in educational research. In H. McEwan & K. Egan (Eds.), *Narrative in teaching, learning and research* (pp.211-226). New York: Teachers College Press.