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A Learning Design-based Environment for Online, Collaborative Digital Story Telling: An Example for Environmental Education

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Abstract: This paper presents the design and implementation of a learning design, online, collaborative and Digital Storytelling (DS) environment, realized within the context of open source Learning Activity Management Systems (LAMS; Dalziel, 2003). For the design of this environment, an innovative description of the Jigsaw collaboration method (Aronson, 1971) was taken into account in combination with DS. The design of this environment is described through special reference to the implementation of a specific example for the learning of essential issues of Environmental Education (EE). Diverse environmental issues related to the entity of water are addressed through online collaborative DS, namely: (a) mythology and traditional issues about water, to connect Past-Present, excite students' fantasy and contribute to their mythological, analogical and global thinking, (b) the water cycle, to extend student knowledge about natural water sources, (c) basic uses of water in the past and present to enhance students' environmental sensitivity, and (d) problems about water at local, and global levels, and the impact of pollution and reduction of water on humans and societies, to contribute to the environmental awareness and responsibility of students.

Keywords: LAMS, Collaboration, Digital Story Telling, Learning Design

Introduction

E-LEARNING HAS BEEN widely acknowledged as a promising approach in education, providing flexible opportunities for learners to overcome time and space constraints on their learning, to enjoy global virtual communication and collaboration, and to perform various and new types of interactions, while also encouraging new forms of learning (Roberts, 2005; van Diggelen and Overdijk, 2009). To this end, involving learners in online collaborative learning activities could provide them with essential opportunities, such as: to engage actively in their learning, to extend and deepen their learning experiences, to try new ideas and improve their learning outcomes, to trigger their cognitive processes, to enhance their diversity in terms of the learning concepts in question and to interact socially as well as develop a sense of community and of belonging online (Koschmann, 1996; Dillenbourg, 1999).

To encourage teams to achieve effective collaboration some amount of structuring may be necessary (Lehtinen, 2003). One way to structure collaboration is through the use of computer-supported collaborative design patterns. A pattern is not necessarily to be reused directly but can assist the informed teacher to build up their own range of tasks, tools or materials that can draw on a collected body of experience (McAndrew, Goodyear & Dalziel, 2006). The idea of using specific collaborative patterns could easily be integrated into

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'learning design'-based e-learning environments, a 'learning design' being defined as the description of the teaching-learning process that takes place in a unit of learning, e.g. a course, a lesson or any other learning event (Koper & Tattersall, 2005). An important part of this definition is that pedagogy is conceptually abstracted from context and content, so that excellent pedagogical models –in the form of 'design patterns'- can be shared and reused across instructional contexts and subject domains.

Especially when it comes to EE, strong emphasis is put on the role of collaborative learning. Despite this, only a few studies refer to the ways that educators have adopted collaboration in their teaching practices (Thompson & Reimann, 2006), possibly because EE is a recently-developed field. In truth, EE teachers require more specific support in their collaborative learning design practices, such as specific tools and good examples of learning activities. To this end, it is worth noting that the type of editor that classroom teachers usually need should be similar to the authoring environment provided by LAMS (Dalziel, 2003), a well-known e-learning system that effectively supports the idea of 'learning design'.

Storytelling plays a central role in our lives and has been used throughout history as a powerful tool for teaching and learning. In fact, stories could help learners make meaning out of experience, build connections with their prior knowledge and form long-remembered learning events (Schank, 1990). As regards EE, storytelling has been proposed as a key teaching strategy for the achievement of the goals of Education for a sustainable future (UNESCO, 2007). Properly-planned environmental storytelling activities could serve as a basis for the development of speculation on ecological, environmental, traditional or contemporary issues at local or global levels and contribute to the construction of conceptions, ethics, values and attitudes that favour a more balanced human-human/human-nature/environment relationship, approaching both ecological and cultural Sustainability (UNESCO, 2008; Agelidou & Tsilimeni, 2009). DS activities in EE could not only lead to students becoming skilled in digital media, but provide a cultural and enninronmental focus for the sharing of knowledge and practices between generations (Wyeld, et al. 2007), which could support students in understanding the natural world and acquiring environmental awareness (Heo, 2004). Given the revolutionary and rapid growth of digital technologies and their impact on all dimensions of our lives, it is not surprising to find DS entering the whole education mainstream; however, its place in the classroom is still unclear (Lowenthal, 2009).

Taking into account all the above, we have attempted to form the 'Jigsaw' collaborative method (Aronson, 1971) into a collaborative design pattern within the context of LAMS to construct DS activities for the learning of essential issues about the water entity in the context of EE, such as: (a) mythology and tradional issues, (b) the water cycle, (c) diachronic uses of water, and (d) problems about water at local, national and international levels, as well as the impact of pollution and reduction of water on humans and societies. Such a sequence of online collaborative DS learning activities for the learning of these environmental concepts - using the Jigsaw method within LAMS - has not yet been reported.

In the following section of this paper, background issues of this study are briefly presented including: DS, LAMS and JIGSAW. There follows a description of a sequence of online collaborative DS learning activities using Jigsaw-within-LAMS with special reference to the aforementioned issues in EE. Finally, the design of this sequence is discussed and conclusions and future research plans are drawn.

Background: Digital Storytelling, LAMS and JIGSAW

Many definitions were attributed to DS, all revolving around the idea of combining the art of telling stories with the assistance of a variety of digital multimedia resources, including combinations of text, images, audio, and video (Robin, 2006). However, DS has been used in education mainly within the context of Center of Digital Storytelling (CDS) tradition (Lambert, 2002). A digital story within the CDS tradition is a short personal story (2-3 minutes) where it is useful to include most – if not all – of the following elements: (a) *Point of View*–what is the perspective of the author? (b) *A Dramatic Question*–a question that will be answered by the end of the story, (c) *Emotional Conten*–serious issues that speak to us in a personal and powerful way, (d) *The Gift of your Voice*–a way to personalize the story to help the audience understand the context, (e) *The Power of the Soundtrack*–music or other sounds that support the storyline, (f) *Economy*–simply put, using just enough content to tell the story without overloading the viewer with too much information, and (g) *Pacing*–related to Economy, but dealing with how slowly/quickly the story progresses.

DS can be an effective instructional tool for teachers and a rich tool for learning. Specifically, DS can be used as a powerful learning tool, enabling learners to create their own stories while at the same time providing them with opportunities to acquire the following essential 21st century skills (Robin, 2006): research, writing, organization of knowledge and materials, presentation capabilities, interviewing strategies, social abilities, problem-solving and assesment skills, as well as technology skills. Educators have also identified other educational benefits of DS, some of which are reported below (Lowenthal, 2009; Robin, 2006): (a) an increase in student engagement, (b) access to a global audience, (c) amplification of the student's voice, (d) leverage of multiple literacies, (e) space for and validation of student emotion, (f) ability to create agentive senses of self and (g) ability to capitalize on students' talents.

Appropriately-designed collaborative storytelling activities acquire a special meaning for Environmental Education For Sustainability (EES), as these can effectively promote: (i) achievement of EES objectives, (ii) an understanding of complex and urgent environmental problems such as water problems, (iii) gradual development of interdisciplinary and holistic approaches, (iv) development of complex/spherical/ global and analogical thinking, and (v) gradual construction of a new value system and a new ecological/environmental culture, simultaneously multicultural and intercultural (Huckle, 2002; Tilbury, 2004; Nanson, 2005; Agelidou & Tsilimeni, 2009).

When it comes to the environmental problems of water, storytelling activities can help students overcome obstacles based on: (a) the absence of empirical and perceptional experience on the part of students. Specifically, many phenomena related to water unfold slowly over more than one lifetime, and needless to say, no human eye can capture all the areas in which these phenomena take place. In fact, the water cycle cannot be easily understood by a human being (Agelidou et al., 2001), and (b) the complexity of environmental water problems and phenomena. To this end, appropriately-designed DS activities, in combination with collaborative, active and constructive approaches and methods, such as simulations, visualizations, and concept maps, can help in effectively dealing with such complexity.

To create digital stories, simple and free technologies can be used which are usually found in most schools. However, some challenges for the appropriate creation and use of DS in education have been considered (Lowenthal, 2009). These challenges are related to the ac-

knowledgement of DS as a demanding task in terms of: (a) design that emphasizes: the story and not only the technical attraction, safety regarding with students' emotions and trust, integration into school curricula and assessment of students' learning, and (b) time, access to specific digital resources, and a trained teacher in both technology and pedagogy.

LAMS

LAMS (Learning Activity Management System; http://www.lamsfoundation.org/) is an open-source tool for designing, managing and delivering online collaborative learning activities. In fact, LAMS offers a set of predefined learning activities, shown in a manner comprehensible to teachers, that can be graphically dragged and dropped in order to establish a flow chart of sequence of activities. When using LAMS, teachers gain access to a highly intuitive visual authoring environment for the creation of sequential learning activities. LAMS is based on the belief that learning does not arise simply from interacting with content but from interacting with teachers and peers. However, the creation of sequential learning activities which involve groups of learners interacting within a structured set of collaborative environments - referred to as 'learning design' - is less common; LAMS allows teachers to both create and deliver such sequences. In essence, LAMS provides a practical way to describe multi-learner activity sequences and the tools required to support these (tools: *Grouping* and *Branching*). Furthermore, LAMS provides tools that support various activities such as: synchronous and asynchronous communication, (tools: *Chat/Chat& Scribe, Forum / Forum& Scribe,* the *dim dim* videoconferencing system*)*, presentation of diverse types of information (tools: *Noticeboard* and *Share Resources),* writing (the *Wiki* tool), mind mapping (the *Mindmap* tool), posing and answering questions (tools: *Question and Answer* and *Survey*) and assessment (tools: *Multiple Choice* and *Assessment)*. Students can also record their thoughts during a sequence of activities in a *Notebook,* while they can submit one or more files to the LAMS server for review by a teacher by using the *Submit Files* activity. The aforementioned tools are provided by LAMS and are demonstrated in its interface (http://wiki.lamsfoundation.org/ display/lamsdocs/Home).

The Jigsaw Collaborative Method

The Jigsaw method was originally proposed by E. Aronson (1971) as a method that can support both cooperative and collaborative learning. Gallardo et al., (2003) also thought that this method could sit well within the constructivist framework of learning. In addition, many researchers have proposed the implementation of this method within the online context (Gallardo et al. 2003; Kordaki, Siempos and Daradoumis, 2010), despite the fact that Jigsaw was originally proposed for face-to-face education (Aronson, 1971). Specifically, the Jigsaw method is a cooperative/ collaborative learning strategy which enhances the process of listening, commitment to the team, interdependence and team work. It is worth noting that, in the context of the online Jigsaw collaborative method, two types of groups are formed: the basic groups and the expert groups. Basic groups are spontaneously formed while each expert group consists of at least one member of each basic group. Each member of the team has to excel in a well-defined subpart of the educational material, undertaking the role of expert. The experts form a different group to discuss the nuances of the subject and later return to their teams to teach their colleagues. The ideal size of basic groups is 4 to 6 members.

Specifically, the implementation of the Jigsaw method could be realized through the following process: 1) Divide the problem into sub-problems, 5) Create heterogeneous groups, 3) Assign roles and material to each student, 4) Form group of experts, 5) Let experts study the material and plan how to teach their colleagues, 6) Let experts teach in their groups, 7) Assess students.

Design of the JiGSAW Activity within the EE Online Classroom

The proposed Jigsaw online learning activity consisted of the following seven phases: 1) Introduction to the activity, 2) Original group creation, 3) Creation of expert groups, 4) Back to the original groups, 5) Group DS formation, 6) Group DS presentation, and 7) Assessment. The implementation of these phases within the context of LAMS is diagrammatically represented - as a 'design pattern' - in Figure 1. The presentation of this collaborative pattern aims at supporting a combination of synchronous and asynchronous collaboration by using the "Chat and Scribe" function and the "Forum and Scribe" function, correspondingly. There follows a description of the aforementioned phases.

Phase 1: Jigsaw: Introduction to the Activity

The main goal of this learning activity is to encourage students to learn through performing specific investigations into the following essential issues in EE: (a) mythology and tradional issues about water, to connect Past-Present, excite fantasy and contribute to students' mythological, analogical and global thinking, (b) the water cycle, to extend students' knowledge about natural water sources, (c) basic uses of water in the past and present to enhance students' environmental sensitivity and (d) problems about water at local, national and international levels, as well as the impact of pollution and reduction of water on humans and societies, in order to contribute to students' environmental awareness and responsibility.

To perform these investigations, students should be separated into expert groups according to the aforementioned issues, namely: (a) the Mythology, Tradition and Water Jigsaw Group, (b) the Water-cycle Jigsaw Group, (c) the Basic Uses of Water Jigsaw Group, and (d) the Water-problems Jigsaw Group. Each of these expert groups are to delve deep into the aforementioned environmental issues about water and to form appropriate digital stories and materials for each of these issues using diverse tools provided by LAMS. Next, students return to their basic groups to tell their stories to their colleagues. Finally, each basic group has to construct a DS incorporating all the aforementioned issues about water and to present this story to the whole class.

To perform the aforementioned investigations successfully, each of the aforementioned groups have to collect diverse types of data from various resources, including significant areas of human life where water issues are involved, namely; (a) interviews with family or other appropriate persons, (b) family thesaurus, (c) specific water forms, (c) art exhibitions, (d) the Internet, (d) libraries, (e) folklore museums, (f) water museums, and (g) water refineries.

In this phase of the Jigsaw activity, students are informed about the whole context of the activity, through the use of a Notice board. Students should exchange ideas and clarify the aims and the whole procedure of the activity using a whole-class Forum or a whole class Chat-room.

Phase 2. Jigsaw: Original Group Creation

The students are assigned randomly – using the Grouping tool - to 4 groups of 6 students. Initially, each group – using a group chat-room or a group forum - discusses the issues presented in the introduction, striving to form a commonly acceptable framework of ideas. Each member of each group should also decide which essential issue of water and EE - from the aforementioned issues – they prefer to investigate.

Phase 3. Jigsaw: Creation of Expert Groups

Each expert group must visit the specific areas of life mentioned in the 'Introduction' of the activity, to collect specific data. Here, the use of the 'Data Collection" tool will be useful. Besides data collection and processing, each expert group must organize an interesting and efficient DS as a learning tool to teach their colleagues in their base groups. Sharing ideas about the formation of an appropriate DS could be implemented through a chat-room or forum for each expert group. There follows a template of possible actions that can be followed by the expert group students before starting to implement their DS: (a) try as much as possible to comprehend the deeper meaning of the data they have collected, (b) emphasize the key ideas of each specific issue at hand, (c) research alternative and interesting DS scenarios in order to provide a pleasant teaching experience for their colleagues, and (d) as DS can comprise a variety of learning representations: e.g., photographs, videos, texts, charts, use simple programs and tools such as Powerpoint, Microsoft's Photo Story 3 for Windows XP, Image Gallery, a camcorder, a scanner, and microphones. The tasks assigned to each expert group are described in the next section.

(a) Mythology, Tradition and Water Jigsaw Group: The experts in this group should collect tales from mythology and tradition regarding basic water forms and their names as well as any traditions, customs, occupations and professions concerned with water. These students can perform interviews with appropriate people and also collect diverse types of data.

Indicating DS activity : Title ' Some day, here, it was a lake, nowadays what? '

Students in this group can use the materials they collected and try to imagine how a lake was in the past and then form a digital story about it, in terms of: (a) its characteristics, eg. name, place, and area, (b) kind of creatures living in and around this lake, (c) how the life of these living entities was, (d) how the life of people around this lake was, (e) what suddenly happened to result in the exsiccation of the lake, (f) what happened a little after the lakes' exsiccation (g) what happened next…

(b) Water-cycle Jigsaw Group: The experts in this group could make such investigations as to be able to: (a) categorize waters in large categories and form appropriate concept maps, (b) create appropriate statistical graphs indicating the distribution of the aforementioned water categories, (c) construct a model of the water cycle, also integrating pollution issues.

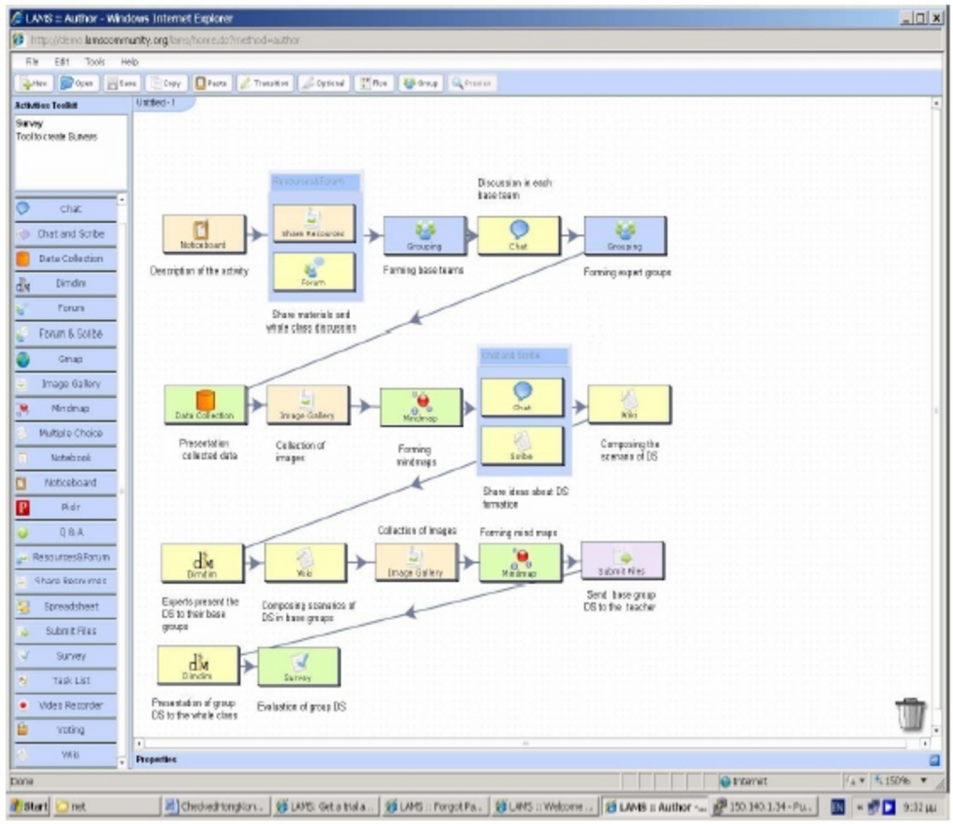

Figure 1: A Diagrammatic Representation of the DS Jigsaw Method Implemented within LAMS

Indicating DS activity: Title '*The trip of a small drop of water' A drop of water is trapped underground and tries to escape and travel*…' Here, students are advised to form a dramatic and adventurous DS describing the possible ways, paths and specific events and obstacles facing this small drop attempting a trip from the underground to the earth, and the sky, then the return home…

To form this DS, students are provided with the instruction to use some of the following key-words: water-cycle, rivers, detergents, fertilizers, factories, filtering, clouds, snow, pollution, lakes, underground-waters, evaporation and fields.

(c) Basic Uses of Water Jigsaw Group: The experts in this group should: (i) investigate basic uses of water in the big sectors of consumption (residence, agriculture, industry) and make connections among these uses and their consequences, (ii) construct specific graphs illustrating the aforementioned uses of water, (iii) make some comparisons between the kinds of uses of water in the past and present, (iv) investigate to see if there are any places in their country or in the world where people still take water from distant places.

Indicating DS activity: Title "*An old story about fresh water*"

The experts in this group can interview old people (grand-fathers and grand-mothers) from their neighbourhoods to tell stories about the uses of water in the past. Some indicative questions that could be used in these interviews are: Where and how did you get drinking/fresh water to bring into your home? Where and how did you use this water? Can you remember any cases of re-using/recycling this water?

(d) Water-problems Jigsaw Group. The experts in this group should cope with the two main problems of water: Pollution and Reduction. Students in this group have to study these problems at a local, national and international level and estimate certain essential issues such as: dimensions of these problems, causes, consequences and solutions. To this end, students can select to study a local environmental water problem and make an appropriate concept map including all the aforementioned issues. Students should also be advised to investigate main water problems in their country and throughout the world and construct appropriate maps plotting the regions with diverse water problems and providing appropriate information. Next, it could be useful to construct a concept map featuring the most essential findings of the whole aforementioned activity.

Indicating DS activity: Title '*Thirsty children in the world…*'

Here, students can organize a dramatized role-playing DS where they can take the role of children from countries or regions with serious water problems. These students could express their feelings about the water problems in their places and also present appropriate visual and other materials to illustrate these problems more clearly. Children from countries without diminishing water supply problems can also take compassionate roles and present issues involving extravagant and unreasonable use of the available water resources.

Phase 4. Jigsaw: Back to the Original Group

On returning to their original group, each expert should propose their DS and other learning materials, aiming to present the knowledge they acquired during their participation in the experiment performed within a specific expert group. The Dimdim videoconferencing system could be used by each expert to present their DS and to facilitate discussions with their colleagues within the original groups.

Phase 5. Jigsaw: Group DS formation

Each group has to prepare a DS about the total knowledge acquired during their learning process. To make decisions about the construction of this DS, the use of synchronous and asynchronous communication would be useful. The 'Submit Files' activity could be used to send the DS to the teacher.

Indicating final DS activity: Title 'The Water *Gods have become angry with people*'

Taking into account all the information included in the DSs and other instructional materials created by the expert groups, each basic group should synthesize a DS (a movie) under the title described above.

To help students in their DS attempts the following introductory scenario could be given "*The Water Gods have become angry with the behavior of people towards water and have*

decided to go down to the Earth to discuss this with them and to provide them with a final opportunity to save the Blue Planet'.

Students can accept different roles in this movie, such as: (a) Water Gods: Oceanus, Oceanid, River, Nereid and Neptune, and (b) people: housewives, manufacturers, farmers and ordinary people. Specific parts of this movie could be: (a) Introduction, (b) Presentation of the *Water Gods*, (c) Description of the water problems, (d) Solutions proposed (e) The *Water Gods* announce their suggestions for the salvation of the Earth and command that the water problems be solved.

Phase 6. Jigsaw: Group DS presentation

Online presentations of the DS activities could be performed by each group, using the Dimdim videoconferencing system. During the online presentation, the teacher can initiate a 'question and answer' session to encourage students to assess the DS of their colleagues. Some assessment criteria are addressed in the next section.

Phase 7. Jigsaw: Assessment

Each student should be set a quiz after the end of the learning activity, for purposes of assessment of the aforementioned original group DS activities. In constructing this questionnaire, some essential points used for successful storytelling activities (Ramondt & Watts, 2005; Agelidou & Tsilimeni, 2009) were taken into account in the context of DS. In fact, students should be asked if each specific DS is: (i) Relevant to both the environmental issue at hand and basic EES objectives, (ii) simple and tangible, (iii) age appropriate, (iv) neither didactic nor dry, (v) compliant with historical and scientific truth, (vi) successful in integrating mythological elements, dramatizations and conflict situations to motivate students' emotions and interest and foster their participation, (vii) able to excite pupils' fantasy and interest. At this point, it should be stressed that the greatest difficulty, which is simultaneously a challenge, is to construct DS activities that share all or most of the points described above.

Summary and Future Plans

This paper presented an online Digital Storytelling collaborative environment for the learning of essential issues about water within the context of Environmental Education by secondary level education students; these include: (a) mythology and traditional issues about water to connect Past-Present, to excite their fantasy and contribute to students' mythological, analogical and global thinking, (b) basic categories and distribution of waters and the water cycle, to extend student knowledge about natural water sources, (c) basic uses of water in the past and present, to enhance students' environmental sensitivity and (d) problems about water at a local, national and international level, as well as the impact of pollution and a reduced water supply on both humans and societies, to contribute to students' environmental awareness and responsibility. The actual innovation of this environment is that the Jigsaw method within LAMS is implemented: (a) for collaborative DS, and (b) to support sequences of online collaboration activities for the learning of the aforementioned issues in EE. Moreover, the tasks assigned to the expert groups consisted of various investigative activities within the real world and not merely the study of various learning materials as is usually proposed. For

the design of the whole collaborative activity, the intuitive 'learning design'-based online tools provided by LAMS were used. To investigate the effect of this collaborative learning activity on students' knowledge, specific field research is needed using a real online classroom.

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