

Chapter 4

Narrative Learning in Technology-Enhanced Environments

An Introduction to Narrative Learning Environments

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Abstract Narrative is recognized as a valid support for learning because it helps make sense of experience, organize knowledge and increase motivation. Narrative learning environments (NLEs) aim to exploit its educational potential by engaging the learner in technology-mediated activity where stories related to the learning task play a central role. This chapter illustrates the variety of NLEs currently available and suggests a classification of them based on the technology used. It also points out what issues need to be tackled to advance the field.

Keywords Narrative learning environments · Story · Narration · Sense making · Motivation · Storytelling · Story creation · Collaboration · Interactive environments · Multimedia editors · Educational design · Web 2.0

4.1 Introduction

Narrative, in the form of stories and narrations, is increasingly used in education. Not only is it a natural expressive form for people of any age and culture (Bruner, 1990), but it is also recognized as a privileged way to help develop cognitive abilities and organize knowledge (Schank, 2000), as well as to work out a coherent meaning for our experience (Bruner, 1990, 2003). As a consequence, stories are being increasingly used in a variety of subjects, not only intuitively related ones such as history, literature and language but also in the scientific domain (Burton, 1996, 1999; Bruner, 2004).

Stories can be used in the educational field for different purposes, that is, to support learning, teaching and research (McEwan & Egan, 1995). In a narrative approach to learning, the focus is on finding meaningful ways for the students to

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make use of stories related to their learning tasks, with the aim of facilitating and improving learning. In a narrative approach to teaching, on the other hand, the attention is on creating and using suitable stories to convey content knowledge incisively and to motivate people to learn, both in school (Jackson, 1995) and in organizational contexts (James & Minnis, 2004). Finally, the use of narrative for research purposes, which is usually called “narrative research”, consists in using narrative as a way to collect data; it entails, therefore, the development of procedures to extract and interpret data from narrations (Lieblich, Tuval-Mashiach, & Zilber, 1998). While there is clearly a relation between the study of narrative to support learning and teaching, narrative research differs both in its aim and operation and is actually an independent research field.

This chapter is focused on narrative learning, in particular within technology-enhanced learning environments. Studying the synergy between narrative and technology for the creation of effective learning environments is of interest because ICT offers a variety of tools and techniques – from 3D graphics and animation to intelligent agents, from communication means to augmented reality – able to exploit and amplify the learning potential of narrative in different ways and for different purposes. This gave rise, in the last few decades, to the research and application field of narrative learning environments (NLEs).

In the next sections we highlight why narrative can support learning, drawing from the literature. Then we discuss NLEs’ main features and learning potential and mention a few examples. Finally, we point out some issues to be tackled in advancing the field.

4.2 Why Narrative Can Support Learning

4.2.1 What Is Narrative

Even though the concept of narrative might seem rather intuitive, defining it precisely is not trivial. This term is often improperly used in everyday speech to mean a wide range of expression types, thus voiding it of its meaning and possible usefulness in relation to learning (Thomas & Young, 2007). Relying on a loose characterization may generate confusion and does not help understanding of what determines the learning potential of narrative. For this reason, we need to start our analysis with a meaningful definition, drawing from the large number of characterizations given in the literature. Let us therefore compare the points of view of four scientists with different orientations working in non-literary fields.

Bruner (1990), whose work on cultural psychology represented a milestone for the development of many subsequent studies on the educational impact of narrative, defines it as follows:

a unique sequence of events, mental states, happenings [. . .] But these constituents do not 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* (p. 43).

Wertsch (1998), who analyses narrative as a cultural artefact in his studies on mediated action, points out its components:

Narrative is organized around temporality, it has a central subject, a plot with a beginning, middle and end, and an identifiable narrative voice; it makes connections between events; it achieves a closure, a conclusion, a resolution (p. 80).

and then adds

The cognitive function of narrative form is not just to relate a succession of events but to body forth an ensemble of relationships of many different kinds as a single whole (p. 81).

Ricoeur (2005), considering narrative in his studies on hermeneutics and the human sciences, explains it as follows:

The activity of narrating does not consist simply in adding episodes to one another; it constructs meaningful totalities out of scattered events. The art of narrating, as well as the corresponding art of following a story, therefore requires that we are able to extract a configuration from a sequence (p. 278).

Herman (2003), in relation to cognitive science, claims

One of the hallmarks of narrative is its linking of phenomena into causal-chronological wholes (p. 176).

It is clear that behind the different phrasings, these characterizations of narrative are in agreement with each other. This is very important, because it indicates that the word narrative is used in a consistent way across different scholarly fields, so that, when working on the use of narrative to support learning, we can rely on theoretical studies of different origins.

All of the cited definitions highlight the presence of connections and relationships among the elements of a story that build a configuration out of them, that is, a whole giving meaning to all single parts. Therefore, loose definitions of narrative that acknowledge the presence of a sequence of events but miss highlighting the configuration created by the relationships end up inadequate, because the presence of relationships among narrative elements is a key point for provoking active thinking and supporting meaning construction. Annals and chronicles are not narratives, because they do not build a complete configuration from a list of events (Wertsch, 1998, p. 79). Analogously, lectures and scientific reports are not narratives just by being discursive, unless they consist of stories with a relational structure, a narrating voice (which suggests that there is a point of view in reporting the facts) and a conclusion. Nor can reflections and explanations be considered narratives, because they do not consist of sequences of related events but rather of descriptions, argumentations, generalizations and abstractions.

On the other hand, the given definitions do not limit the nature of the content or the language employed. Hence, narrative includes both invented and true stories, as well as narrations of personal experiences. It can be expressed in a variety of different languages, such as spoken words, written texts, sequences of static or moving pictures and even body language and shadows, or a combination of all of them.

4.2.2 Learning Potential of Narrative

The presence of logical relationships among the elements of a narrative allows its users to infer more than is explicitly reported (Bruner, 2003) and hence leads people – both receivers and producers – to engage in a meaningful construction process. This makes narrative a powerful sense-making device and cognitive tool.

Starting from this essential characterization, many authors have deepened the analysis of narrative properties, identifying roles which are relevant for learning, such as *external knowledge representation* (Porter Abbott, 2002), *cognitive process* (Luckin et al., 2001; Scalise Sugiyama, 2001), *context setting element* (Aylett, 2006), *organizational principle* (Polkinghorne, 1988), *way to structure human experience* (Aylett, 2006) and *mediator of human action* (Wertsch, 1998).

Moreover, the literature highlights that narrative can support not only cognition but also motivation and emotion, which are equally important components of learning. As Bruner (2003) points out, “narrative in all its forms is a dialectic between what was expected and what came to pass” (p. 15), as well as “an invitation to problem finding, not a lesson in problem solving” (p. 20). For this reason, the use of narrative in learning can result in challenging and stimulating curiosity and fantasy, which are the major components of intrinsic motivation according to the taxonomy proposed by Malone and Leppers (Rowe, Mcquiggan, Mott, & Lester, 2007).

The support for emotion arises from the fact that “stories are based on an interplay between characters and causation” (Aylett, 2006), which leads the user to highlight aspects of personality, emotional state and social standing, as well as the motives and intentions underlying characters’ actions.

4.3 What are NLEs

The expression *Narrative Learning Environments* was created in the 1990s within the field of artificial intelligence (AI) to indicate learning environments where stories, interactively created by user and system, had a central role in facilitating learning. In recent years, however, due to the widespread interest aroused by the educational potential of narrative, this expression started to be used in connection with learning environments that originated within other contexts and were developed with different technology. Such environments share with the original NLEs the characteristic of being based on ICT-mediated learning activities in which narratives related to the task at hand play a central role. They differ, however, in a meaningful way.

AI-based NLEs are *technological* constructions, with all the necessary components packaged in them. That is, they include the assignment of relevant narrative activities, a pedagogical approach to guide them and a selection of suitable technological tools. NLEs created in other research fields, on the contrary, are *conceptual* constructions, making use of some technological tools that facilitate a relevant narrative activity; they require some human labour to set up narrative tasks and

define a pedagogical approach apt to favour task completion and the achievement of the expected learning. Moreover, technological NLEs allow joint story construction by user and system, thanks to AI technology, as will be explained in Section 4.5. For this reason, they are called *interactive NLEs*. Conceptual NLEs allow only the level of interactivity usually provided by currently available software, such as hypermedia navigation and communication with networked users; therefore, they are not usually considered interactive, even though the learner interacts with a story and with other learners.

The Special Interest Group on Narrative Learning Environments¹ of the Kaleidoscope Network of Excellence played an important role in recognizing the wide similarity between technological and conceptual NLEs by comparing different points of view and similar outcomes of people working with narrative learning. This activity led to the spotting of similarities and differences, thereby providing the basis for the NLE classification presented in this chapter.

Even though meaningful narrative learning activities can be realized with traditional educational means (e.g. drawing, dramatization, books), NLEs usually make use of some form of ICT tool. This allows easier and faster management of multimedia narratives, hence leading the learners to become familiar with multiple representational modes, within an activity – the interaction with stories – which is naturally appealing and not too difficult. Non-verbal narratives can also be constructed easily, allowing people with language-related disabilities to exploit the learning potential of narrative (e.g. Faux, 2006).

Among the variety of technological means that are used in NLEs, some influence the appearance of the environment and interaction mode, while others determine its structure and the experience afforded. The first group includes 2D and 3D graphics, animations, sound and tactile interfaces. Intelligent agents, natural language processing, multimedia editors, web 2.0 technology and general purpose tools belong to the second group.

Besides AI, the fields that most influence the creation of NLEs are multimedia and educational design. The increasing diffusion of web 2.0 technology is also providing technological tools that can properly be used to set up NLEs centred on role playing. Hence, at present, we can identify four main groups, which resort to different kinds of technology and require varying amounts of human labour to set up stimulating tasks and control the development of the narrative activity. Table 4.1 summarizes them, highlighting what kind of technology is used in each group. The four groups are described in Section 4.5, together with some examples.

It is important to note that not just any learning environment including a story can properly be considered narrative. There are environments where a story is given as an appealing background to problem solving, without a conceptual integration between the given narrative and the assigned tasks. In this case, the back-story simply aims to provide a generic, extrinsic motivation to work in the environment. This may work well in disciplines (such as mathematics) that are scarcely appealing for

¹ <http://nle.noe-kaleidoscope.org> or <http://gaips.inesc-id.pt/nle/en/context.html>

Table 4.1 Classification of NLE types according to the technology used

	Focus on creating a story	Focus on receiving a story
<i>Interactive NLEs based on AI technology</i> (control of the activity is largely embedded in the environment; limited teacher intervention is necessary)	Stories emerge from collaboration among users and environments. Parts of narrative are automatically created by means of intelligent agents, e.g. Teatrix	Interactive environments where users are given a narrative that can help them understand a problem situation. The narrative is mainly produced by the environment, but the users influence it. New stories are produced at each use, e.g. FearNot!, Crystal Island
Equal space to story telling and listening, e.g. SAM		
<i>NLEs based on multimedia technology</i> (technology provides features to facilitate story creation, but organization and control of the activity relies on users)	Environments based on narrative editors, i.e. multimedia editors oriented to the creation of stories in the form of cartoon strips or animations, e.g. StoryMakerII, MediaStage, Kart2ouche, ZimmerTwins	Multimedia environments where the user is given a narrative to help them understand a problem situation. The narrative is pre-defined, the user has only navigation freedom, e.g. Ecolandia
<i>NLEs based on web 2.0 technology</i> (story creation facilities, pedagogical planning and activity control are necessary)	Intrinsically collaborative, mainly based on role playing. Users participate in story creation, receiving part of a narrative from the other participants and contribute to it complying with constraints and adjusting to the story's global development, e.g. Revolution	
<i>NLEs based on general purpose technology and on educational design and theories</i> (the narrative activity is completely decided by the humans involved in the environment)	1) Environments where some relevant narrative activity is assigned within an articulated learning task, e.g. Dolk & Den Hertog (2006), de Vries (2006), Makrì (2006), Walker (2006a, b) 2) POGO, a virtual story world, accessible through a number of physical interactive tools	This falls under Narrative Teaching

many students, as a way to sweeten an unpleasant pill (Aylett, 2006), but it does not characterize such environments as NLEs.

4.4 Learning with NLEs

NLEs may be devoted to developing narrative competence, which is a relevant cognitive task, especially for children and teenagers. They can also aim to support learning in a variety of subjects, such as linguistic expression in a mother or foreign

language, history, science or to develop social competence and soft skills, such as relational behaviour in critical conditions, decision making. These two possibilities are not alternatives to each other but in fact intertwined and always take place together: using narrative to foster learning in a given field is a way of practicing with narrative as well, while reinforcing narrative competence necessarily involves also other skills, such as the use of language or of some other expressive code. This is not surprising, because narrative is a cultural artefact used in NLEs to mediate learners’ action, and it is typical of mediated action to have multiple simultaneous goals (Wertsch, 1998, p. 25).

Learners can interact with narrative in different ways, that is, by receiving a narrative, by producing a new one or by telling a known one, no matter whether the environment’s learning aim is to build competence in narrative, a subject or a soft skill. Each of these activities can be performed individually or by interacting with peers or software. In all cases, a number of cognitive abilities are brought into play, favouring the acquisition of several basic skills, as shown in Table 4.2, which add to the environment’s learning aims.

Story creation fosters creativity and understanding of logical consistency, while storytelling stimulates recognition of main elements and memory. Receiving a story, on the other hand, entails building a mental picture of the narrated events. This turns out to be very useful in problem solving, because it helps to highlight the elements in play and to relate them with each other, giving rise to a meaning-creation process that supports the construction of a solution. This data-highlighting role is neither trivial nor irrelevant: a number of research studies have underlined 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).

Table 4.2 Basic abilities and skills supported by user’s roles and working modes in NLEs

	Individual work	Interaction with peers	Interaction with software
Story creation	Creativity Learning to narrate Respect for logical constraints Communication skills	Same as in individual work Negotiating story plot with peers	Same as in individual work Adjusting individual plans to story
Story telling	Understanding story Detection of plot’s main elements Memory Personalization Communication skills	Same as in individual work Negotiating story representation with peers	Same as in individual work Matching mental plot with actions made by the software
Story use	Mental picture of narrated events Understanding meaning and relations of story elements and data	Discussing configuration with peers Negotiating meanings with peers	Same as in individual work, with the possibility of asking personal questions to clarify the situation

4.5 A Classification of NLEs

4.5.1 *Interactive NLEs*

The group of NLEs originating from AI research consists of *interactive* NLEs, that is, technological environments where the users interact in non-trivial ways with the system to generate consistent narrative, thanks to *intelligent agents* and other AI procedures. It includes primarily environments produced within research projects; they are, hence, well documented by research reports but not commercially available.

Implementing this kind of environment entails working out a solution to a number of technological and conceptual issues. A major issue concerns making computers automatically generate consistent and believable narrative. To this end, researchers derive formalisms for story generation by drawing from narrative theories formulated within narratology studies (Cavazza & Pizzi, 2006). Another important issue concerns realizing interactivity between human and computer in narrative construction. This entails addressing a number of complex questions balancing the user's freedom and the system's intended aims. Research in this field has given rise to several different approaches (Paiva, 2005), leading to a variety of solutions for the creation of *emergent narrative*, that is, consistent stories collaboratively created by human-computer interaction (Aylett, 1999).

Though always involving the user to some extent as a participant in story creation, interactive NLEs may be more focused on narrative construction or on narrative use. An environment focused on story construction is Teatrix,² a virtual stage where pupils can build and play stories in collaboration with other networked users and with artificial characters. Moreover, some AI functions help the users check the consistency of their stories and of characters' behaviour.

An example of interactive NLEs where a story is mostly given is FearNot!³ This environment aims to help pupils understand what is bullying and cope with it. It offers stories generated by following the suggestions given by the user to the environment's main character, a child who is being bullied in school. The implemented learning approach consists in raising empathy in the users so as to make them become aware of the negative side of bullying.

Crystal Island (Rowe et al., 2007), an environment for middle-school students supporting inquiry-based learning in microbiology and genetics, also proposes a story to the learner, who is invited to identify with one of the characters. He/she takes the role of a member of a scientific expedition who needs to solve a genetic problem to stop an epidemic disease that is afflicting the research group. The student navigates the environment and, interacting with the story characters, gets information on the object of study and suggestions for working out a solution. The characters are animated by semi-autonomous agents, which means that (partially) new dialogues are generated each time one of them interacts with the user.

² <http://gaips.inesc-id.pt/teatrix/>

³ <http://info.nicve.salford.ac.uk/victec/> and <http://www.e-circus.org/>

SAM,⁴ which both encourages and carries out storytelling, lies across the two groups. In this environment, which aims to help children become fluent in storytelling, a virtual child, projected on a wall, invites the user to engage in a game of telling stories to each other, taking turns. In this case, story creation is done individually by the real and the virtual child, but the system selects some keywords in the user's stories to guide the generation of the next story told by the virtual child, so as to give the impression of a kind of dialogic activity.

4.5.2 NLEs Based on Multimedia Technology

The second group of NLEs, which sprang from research in multimedia, also includes hypermedia environments where some narrative is given, as well as environments that facilitate the creation of stories.

Ecolandia, a nice example of a multimedia environment presenting a narrative (Dettori & Giannetti, 2006), aims to foster reasoning on environmental issues, showing that it is necessary to integrate information from different sources and that complex problems may have more than one possible solution. Here the student plays the role of an expert who is sent to solve the garbage disposal problem of three neighbouring cities and gathers the data necessary to tackle the task by going to the library and listening to public administrators, citizens and experts.

Multimedia NLEs for story creation can be set up with the use of narrative editors, that is, multimedia editors explicitly oriented to the creation of narratives in the form of cartoon strips or animations (Earp & Giannetti, 2006). Both commercial software, such as Kar2ouche Composer,⁵ MediaStage,⁶ StoryMaker II, and freeware, such as Zimmer Twins,⁷ are currently available. These differ from each other as far as the graphics used (2D or 3D), the kind of animation allowed, the complexity of scene and dialogue supported. Plain multimedia editors (such as Textease)⁸ can also be used (Faux, 2006), as well as programmes for movie editing (e.g. Kynigos, Kazazis, & Makri (2006) use Camtasia Studio;⁹ Arnedillo-Sanchez (Chapter 14) uses Microsoft MovieMaker with images and sounds collected with mobile devices). Multimedia editors usually offer facilities for multimedia composition analogous to narrative editors, and often even better ones, but do not provide choices of characters and story-like backgrounds, as is the case with narrative editors.

Both narrative and multimedia editors offer facilities for story construction but do not provide functions for checking story consistency or built-in tasks or learning approaches to guide the narrative activity; they require therefore some attention from the users (teachers or mentors or the learners themselves) to shaping the narrative

⁴ <http://www.media.mit.edu/gnl/projects/castlemate/>

⁵ <http://www.mediastage.net/kar2ouche/>

⁶ <http://www.mediastage.net/mediastage/>

⁷ <http://www.zimmertwins.com>

⁸ <http://www.softease.com/textease.htm>

⁹ <http://www.techsmith.com/camtasia.asp>

learning activity, checking the consistency of the stories constructed and reasoning about logical constraints.

4.5.3 NLEs Based on Web 2.0 Technology

The multimedia communication technology of web 2.0 gives rise only to collaborative environments where the users participate in story creation.

The educational game Revolution¹⁰ is a web 2.0 environment that was expressly designed for learning. It is a multi-user role-playing game on the American revolution designed to be played by a group of learners in a networked environment, in 45-minute sessions. During the game, narrative action unfolds and the users become part of it by taking one of seven different social perspectives, hence experiencing the social, economic and cultural life of the period. The given historical context constrains the participants' actions, turning the game into a learning activity where knowledge is built by interacting and discussing with peers. As with all role playing, however, suitable preparation is essential for generating consistent narrative and giving educational meaning to the experience. A debriefing phase to acquire awareness of the learning achieved is also advisable.

Moreover, online multi-player games with a narrative background, such as World of Warcraft¹¹ (WoW), or even role-playing environments without pre-defined back-story, such as Second Life,¹² are also arousing interest in the educational field and could be used as technological engines for setting up NLEs. Usually a kind of story arises from the interaction among participants, and some learning is involved, at least as concerns the creation and application of strategies. Mass multi-player games, however, cannot be considered NLEs as such, in that a learning approach is missing and the variety of participants' possible behaviours and motivations does not favour the creation of really consistent stories. In order to build NLEs by means of such online games, therefore, it is necessary to design meaningful narrative activities, specifying the learning aims and their relation with the created narrative.

4.5.4 NLEs Based on General Purpose Technological Tools

The literature reports on a number of learning environments based on general purpose technology, that is, not strictly oriented to the production of stories, that can be considered NLEs. They are strongly human-centred and envisage some narrative task within the overall design of a learning activity. For instance, de Vries (2006) has pupils create narrations of science classes by e-mail, with the aim of stimulating the learners to reflect on what they are learning. Dolk and Den Hertog (2006)

¹⁰ <http://www.educationarcade.org/revolution>

¹¹ <http://www.worldofwarcraft.com/index.xml>

¹² <http://secondlife.com/>

challenge trainee teachers to collaboratively develop narratives of classroom situations, with the aim of improving their ability to observe and detect learning difficulties. Makrì (2006) has trainee teachers exchange narrations of learning experiences by means of blogs, with the aim of helping them reflect on the teaching profession. Walker supports the creation of narrative trails in museums (2006a) and in botanical gardens (2006b) by means of mobile technology, with the aim of stimulating and facilitating reflection on experience. In all cases, the use of some technological tools amplifies the impact of the narrative activity.

Such environments are shaped by educational design. They are characterized by a stronger human component than the other NLE groups, because the technology they rely on is neutral with respect to narrative, so that organizing narrative activities completely relies on human intervention. Because they are not supported by narrative-oriented technology, setting them up requires knowledge of narrative learning and educational theories, in order to plan meaningful and consistent narrative tasks. It also requires controlling that the learners' activity be actually narrative, because relying on other types of discourse would obviously influence learning in a different way.

We can also place within this group of NLEs POGO (Fusai, Saudelli, Marti, Decortis, & Rizzo, 2003), an environment very different from all of those mentioned previously. POGO, which aims to facilitate children's collaborative creation of stories, is a virtual world, accessible through a number of interactive tools that are distributed in the physical environment and allow children to create and manipulate the story elements. This leads them to mix the physical (scanned drawings and objects, videos of themselves performing) and the virtual (digital elaborations) in story creation. Unlike the other NLEs in this group, POGO has a technological core. The technology used, however, even though developed specifically to appeal to children, is suitable for a wide range of operations. Moreover, good use of it requires pedagogical planning, which makes POGO more similar to the environments in this group than to those in the others.

4.5.5 Appreciating Differences

NLEs classified in different groups often appear to be similar. This similarity, however, is only superficial.

Let us compare, for instance, the interactive NLE Teatrix and an environment based on the narrative editor StoryMaker II. Both of them support story construction and stimulate creativity, but the experience of story creation is structured and developed in different ways. In Teatrix, the number of character types available is limited, but the characters are completed by a description constraining their behaviour. The environment also includes a function that detects inconsistencies, thus encouraging awareness of characters' intentions. This strongly fosters the development of narrative competence, particularly for causal reasoning. Using StoryMaker II, on the other hand, orients the user's activity towards developing communication

skills, because this editor provides multimedia facilities such as recording speech or producing spoken sentences by means of a text-to-speech tool. It offers a library of backgrounds, props and characters much richer than that provided by Teatrix, with more complex animations and more refined graphics. These features not only support the creation of more articulated and fancier stories, but also favour the acquisition of technological literacy in relation to multimedia expressive capabilities.

Crystal Island and Ecolandia also have similar aims and tasks, but differ in their functioning. Being interactive, Crystal Island does not propose pre-determined stories, but generates new variants every time, taking into account the user's behaviour and questions. Ecolandia, on the other hand, is based only on multimedia technology, so that the learners are free to move in the environment, but their possible interactions with the characters are all pre-defined. The user can only try to find answers to his/her questions by browsing through the environment's material.

It is clear from these examples that the technology used is a meaningful parameter for the classification of NLEs, because it actually influences the cognitive activities afforded and the expected learning.

4.6 Research Directions and Open Issues

The field of NLEs can be considered to be an emerging one, because its taxonomy is still an object of study, its dissemination limited and many conceptual and practical issues need to be addressed. Attention to the use of narrative to support learning is rapidly increasing, however, and we can expect a rapid development of the research in this field and dissemination of its applications.

In order to advance the field, work should be done in (at least) the following three directions:

1. *Enrichment.* Different cases of NLEs should be explored, as concerns both their structure and the topic addressed, leading to a better understanding of the field. The educational potential of NLEs should be analysed in depth, in relation to different subjects and skills. More effective and interactive environments should be researched, for example, by suitably exploiting the interaction engines developed for narrative applications without educational aims, such as narrative games and virtual storytelling systems.
2. *Evaluation.* Suitable approaches for evaluating NLEs should be worked out. This is a complex task which involves many different aspects: technical features and ease of use; activities carried out in the environment, as concerns both process and outcomes; support for improving user's learning ability; enjoyment of the experience, because this supports learning by producing a positive impact on emotion and motivation.
3. *Dissemination.* In order to make NLEs a real educational option, teachers and educators should be prepared for informed and conscious use of them, especially as concerns conceptual NLEs, which require knowledge of narrative learning and pedagogical planning. It would also be necessary to develop quantitative studies

to provide evidence of outcomes, as well as to share reports of experiences and analyses of case studies within the scientific and educational communities, so as to inspire and guide the use of NLEs in formal and informal learning.

4.7 Concluding Remarks

Narrative is a form of thought which is innate in human beings (Bruner, 1990), not simply an activity or a learning approach. As a consequence, it can support learning and skill formation with regard to cognition, motivation and emotion in the most diverse fields. Narrative learning is not an alternative to other learning approaches, but rather a possible way to complement them and improve their effectiveness. The interactive environment Crystal Island offers an example in this respect, providing an inquiry learning activity in a narrative context likely to support learner's engagement and motivation and to guide problem solving.

Another example is provided by online learning activities, which can be supported by taking place in narrative learning environments, as exemplified by NLEs based on web 2.0 and by the narrative blog mentioned in Section 4.5.4. A positive synergy between narrative and online learning is also observed in the literature by Arnold, Smith, & Trayner (2006), who point out how narrative can foster the creation and cohesion of online learning communities. This is not surprising, because narrating is essentially a social activity and hence particularly suited to a mode of learning which relies heavily on social practices. Wider dissemination of NLEs could therefore help address the issue, pointed out by Dillenbourg, Järvelä, and Fischer (Chapter 1), of supporting motivational and emotional aspects in online learning.

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