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Pedagogical analysis of educational digital storytelling environments of the last five years

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Abstract

Digital storytelling, the modern and challenging successor of storytelling, emerged over the last few years as a powerful teaching and learning tool, engaging both teachers and their students. For the evaluation of Educational Digital Storytelling Environments (EDSE), pedagogical aspects of designing or using EDSE are much less frequently studied than technical ones. Thus, taking into account modern, social and constructivist views of learning, a new pedagogical evaluation model was created (Psomos & Kordaki, 2011), using sixteen pedagogical criteria-dimensions. In this paper, the aforementioned pedagogical evaluation model is used to pedagogically analyze EDSE of the last five years.

Keywords: digital storytelling, pedagogical evaluation model, pedagogical dimensions,expert review;

1. Introduction

Storytelling is an undoubted cultural achievement of the human race. The Iliad and the Odyssey by Homer are great examples of the power of storytelling on human cultural development and improvement. Homer is one of the first storytellers of mankind and it is thought that the epics we know today are the result of generations of storytellers passing on the material. Actually, storytelling is the original form of teaching (Pedersen 1995).

Digital storytelling follows the same well-known strategies similar to classical storytelling, such as the poetic story of Aristotle, described a long ago. Following his ideas and theories, most narratives are divided in the four phases: exposition, ascension, climax and conclusion. Digital storytelling has captured the imagination of both students and teachers and the act of crafting meaningful stories has elevated their experience (Robin and Pierson, 2005). Compared to conventional storytelling, digital storytelling audiences are viewed not only as listeners but also as active learners who can interact and shape the story (Dorner, 2002). Barrett (2006) found that digital storytelling facilitates the convergence of four student-centered learning strategies: student engagement, reflection for deep learning, project-based learning, and the effective integration of technology into instruction. Building on modern social and constructivist views of learning (Piaget, 1952; Bruner, 1960; Vygotsky, 1978; Jonassen, 1999). DS is a great channel to apply these theories in practice. Moreover, according to Di Blas (2009, 2010): (a) DS in an educational process that helps students work in groups and strengthen the bonds between children in class, and at the same time between students and their teacher, (b) As far as digital literacy is concerned, students acquire several technological skills through storytelling, (c) Another social benefit is that creating digital stories helps the integration of disabled students or students with learning difficulties through taking with this opportunity an active role, and (d) Last but not least, a major educational benefit gained with DS, is the ability to narrate.

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To this end, a number of requirements (technical & pedagogical) which may serve as criteria for digital story and related areas of digital learning software evaluation have been reported: Schafer (2004) has proposed an evaluation model of DS applications consisting of the following twelve dimensions: Concreteness, involvement, coherence, continuity, structure, cognitive effort, virtuality, spatiality, control, interactivity, collaboration and immersion. Spierling (2002) presented a four hierarchical level architecture for authoring interactive storytelling applications. Each of these levels provides a different degree of agency for the user in the development of a story. On each level the architecture consists of an engine and a corresponding model e.g. story engine and story model. The engine is responsible for driving the action on that level, while the model contains rules which define the procedure. Furthermore, Mateas (2000) presented a character-based evaluation approach in extension of Aristotle's model of drama. His approach provides design and technology guidance for the particular case of building interactive drama systems. Finally, Murray (1998) introduced three categories for the analysis of digital story applications: immersion, agency and transformation. The limited number of existing DS evaluation models shows that pedagogical aspects emerged from modern social and constructivist views of learning (Piaget, 1952, Bruner, 1960, Vygotsky, 1978, Jonassen, 1999) for designing/evaluating EDSE are not fully addressed and these are also much less frequently studied than technical ones. However, taking into account the aforementioned views of learning a novel pedagogical evaluation model for DS has been recently proposed (Psomos and Kordaki, 2011), This model is entitled ''DS pedagogical evaluation star' and is consisting of sixteen criteria-dimensions.

This study attempts to analyse the EDSE of the last five years by using the aforementioned pedagogical evaluation model. This is the contribution of this paper. In the next section, the 'DS pedagogical evaluation star' is outlined. Then, these EDSE are analytically evaluated by using the proposed 'star'. Finally, the paper ends with the discussion and a summary of essential points of the proposed model as well as our future research plans.

2. "DS Pedagogical Evaluation Star": a pedagogical evaluation model for digital storytelling

The selection of the pedagogical dimensions of the "DS Pedagogical Evaluation Star" model was based on basic aspects of modern social and constructivist learning approaches (Piaget, 1952, Bruner, 1960, Vygotsky, 1978, Jonassen, 1999). In fact, sixteen dimensions are proposed for the evaluation of the pedagogical soundness of EDSE, namely: collaborative learning, creativity and innovation, multiple representations, motivation, cultural sensitivity, gender equality, cognitive effort, feedback, learner control, flexibility, learner activity, valuation of previous knowledge, sharply-focused goal orientation, experiential value, knowledge organization and metacognition (fig. 1). The typical 4-grade Likert scale for measuring each dimension is used (low, medium, high, very high). Next, we proceed to briefly describe each dimension in the context of DS:

(i) Collaborative learning refers to the extent that an EDSE encourage collaborative creation of digital stories, (ii) Creativity and innovation refer to the degree that an EDSE enables students to create something new that has some kind of value(create digital stories from scratch, thus freeing their imagination), (iii) Multiple representations refers to the extent that external representations can be used such as text, pictures, video, voice, graphs, diagrams etc so as to reinforce the messages designed to be conceived by the learners, (iv) Motivation refers to the degree that intrinsic and extrinsic motivation is provided by the EDSE at hand to motivate students, (v) Cultural sensitivity refers to the extent an EDSE adapt to the cultural diversity of the students, (vi) Gender equality refers to the extent to which an EDSE is designed in a way that promotes gender equality, (vii) Cognitive effort refers to the mental work necessary to put together a story out of the clues presented to the user, (viii) Feedback refers to the extent extrinsic and intrinsic feedback is provided by an EDSE, (ix) Learner control refers to the degree to which the user is able to modify or influence the flow and outcome of the story, (x) Flexibility refers to the extent to which the EDSE at hand takes into account learners individual preferences and background, (xi) Learner activity refers to the degree an EDSE enables both; learners to take an active role in their learning and teachers to change their role from a traditional didactic one to that of a facilitator, (xii) Valuation of previous knowledge refers to the extent an EDSE highlight the importance of learner's previous knowledge and the cumulative nature of knowledge becomes clear to the learner, (xiii) Sharply-focused goal orientation refers to the extent that the learning goals are clearly defined to the learner, (xiv) Experiential value refers to the degree learner results can be changed from reflection on direct experiences, (xv)Knowledge organization refers to the extent an EDSE can promote children's conceptual

development and understanding and facilitate learning by building new knowledge on old knowledge, and (xvi) Metacognition refers to the extent an EDSE could enhance learners' metacognitive skills.
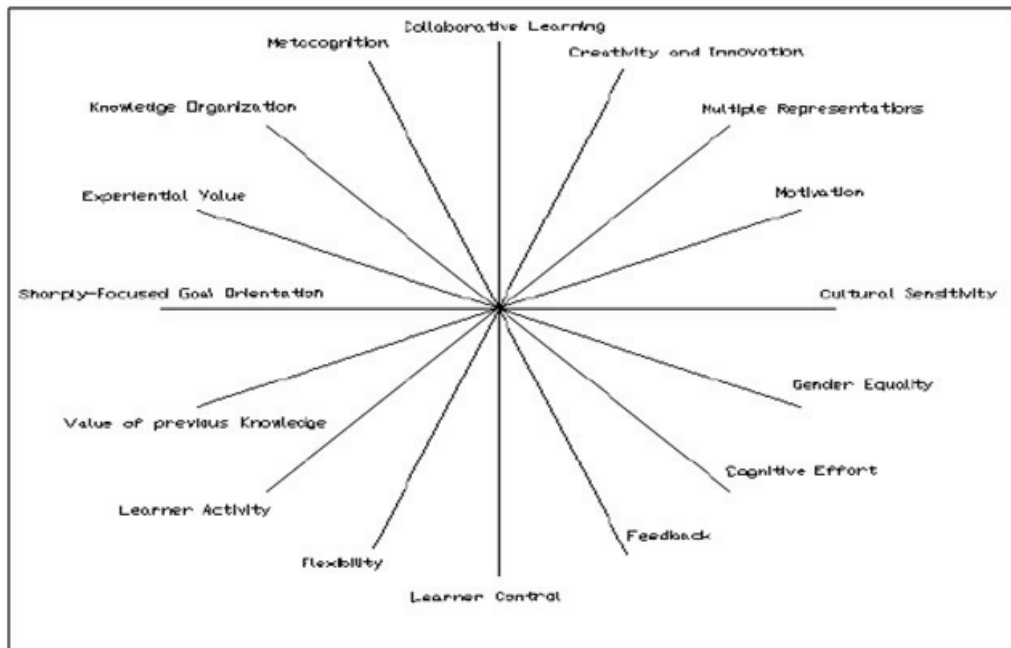

Figure 1: DS Pedagogical Evaluation Star

3. EDSE of the last five years

(A) *Toontastic*: Toontastic (Russell, 2010), is a collaborative digital animation creator that bridges the gap between game and more formal methods of storytelling. It is a constructive tool designed to help children capture and share their stories with other children around the world. It is designed to appeal to a broad group of users. As a drawing tool it is simple enough for six years old children and very interesting to entertain adults. However, ages that it is primarily addressed are between eight and twelve. The aim of this software -that underlines its theoretical background- is to provide children with opportunities to outline their internal representations and convert them to external, with visual and physical representation, so that children are able to debug and rebuild their mental models.

(B) *Kodu*: Kodu (http://research.microsoft.com/en-us/projects/kodu/), is a visual programming language which is used for the creation of digital games. It is easy to use and includes tools for creating three-dimensional worlds. Kodu is a multi-dimensional tool for digital storytelling with a variety of possibilities for creating digital stories. It is designed to be user friendly and accessible for children aged between 8-18 years. The creation of digital stories is made through the selection of appropriate characters and objects (e.g. character Kodu, trees, clouds, rocks etc.) that can be used in specific situations. Kodu helps children build a sound programming literacy without complicated programming concepts.

(C) *Storytelling Alice*: Storytelling Alice (Kelleher, 2006), introduces students to computer programming through the construction of 3D animated stories. Its main age target group is between 10 and 17 year old children. It's a variant of Alice which is an object-oriented educational programming language. Its emphasis on storytelling is based on the following three differences: i) Social interactions between the characters are possible through the programming of high-level animations. ii) Users are introduced to programming through building a story with the help of a story-based tutorial iii) A library with 3D characters and scenery is existent so as to stretch users' imagination.

(D) *Scratch*: Scratch (http://scratch.mit.edu/) is an educational environment designed from MIT in which novice programmers can express their creativity while promoting their computational thinking. Storytelling is a common

use for Scratch as a method of personal expression. Students can create autobiographies, and various stories that give a new dimension to their interests and talents. Its target age group is between 6 to 16 year old children, but people of all ages can use Scratch.

(E) *JabberStamp*: JabberStamp (Raffle, 2007) is an EDSE in which users can embed their voices and ambient sounds in their drawings, paintings and collages. The main age target group for this EDSE is children between 4-8 years. In this age children's writing level is not high, however, in JabberStamp, they record the meanings of their drawings and compose a story that is based on their paintings. In Jabberstamp children draw in a typical paper and its main goal is to create the illusion that children's sounds exist within the paper page.

(F) *Wayang Authoring*: Wayang Authoring (Widjajanto, 2008) is a web-based EDSE in which children from culturally diverse storytelling styles can create digital stories by using digital puppets. The idea of Wayang Authoring is based on Wayang which is an Indonesian ancient form of storytelling. Wayang Authoring is composed of three elements: i) the imagination step that gives an inspiration to children through tutorials or pre-built stories, ii) the creative step in which children create and save their stories, and iii) the social step in which they can share, comment or even rank other children stories. The age group that Wayang Authoring is supposed to attract is 6-11 year old children.

(G) *ShadowStory*: ShadowStory (Lu, 2011) is a digital storytelling system for children, inspired by and capturing key elements of the traditional art form of Chinese shadow puppetry. ShadowStory allows children to use a Tablet PC to create articulated digital characters and other props in the style of shadow puppets and perform live stories together on a projection screen. The control of the characters is made with simple body movements through wireless handheld orientation sensors. ShadowStory includes two interaction modes: "Design" mode, in which story elements can be created; and "Perform" mode, in which stories can be performed in public. There is also a video library of real shadow puppet plays that is available for the children to watch at any time.

(H) Fate2: Fate2 (Garzotto. 2010), is a web-based, collaborative, multi-user digital storytelling environment. It is based on the Story Grammar theory (Propp, 1968) which defines the morphology and syntax of stories. What is more, it provides a two and three dimension virtual space for children. The ages that Fate2 is mainly targeted are between 7 and 11 year old kids. It includes both educational and entertainment activities in order to increase engagement, emotion and motivation. Furthermore, it promotes collaboration through a shared WYSIWIS ("What You See Is What I See") environment in which users can be simultaneously connected to a network, thus synchronizing movements and object manipulation.

4.   Evaluation of EDSE using the 'DS Pedagogical Evaluation Star' model

 The EDSE described in the previous section were evaluated with the "Dimension Star" model. In fact, each of the authors of this paper individually used this model to evaluate the aforementioned environments. In terms of methodology, this study is a qualitative study which can be characterized as an 'expert review' study. This method may be classified as predictive evaluation (Squires, 1996). Despite the fact that, the use of a combination of various methods has been proposed for educational software evaluation, the use of expert review is also recommended as flexible, fast a cost effective method (Price, 1991). Specifically, each of the authors experimented with the features of each of the aforementioned EDSE in order to produce digital stories. During this experimentation each of the authors tried to make sense of how each of the dimensions of the aforementioned "Dimension Star" model is treated -within each EDSE- in order to measure them. The value of each of the twelve dimensions of this model is measured using a 4-grade scale [low(L), medium(M), high(H), very high (v. H)]. However, the authors collaborated in order to make an agreement, when their evaluation results were different. The authors also investigated the research literature related to the features of the aforementioned EDSE so that to compound in trustworthy results. The results of using the aforementioned method to evaluate the said EDSE are depicted in Table 1 and are briefly discussed below:

 As far as *Collaborative Learning* is concerned, Toontastic and Shadowstory receive the highest value. Toontastic receives a high value since up to five children can paint story heroes at the same time and then, children can share their stories via the internet. In Shadowstory, several performers, each controlling one or several characters, need to work in precise coordination for interactive actions such as shaking hands, hugging, fighting, etc. In the dimension

Creativity and Innovation Toontastic, Kodu, Storytelling Alice and Shadowstory receive the highest value because they enable students to create a diversity of stories from scratch. As far as *Multiple Representations* are concerned Toontastic, Kodu, Storytelling Alice and Scratch receive the highest value since the creation of text, voice, pictures, graphs and videos are supported by these pieces of software. In the dimension *Motivation*, Toontastic, Storytelling Alice, Kodu and Scratch receive the highest value. Toontastic motivates students in the construction of the story while Alice, Kodu and Scratch motivates students to learn programming through creating digital stories and games which makes programming more appealing.

Table 1. Evaluation of EDSE with the "DS" model

Dimensions	Toon tastic	Kodu	Storytelling Alice	Scratch	Jabber Stamp	Wayang Authoring	Shadowstory	Fate2
Collaborative Learning	H	M	L	M	L	M	H	M
Creativity and Innovation	v.H	v.H	v.H	H	L	L	v.H	M
Multiple Representations	H	H	H	H	L	M	M	M
Motivation	v.H	v.H	v.H	v.H	L	M	H	H
Cultural Sensitivity	M	L	L	L	L	H	H	M
Gender Equality	H	L	M	M	L	M	M	M
Cognitive Effort	M	H	H	M	L	L	M	M
Feedback	L	L	M	L	L	L	L	L
Learner Control	H	M	M	H	H	M	M	M
Flexibility	H	L	M	H	L	L	L	L
Learner Activity	v.H	H	H	H	M	M	H	M
Value of previous Knowledge	L	L	L	L	L	L	L	L
Sharply-focused goal orientation	M	v.H	v.H	v.H	L	M	M	M
Experiential Value	M	H	H	M	L	L	v.H	M
Knowledge Organization	L	L	L	L	L	L	L	L
Metacognition	H	H	H	H	L	L	M	M

As far as *Cultural Sensitivity* is concerned, Wayang Authoring and Shadowstory receive the highest value because characters from diverse cultural backgrounds could be used. In the dimension *Gender Equality*, Toontastic receive the highest value since animations of both genders could be represented and the student or the teacher can also draw their own characters. As far as *Cognitive effort* is concerned, Kodu and Storytelling Alice receive the highest value because a lot of effort from both students and educators is required in order to understand the functionality of the software. In the dimension *Feedback*, Storytelling Alice receives the highest value, since warning messages are given if there is faulty programming. As far as *Learner Control* is concerned, Toontastic, Scratch and Jabberstamp receive the highest value because the user can build step by step, every piece of the story. In the dimension *Flexibility*, Toontastic and Scratch receive the highest value because each student can create the characters and the story he wants, thus personalizing the story creation. As far as *Learner Activity* is concerned, Toontastic receives the highest value because it gives great emphasis on the student's activity by empowering them to create and share their own stories with other children around the world through a peer-to-peer storytelling network, thus helping them learn from its other knowledge; that is significant, as children seemed to learn more from social dialogues at a peer level, than from formal adult instruction (Vygotsky, 1978). In the dimension *Value of Previous Knowledge*, all the aforementioned pieces of software are of low value because they did not allow a systematic review of the central concepts of previous knowledge that is necessary for the understanding of the present concepts in focus. As far as *Sharply-focused Goal Orientation* is concerned, Kodu, Storytelling Alice and Scratch receive the highest value because their basic and clear goal is to help children build a sound programming literacy, without complicated programming concepts. In the dimension *Experiential Value,* Shadowstory takes the highest value since it is a mixed

reality software that provides a high degree of immersion to the students. As far as *Knowledge Organization* is concerned, all the software receive a low value since concept maps are not used by all the aforementioned pieces of software and finally in the dimension *Metacognition*, Toontastic, Kodu, Storytelling Alice and Scratch receive the highest value since students can focus on their own activity and advance their knowledge through experimentation, construction and reflection.

5. Conclusions

This paper presented an analysis of eight Educational Digital Storytelling Environments (EDSE), -developed in the last five years- using the "DS Pedagogical Evaluation Star" reference model (Psomos and Kordaki, 2011) consisting of sixteen pedagogical criteria-dimensions, namely: collaborative learning, creativity and innovation, multiple representations, motivation, cultural sensitivity, gender equality, cognitive effort, feedback, learner control, flexibility, learner activity, valuation of previous knowledge, sharply-focused goal orientation, experiential value, knowledge organization and metacognition. This analysis may help the researchers in the field of DS to make a clear picture of some essential pedagogical dimensions of the existent EDSE so that be able to make appropriate decisions for the pedagogical design of EDSE. Moreover, this study can help teachers to choose appropriate EDSE so that be able to fulfill specific pedagogical goals in their classrooms. An imminent goal of this research is to reflect on the analysis of existent EDSE for the development of general pedagogical guidelines for the development of EDSE and finally, to use these guidelines in combination with the "DS Pedagogical Evaluation Star" model for the construction of a novel EDSE.

References

Bruner, J. (1960). *The Process of Education*. Cambridge, MA: Harvard University Press.

Di Blas, N. & Boretti, B. (2009). Interactive storytelling in pre-school: a case-study, In Proceedings of *IDC 2009*, ACM, NY (2009), pp. 44-51.

Di Blas N., Paolini P., Sabiescu A. (2010). Collective digital storytelling at school as a whole-class interaction. Proceedings of the 9th international Conference on interaction Design and Children. *IDC '10*. ACM, New York, NY, pp. 11-19.

Dorner, R., Grimm, P., & Abawi, D. (2002). Synergies between interactive training simulations and digitastorytelling: a component-based framework. Computers & Graphics, 26, 45–55.

Garzotto, F., and Forfori, M. FaTe2: storytelling edutainment experiences in 2D and 3D collaborative spaces, in Proceedings of IDC '06 (Tampere, Finland, June 2006), ACM Press, New York, pp.113-116.

Jonassen, D. H. (1999). Designing constructivist learning environments. *Instructional design theories and models*, 2, pp. 215-239.

Kelleher, C. (2006) 'Motivating Programming: Using storytelling to make computer programming attractive to middle school girls.' PhD Dissertation, *Carnegie Mellon University, School of Computer Science Technical Report* CMU-CS-06-171.

Lu, F., Tian, F., Jiang, Y., Cao, X., Luo, W., Li, G., Zhang, X., Dai, G., Wang, H.(2011) 'ShadowStory: Creative and Collaborative Digital Storytelling Inspired by Cultural Heritage'. In Proceedings of the *29th ACM, CHI '11*, pp. 1919-1928

Mateas, M. (2000). A neo-Aristotelian theory of interactive drama. In Proceedings of the *AAAI Spring Symposium on Artificial Intelligence and Interactive Entertainment*, pp. 56-61, Palo Alto, California.

Murray, J. (1998). *Hamlet on the Holodeck: The future of Narrative in Cyberspace*. MIT Press, Cambridge, MA, USA.

Pedersen, E. (1995). Storytelling and the art of teaching. *FORUM*, 33(1). http://eca.state.gov/forum/vols/vol33/no1/P2.htm, Retrieved 20/102011.

Piaget, J. P. (1952). The origins of intelligence in children. International Universities Press, New York.

Psomos, P. and Kordaki, M. (2011). A Novel Pedagogical Evaluation Model for Educational Digital Storytelling Environments. In Proceedings of *E-Learn 2011*, October, 17-21, Honolulu, Hawaii, USA, pp. 842-851, Chesapeake, VA: AACE.

Raffle, H., Vaucelle, C., Wang, R., Ishii, H. (2007). 'Jabberstamp: embedding sound and voice in traditional drawings.' Proceedings of *Interaction Design and Children*, Denmark, June 6-8, 2007, ACM Press.

Robin, B., & Pierson, M. (2005). A multilevel approach to using digital storytelling in the classroom. Digital Storytelling Workshop, *SITE 2005*, University of Houston. http://faculty.coe.uh.edu/brobin/homepage/SITE2005-article.htm. Retrieved 20 October 2011.

Russell, A. (2010) 'ToonTastic: A Global Storytelling Network for Kids, by Kids.' *TEI 2010*, Cambridge, MA, USA, pp. 271-274.

Schafer, L. (2004). Models for Digital Storytelling and Interactive Narratives. *4th international conference on Computational Semiotics for Games and New Media*, Split, pp.148-155.

Spierling, U. (2002). Setting the scene: playing digital director in interactive storytelling and creation, Computers & Graphics, 26 (1), pp. 31-44.

Vygotsky, L.S. (1978). *Mind in Society*. Cambridge, MA: Harvard University Press.

Widjajanto, W-A., Lund, M. and Schelhowe, H. (2008) 'Wayang Authoring: a web-based authoring tool for visual storytelling for children.' In Proceedings of the *6th International Conference on Advances in Mobile Computing and Multimedia*, (Eds.). ACM, NY, USA, pp.464-467.