

# Learning temporal connectives by playing: the TERENCE experience with children

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## Extended abstract

**Introduction** Reading is a complex cognitive activity that transforms print to speech and print to meaning through a negotiation of meaning between the text and its reader, as an activity of problem solving [23]. According to [13], reading is a multidimensional process, including *decoding* and *comprehension*; although correlated, these skills depend on different cognitive and linguistic skills [20] and thus researchers classify poor readers in *poor decoders* and *poor comprehenders*, with distinct cognitive and linguistic profiles [12]. While poor decoders, often defined as dyslexics, have difficulties with fluent reading, yet manage to comprehend what read reasonably well [25], poor comprehenders read words and sentences accurately, fluently and at age-appropriate levels, but have serious difficulty understanding what they have read [19]. Stories have been recognized as first class tools of poor comprehenders oriented psycho-pedagogical stimulation plans [24]: text comprehension may be improved by educational interventions aimed at reasoning about stories designed so to include appropriately interspersed *temporal connectives* through which children construct relations about story's events (e.g., [5]).

In this extended abstract we summarize the experience we gained in such a context within the framework of the TERENCE project ([www.terenceproject.eu](http://www.terenceproject.eu)), by sketching main results about the roles of smart games in the construction of the child mental model for temporal reasoning and the evaluation of the system (which is necessarily referred to the psycho-pedagogical value of the system given its Technology Enhanced Learning (TEL) nature). Ideally, one should turn evaluation evidences into specific guidelines for design. However, when talking about children the translation from experimental data to guidelines raises difficulties that designers do not experience when designing for adults, for a number of reasons [14, pp. 361-362]: first of all, since children are a moving target, rapidly learning and changing their cognitive, sensory and motor skills, longitudinal studies should be necessary; furthermore, guidelines may shortly become obsolete since children in one decade tend to have more experiences with ICT devices than children from the previous decade. It is anyhow crucial that designers report on their findings, to contribute to the maturation of the field (as advocated, e.g., by [14]). In particular, we report some reflections about the differences that a designer has to take in mind when designing for children and for adults, for what concerns (1) the visual elements used to support temporal reasoning and (2) the gamified approach to the interaction.

**The TERENCE learning approach.** TERENCE was a an FP7 multidisciplinary project that developed the first Adaptive Learning System for supporting 7-11 years old poor text comprehenders and their educators. Based on consolidated results about games as a means for fostering deep learning (e.g., [18]), and having in mind Kapp's view of *gamification* in learning context (*game-based mechanics, esthetics and game thinking to engage people, motivate action, promote learning, and solve problems*) [26], the TERENCE *learning approach* is grounded on the ideas of "learning through gaming", "training via iterations", and "rewarding structures" [10]. For encouraging reading, it is important that readers play and enjoy *repeated learning experiences*; the sessions (two/three per week) are collectively run in a dedicated classroom under the vigilance of a teachers, while each learner has his/her own individual experience with the system. The *stimulation plan*, designed by the psycho-pedagogical expert of TERENCE, is grounded on two basic principles, guiding the system adaptivity: (P1) learners have to be presented with material at an appropriate level of difficulty but nonetheless challenging; (P2) progresses in text comprehension are to be achieved by associating reading and playing, within sessions with a warm-up (reading a story), peak (playing with smart games), and relax (playing with relaxing games) structure; points and relaxing games are designed as tangible rewards. The feature selected as primary guide for adaptation mechanisms is the *reading comprehension* (RC) skill, introduced by TERENCE experts and measured on a scale with four levels, taking into account comprehension of lexicon and grammatical skills, global coherence and local cohesion skills.