Learning about Urban Sustainability with Digital Stories

Promoting Collaborative Creativity from a Constructionist Perspective

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> **Context** • Sustainability is among major societal goals in our days. Education is acknowledged as an essential strategy for attaining sustainability by activating the creative potential within young people to understand sustainability, bring forth changes in their everyday life, and collectively envision a more sustainable future. > **Problem** • However, teaching and learning about sustainability and sustainability-related issues is not an easy task due to the inherent complexity, ambiguity, and context-specificity of the concept. We are in need of innovative pedagogical approaches and tools that will allow us to design learning activities in which learners will be empowered to develop new, alternative interpretations of sustainability in personally and collectively meaningful ways. > **Method** • We argue that a constructionist perspective involving the use of expressive media for digital storytelling offers an appropriate frame for designing learning activities fostering collaborative creativity in thinking and learning about urban sustainability. Our study is based on the design of a learning activity following this rationale. We adopted a qualitative approach in the collection and analysis of different sources of data with the aim to explore collaborative creativity as a learning process based on the students' collective processes and resulting in the co-construction of new ideas and insights about sustainability, and new tangible artefacts (the digital stories) encompassing them. > **Results** • Our analysis of the collaborative creativity exemplified in the three digital stories produced identified important creative elements with regards to the three components of a digital story (script, technical characteristics, and ideas of urban sustainability) and how they were embodied in each digital story produced as a result of the students' joint constructionist activity. > **Implications** • Our study provides some preliminary evidence that collaborative creativity from a constructionist perspective can stand as an appropriate framework for designing learning activities addressing the difficult concept of sustainability. There are several implications for both theory and educational practice in environmental education and education for sustainable development, constructionism, and digital storytelling in education. Moreover, our study opens up new fields for research and theory in creativity. > **Key words** • Sustainability, urban sustainability, collaborative creativity, constructionism, digital storytelling, learning design.

Introduction

« 1 » Constructionism has established itself as an epistemological paradigm, a learning theory, and a design framework, mainly in conjunction with the advent of digital media designed to be used for engagement with mathematics (Kynigos 2012). However, it has gradually passed into more disciplinary domains and their related educational fields, such as science education and information technology education. However, extending constructionist frames of thinking beyond these domains of knowledge, commonly-regarded as traditional "hard," objective and value-free, to the social sciences, humanities, and the arts is a challenge that has never been taken up seriously (Daskolia & Kynigos 2012). This applies in particular to fields of knowledge and educational practice dealing with "soft," value-laden, and elusive concepts and problems of our current reality, such as those labelled under the topic of *sustainability*.

« 2 » Sustainability has been a core concept of environmental policy discourse over the last two decades (Hopwood, Mellor & O'Brien 2005) and among the key topics of most education curricula worldwide (UNESCO 2005). Designing and providing learning experiences with a focus on sustainability is acknowledged as a prerequisite for young generations to gain a deeper understanding of current socio-environmental problems and become involved with the elaboration of plans to bring change to their everyday life and the world. To this end, pedagogical designs and tools have to be prioritized, with a focus on activating the stu-

dents' creative potential for developing new understandings of sustainability within the context of their current reality, and shared visions of a more sustainable future (Blewitt 2005; Daskolia & Kynigos 2012; Daskolia, Dimos & Kampylis 2012; Wals 2010).

« 3 » So, how can constructionism lead the way in designing learning situations fostering the students' creative engagement with sustainability issues? The study reported here is used as an example of applying such a constructionist lens in teaching and learning about "urban sustainability" through digital storytelling. We argue that such a constructionist design entails a genuine pedagogical potential for enhancing collaborative creativity in students' learning around and about the concept of sustainability.

« 4 » The three first sections provide the theoretical framework of our study. In the first section it is argued that there is an ongoing discourse over the concept of sustainability and most sustainability-related issues, which render them complex, elusive, and thus difficult topics to address on a pedagogical basis. New approaches and tools for teaching and learning have therefore to be explored, fostering collaborative creativity in thinking and learning about sustainability. In the second section, collaborative creativity is addressed from a constructionist point of view and a proposed definition is offered. Finally, the third section situates digital storytelling as an appropriate medium for boosting collaborative creativity and learning along this line of thought. The following three sections present the research design and focus of the study and describe and discuss the results. The final section of the article summarises the conclusions drawn from this study.

On the concept of sustainability and urban sustainability

«5» Over the last twenty years, the concept of sustainability has been closely associated with education. Learning about sustainability is acknowledged as an essential strategy for achieving sustainable societies and as a tool to enhance quality in edu-

cational practice (European Council 2010). However, there are inherent difficulties in dealing with sustainability from a pedagogical point of view due to its inherent complexity, vagueness, and context-specificity (Daskolia & Kynigos 2012).

« 6 » There is a plurality of meanings and interpretations assigned to the concept of sustainability, which are eloquently depicted in the more than three hundred available definitions counted by Andrew Dobson (1998) more than 15 years ago. As a means to overcome the lack of definitional consensus, there is some sort of agreement that sustainability can be thought of as bringing together three interdependent and overlapping systems: *environment, economy,* and *society* (UNESCO 2005). The proper functioning of all three dimensions is proposed as a necessary condition for achieving sustainability. However, there are differing, even competing suggestions as to what should be cared for, promoted, or avoided under each of these sustainability dimensions, with each of these approaches emanating from diverse disciplinary and / or ideological standpoints (Hopwood, Mellor & O'Brien 2005).

« 7 » The same complexity and indeterminacy applies when it comes to defining sustainability in every context and related issue, as in the case of *urban sustainability*. Contemporary cities are complex agglomerations of human-made and physical environmental systems, and as such they offer many opportunities for identifying and pursuing sustainability. However, there are different approaches as to what "a sustainable city" implies. Although many view it as an ecological entity, or as the extended version of an ecosystem (Newman 1999), the idea of the sustainable city has been worked on through various disciplinary and ideological lenses. This has led to a plethora of models on urban sustainability, all of them arguing for a systemic conception of all interconnected dimensions (social, economic, and environmental), while each of them places the emphasis on a particular operationalisation of it in terms of the issues involved and the necessary actions to alleviate them.

« 8 » The plurality and open-endedness of perspectives underlying urban sustainability undoubtedly renders it a "difficult" theme to teach. On the other hand, it is this relativistic "plasticity" characterising all sus-

tainability-related concepts and issues that involves a particular pedagogical strength, if identified and properly treated: by refuting the existence of one correct interpretation, *sustainability* challenges learners to become engaged in creatively constructing "their own" understanding of it (Daskolia & Kynigos 2012). New approaches and tools for teaching and learning have therefore to be explored, allowing learners collectively to identify and define "sustainability" on their more proximate levels of their everyday life. We argue that constructionist designs of learning about "what living sustainably in a city" means can foster collaborative creativity in thinking and learning about sustainability. We also suggest that digital storytelling is an appropriate medium for boosting learning along this line of thought.

Collaborative creativity from a constructionist learning perspective

« 9 » There are many conceptual and theoretical overlaps between creativity and collaborative learning, and the borders between them are frequently blurred. Both concepts refer to shared meaning-making and knowledge-construction processes. From a constructivist point of view, novel or alternative ideas can be generated through a combination of individual and collaborative activities embedded in particular sociocultural contexts (Craft 2008). Such an approach approximates the constructionist paradigm of learning, which gives learners a designer role, emphasises the importance of social participation and sharing processes in the knowledge-construction, and recognises the importance of designing artefacts that are of relevance to a larger community (Papert 1980, 1993; Kafai 2006).

« 10 » Constructionism places an overt emphasis on learners' creative performance, expressed by the active exploration, construction, and modification of digital artefacts (Papert 1993; Kafai & Resnick 1996). Digital media and tools can be used by learners to construct *meaningful objects* as the tangible outputs of their meaning-making processes while they interact with them and the learning context; they are at the same time representations of their ideas

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and understandings of the world (Kynigos 2007a). Equal importance is attributed to the mediating *tools* and the *social context* with and within which constructionist activities as processes and products occur. Distributed constructionism was the first attempt to focus on collaboration and discussion around and about constructions, either insights or digital artefacts (Resnick 1996). It was based on the idea of combining constructionism with distributed cognition, and addressing learning "not as a property of a person but as the process of interaction with others and the environment" (ibid: 281). Digital tools and social environments that allow learners to use them collectively in meaningful ways, to think collaboratively with them and discuss them, and to smoothly move from inquiry to playful activity, imaginative expression, and bricolage, are important coordinates of a learning context fostering collaborative creativity (Burleson 2005; Sullivan 2011).

« 11 » Although we are in need of a more robust theoretical groundwork to understand collaborative creativity in general (Sullivan 2011) and from a constructionist perspective (Daskolia & Kynigos 2012), the existing literature allows us to define it constructively as the joint, intentional, and participative learning processes between members of a group (or community) of learners, which:

- take place within a particular socio-cultural and learning context;
- are related to a specific subject domain;
- can be aided by a range of mediating tools; and
- end up in the co-production of (a) new ideas, insights, and interpretations of the learning object, and (b) new tangible artefacts, which result from and encompass (a).

« 12 » Our proposed definition is embedded within the general theoretical paradigm of "everyday" or "little c" creativity, i.e., creativity that is related to a potential all people are capable of displaying, and can be manifested in various situations of everyday life (Simonton 2010). It is more particularly based on two special cases of little-c creativity, namely "mini-c" creativity and "middle-c" creativity. "Mini-c" creativity refers to creativity in the learning process, which is inherent in the students' unique and person-

ally meaningful insights and interpretations of their experiences, actions, and events as they learn new subject matter (Kaufman & Beghetto 2009). However, our perspective also borrows from "middle-c" creativity (Moran 2010) by assuming that new understandings and products emerge within small communities and groups as a result of the collaboration, conversation, and joint thinking processes (Moran & John-Steiner 2003) that occur while they are tinkering with ideas and artefacts with the aid of mediating tools allowing expression and experimentation (Kynigos 2012).

Digital storytelling as a tool for fostering collaborative creativity

« 13 » We identified digital storytelling as one such appropriate mediating tool for collective engagement in creative meaning-making processes on the concept of urban sustainability. But what is digital storytelling?

« 14 » Alan Levine and Bryan Alexander (2008) define it as the practice of telling a story through the use of digital media. In technical terms, digital storytelling is mostly supported by short videos including images and / or video clips, soundtrack music, and / or narration, and also by media slideshows, interactive presentations, and hypertext embedded in Web 2.0 tools such as blogs, podcasts etc. In the classic model of digital storytelling, pioneered by the Center for Digital Storytelling in Berkeley, California, digital stories are narrated in the storyteller's own voice. They are produced by using inexpensive, readily available software, with a focus on compressing the elements of the film into a short piece only a few minutes long (Lambert 2002).

« 15 » Digital storytelling has been applied in a broad spectrum of educational contexts and in a variety of mediation mechanisms provided by new technology. In higher education only, the practice of digital storytelling spreads across a broad range of disciplines, from history and literacy / ESL studies, to knowledge management, business and leadership, community planning, psychology, gender studies, social and cultural history, and much more (Benick 2012).

Nevertheless, there are very few applications of digital storytelling in the service of interdisciplinary domain learning, such as in the context of learning about sustainability.

« 16 » When more than one person is involved in the practice of digital storytelling, then we refer to either *group storytelling* (Benick 2012) or *collaborative storytelling* (Gabriel & Connell 2010). Flávia Santoro and Patrick Brézillon (2005) define group storytelling as a collective sense-building activity, during which many individuals contribute their ideas and interpretations of a shared repertoire of experiences. Yiannis Gabriel and Con Connell (2010) refer to co-created stories, stories that are created simultaneously as different people interact and add specific elements to the narrative; thus the person who introduces a dilemma or a choice into the plot is not the one who has to decide its outcome. Joint story construction supported by collaborative constructionist principles, is also put to use by Inmaculada Arnedillo-Sanchez (2008) and Mike Sharples et al. (2009) using mobile learning technologies.

« 17 » Finally, from a constructionist point of view, collaborative storytelling is the collective creation of a *meta-story* from individual stories constructed in parallel (Freidus & Hlubinka 2002). Along this line of thought, stories become *objects to think with*, i.e, constructs that evoke reflection, negotiation and dialogue, involving and inducing new ideas and understandings. Their quality ameliorates as the dialogue progresses, and as successive versions are presented and exposed to an in vitro audience, i.e., the other groups within the community. It is therefore almost by definition that the co-construction of a digital story is a collaborative creative learning process and a product by itself.

The context of the study

« 18 » The study reported here was conducted with three small groups of Greek undergraduate students. They were all participants in a workshop entitled "Learning about urban sustainability through collaborative construction of digital stories," which was organised in the context of an introductory foundation course in environmen-

tal education offered by the Department of Pedagogy of the National and Kapodistrian University of Athens (Greece).

« 19 » The design of the workshop was to engage students in collaborative constructionist activity entailing sharing, reflecting, and combining their ideas and interpretations of sustainability with their experience and visions of living in Athens while they were designing and constructing their digital stories. Two educators (the first and the third author of this article) were in charge of designing and running the workshop. They were assisted by a post-graduate student in environmental education, who acted as a moderator and note-keeper for the sessions, while also conducting her master's thesis research on this topic.

« 20 » The workshop was carried out in six 3-hour (face-to-face) sessions, which were structured around:
1 | progressive discussion and negotiation of ideas on the concept of *sustainability* and in particular *sustainability in the city*, and
2 | the digital literacies needed to create digital stories, such as the synthetic skills needed for the composition of a multimodal construct (multimedia authoring, including sound, video and image processing).
Apart from the face-to-face sessions, which took place in the computer room of the Educational Technology Lab of the Department of Pedagogy, the students participated in tasks that involved use of the electronic platform of the University (e-class), and met several times outside the context of the workshop to work on their joint tasks. The whole duration of the activity was 2.5 months, from early April until mid-June 2013.

« 21 » Eight (8) female and three (3) male students in their third and fourth/final year took part in the study, allocated into three groups of three to four students. The instructions given to them were that their digital stories should:
1 | organically integrate all individual members' ideas on sustainability,
2 | be short (up to 3 minutes), and
3 | be made with inexpensive, readily available technology (for this, Windows Movie Maker was selected as a low-cost and user friendly option).

This has been termed the "home made" approach to NLE (narrative learning environments), including examples of such environments that make use of general purpose technology and envisage some narrative task within the overall design of a learning activity (Dettori & Giannetti 2006).

« 22 » The assistance provided by the educators / researchers to all three groups was in terms of progressively helping them develop their subject-matter and digital literacies as a prerequisite for getting involved with collaboratively constructing their digital stories and in supporting them to establish a good climate of collaborative work. Issues of work organization, choice and use of media, story construction, and application of knowledge on sustainability were all dealt with within the groups.

« 23 » The products / artefacts, both digital and non-digital, produced and / or used by the three groups during this constructionist activity were:
1 | photographs taken by students, and used as primary material for a first draft of their digital story;
2 | concept maps, as representations of the group's ideas on urban sustainability;
3 | story scripts, in the form of written texts;
4 | a "contract of good collaboration," including basic principles on group collaboration, defined by the groups themselves; and
5 | digital video files, as drafts of the digital story in progress.

« 24 » Each session included either the initial drafting or the improvement / negotiation of one or more of the above materials. These products, thus, evolved in parallel to the participating students' ideas and provided different ways of representing jointly-negotiated meanings on the theme of urban sustainability at different stages of synthesis.

Research focus and method of the study

« 25 » Our research interest in this qualitative study focused on exploring *collaborative creativity* as a *learning process*, having led to the students' generation of
1 | new *ideas and insights* about the sustainability concept, and

2 | new and meaningful *tangible artefacts* (the digital stories), which are viewed as both the outputs of the learning process and the students' representations and understandings of the sustainability concept.
Our approach thus puts forth a constructionist perspective of collaborative creativity as an activity occurring within a learning context that involves and results in the generation of *new* understandings and tangible artefacts on the sustainability concept (new, at least for the students themselves), along with their collaborative construction of the digital stories.

« 26 » Two categories of data were collected:
1 | data on what was orally exchanged during the sessions, and
2 | data on what the students constructed.
For (1), data included transcripts from all recorded sessions, the focus group interviews, the online discussions in e-class, and the researchers' observation reports. For (2), data included the successive versions of the digital stories produced, and all the material brought in or produced by the students as an input to their digital stories (the photographs taken by the students, the groups' concept maps on urban sustainability, the story scripts, etc).

« 27 » The units of analysis were:
1 | the *idea* on (urban) sustainability, and
2 | the *digital story* as the final product.
Data were analysed according to emerging themes in the students' shared ideas and representations of the sustainability concept for each group case across all data sources, in each specific category of data separately, and in various combinations of data sources. In this article we present the findings from the analysis we carried out in the digital stories produced out of each group's constructionist activity, combined with the notes taken throughout the activity by the researchers and the data gathered from the focus group discussion conducted with each group, which took place in session 5. However, we treat the three groups as one single case and not as three separate ones.

« 28 » The general research question that guided the part of the analysis reported in the following section is the following:

« 29 » How is collaborative creativity manifested in terms of new ideas and un-
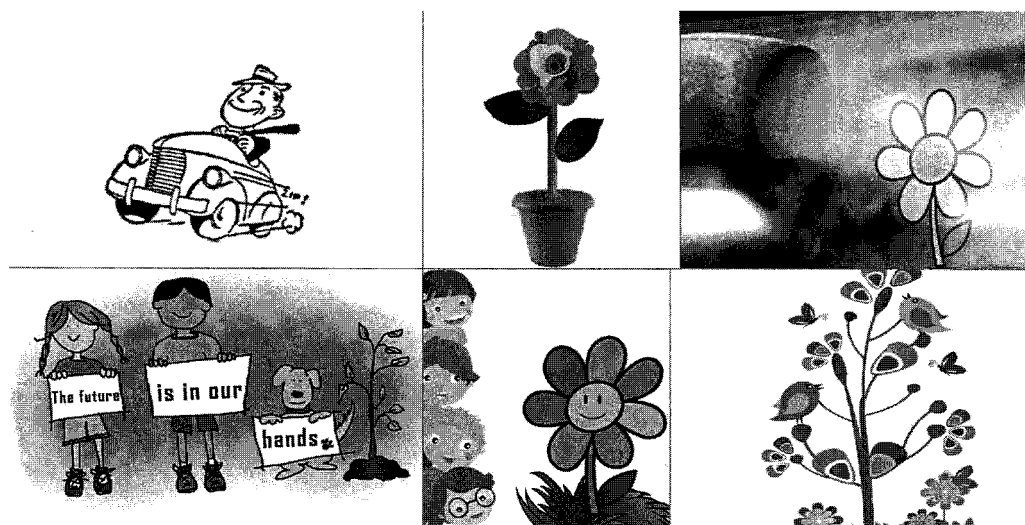
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Figure 1 • Selected frames from the digital story of Group 1.

derstandings generated out of the groups' collaborative processes, and embodied in the digital stories produced, each of them viewed as a constructed learning object encompassing (a) a script, (b) a technical, and (c) a subject-domain ("urban sustainability") component?

« 30 » In the following section we present and discuss our findings for each digital story separately. The headings for each subsection are the titles given by each group of students respectively (Group 1 to Group 3) to their digital story. All quotes used in the text are taken from the focus group discussions that took place in session 5.

Findings and discussion

"La vie en vert"

« 31 » The digital story created by Group 1 is about *a flower growing in some place in a big noisy city, with no sun and water, and suffering from pollution caused by exhaust fumes and people's littering behaviour and neglect. Some hope appears when a group of children adopt it and save it, and so the flower lives happily ever after, along with its newfound friends.*

« 32 » On a first glance, the story appears over-simplistic. However, the group's collaborative processes in devising and displaying a story that is satisfactorily "creative" to their standards and faithful enough in representing their idea of sustainability in its full meaning and complexity is quite interesting.

« 33 » Actually, this is the second story this group produced. The first one was a totally different digital story that was based on their in... idea to combine the photos they had take... m their city into a coherent set, which they then tried to articulate in a video based on a script about a homeless man who is given a second chance in life through appropriate measures taken by the state and the concern of some supportive citizens. This first try, however, did not satisfy them, as they thought it covered only the "social" aspect of sustainability. An important factor also contributing to the rejection of this first draft was the group's frustration with the affordances of Movie Maker as a tool.

« 34 » In their second effort, the group started using animation software and developed a new script which led them to the final version with the flower. They spent many hours using professional image editing software to make different still frames that would give the impression of a moving graphic. They finally came up with two animated frames and complemented the story with still graphics of similar aesthetic style. It could thus be claimed that the group's history of constructing their digital story embodies their experimentation with a range of technological tools and domain ideas on the concept of sustainability in an effort to attain their desired final product.

« 35 » In technical terms, the second digital story is an interesting amalgam of still graphics, photo-collage and animated graphics. There is a soundtrack and no oral narration, the latter substituted by successive text legends appearing middle screen between each graphic, illustrating the evolution of the plot. The story is conceptually divided into two units: the first including graphics in black and white to accentuate the ambience of the flower-hero's time of misfortune, and the second including graphics in vivid colours to depict the flower-hero's twist of fate (see Figure 1, top and bottom succession of scenes). The characters, as well as the name of the city, are not specified. An equally abstract script, consisting of few short phrases, reinforces this vague context.

« 36 » This group's conceptualisation of sustainability in the city also developed from their first digital story to the second. They actually moved from an interpretation related almost exclusively to a social indicator of urban sustainability, homelessness alleviation – a traditional "hard" social sustainability theme (Colantonio 2010) – to an expanded conception, encompassing more environmental but also some social and economic concerns. This transition from a one-dimensional to a more holistic view of sustainability is an indication of a "creative" learning act, which resulted from the students' discursive processes while tinkering with their digital story:
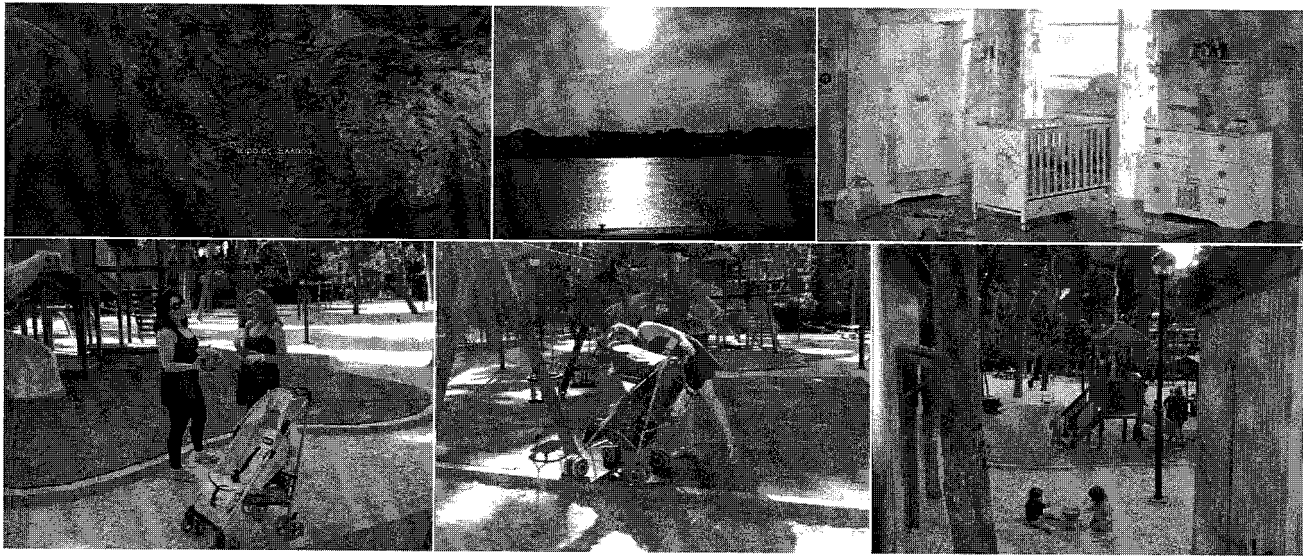
Figure 2 • Selected frames from the digital story of Group 2.

"In our first story we were talking about only one aspect of sustainability. However, sustainability goes through three dimensions: economy, society, and environment... In the first story we were focusing on society. We were showing a person who was alone and homeless. However, in this second story we have recasted, we have profoundly re-constructed our concept to have all three sustainability aspects present." (Excerpt from the transcribed focus group interview)

« 37 » What both stories share in common is that they start from ascertaining a lack of sustainability based on the identification of specific socio-environmental problems. However, the first story focused on one striking social issue of contemporary cities, while the second speaks of more problems, and more environmentally-focused problems (air and noise pollution, waste, overpopulation and urban density, and lack of green spaces). Both digital stories try to end with an optimistic message and call, without neither of them avoid some naïve over-simplification ("the solution lies in our hands," "tree-planting as a solution to the problem"). It is interesting, though, to see how the very experience of collectively searching for the meaning of sustainability shaped their understanding into propounding the adoption of collective action as the main roadmap to sustainability (Roseland 2012). They are also aligned with a view of

sustainability as a future-orientated scheme of action, to be succeeded at if youth generations unite their visions and efforts to bring about change (Norton 2005). This, they argue, is their responsibility to the generations to come:

"The future is in our hands! The way we have conceived and made our story is that a better future lies in the new generations. We believe that it is in our hands to bring subversion. Sustainability is connected to the future." (Excerpt from the transcribed focus group interview)

« 38 » Although collaboration was not always balanced within this group, no explicit incidents of mistrust or conflict were witnessed. However, two group members, a boy and a girl, showed a greater degree of involvement in the whole task, in terms of both communicating their ideas on sustainability and constructing the digital story. This may be due to personality traits (they were evidently more self-confident and extrovert) and to a greater degree of media literacy, a fact also acknowledged by the other group members.

"A dream-road in hurdles"
« 39 » The digital story of Group 2 is staged in the city of Athens, *where, on a beautiful morning, Alexandra, living in Pireaus with her toddler son, Orestis, decides to join her cousin and her toddler daughter,*

Charis, at a playground park located in the area of Zografou. Their route to Zografou appears full of obstacles for a mother pushing a stroller, an image deteriorating through broken pavements and litter thrown all around. Fortunately, the park is in a much better condition, despite some garbage thrown carelessly on the ground. The mothers discuss the state of some areas of the city, but are compensated by their children's joyous play at the park.

« 40 » In technical terms, this digital story is a multimedia synthesis including photographs taken by the group members, a soundtrack synchronised with narration, and three videos recorded using Google Earth and inserted in between the photographs. There are two creative practices invented by Group 2 and reflected in their digital story: the first is the use of Google Earth as a device to indicate movement from place to place; the second is the use of role-playing. As the group's story progressed in their script, they became aware that they needed actual people in their photographs. As getting consent to take pictures of mothers and children is a delicate issue, they decided to impersonate the characters of the story themselves.

« 41 » With regards to the idea of the sustainable city, the group tried to offer a balanced representation of sustainability by projecting various dimensions of it, highlighting different problems everyday people face in a big city, while not leaving aside

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Figure 3 • Selected frames from the digital story of Group 3.

the bright side of urban life. A core theme in their conceptual▮tion of urban sustainability is that th▮▮are various contradictions inherent in a city, emergent in the different experiences of living in the same city (Milgram 1970). This is depicted in their story as the hurdles their heroes are confronted with while taking an everyday walk in the city, hurdles for which they blame the lack of infrastructure and state welfare. However, this problematic view of the city is compensated by the beautiful green public places designed for recreation and socialising that the students had identified and captured in their photos as good examples of sustainability in their city.

« 42 » Displaying complexity in a city's life is interwoven with the students declaring uncertainty about how to define sustainability. They deliberately address this question back to their audience when closing their story, with the aim of instilling deliberation and reflection ("Is your city sustainable?").

« 43 » However, while declaring there is indeterminacy regarding the boundaries of sustainability, the students consciously focus on one aspect of it – quality of life – instead of trying to encompass all aspects of it within the limits of a short digital story:

S1: "Sustainability! Such a huge issue... It's impossible to talk about all aspects in a 2.5 min video..."

S2: "Moreover, we thought that if we tried to put everything into our story, our message would risk to get lost."
S3: "We tried to focus on only one aspect of sustainability. In one video you can't say everything there is to say."
R1: "Did you try to convey what is closer to your own view of sustainability?"
S2: "Yes. And also combine them with what we actually met and realised out of the investigation we conducted." (Excerpt from the transcribed focus group interview)

« 44 » The students therefore used "quality of life" as an organising theme (Van Kamp et al. 2003) to bring various current sustainability issues to light, such as ease of access and transportation, efficient waste management, adequate infrastructure provided by sufficient state welfare, and proper distribution of green spaces and public spaces for recreation and socializing in the city's system.

« 45 » What is finally worth noting in their view is that sustainability starts from and ends with people's awareness of the faults of their city, and their concern to change them to bring forth sustainability:

R2: "What is your aim if your story were addressed to a larger audience? What is the message you want to convey?"
S1: "To make people more aware of [...] their

city. Do they like living in a city like the one we are showing them?.. To become concerned (the people) about how to change it to make it better. Actually to get involved (the people) with how to make their city to meet their standards of living and how to better serve their needs." (Excerpt from the transcribed focus group interview)

« 46 » Collaboration within this group was characterised by a shared vivid interest in the task and a sense of complementarity. Mutual engagement seems to have resulted from the degree of negotiation of ideas at all levels, but also from the members' openness to alternative ideas and suggestions. Every decision was taken by all members, after articulating and sharing all proposed alternatives. There were arguments and counter-arguments, but no issue was left unresolved.

"It happened in Elefsina…"

« 47 » This group created a digital story about *a young student coming from a well-off family and very much concerned about sustainability issues. Vassilis was also a member of an environmental NGO. When his father, owner of a small factory in Elefsina (an industrial area on the outskirts of Athens with many archaeological sites), announces his decision to build another industrial plant right next to the archaeological sites, already suffering from corrosion caused by the air pollution, Vassilis has a strong argument*

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with him. *His father, though, puts him in a dilemma, arguing in favour of more profit for the family, increased productivity, and the creation of new jobs for the locals. The solution for Vassilis comes quite effortlessly, since his father's plans are cancelled because of the economic crisis striking Greece. Vassilis then, with his friends from the environmental NGO, undertakes the reforestation of the area next to his father's factory.*

« 48 » In technical terms, this digital story is a homogenous multimedia synthesis using the graphic element of comics (with no speech bubbles) and music synchronized with narration (from three successive narrators' voices). It comes from their decision to use an online comic maker (Pixton) after experimenting with other alternatives. Their first draft was a video made with their own photos. However, they were not very satisfied as they had already begun to shape the story of Vassilis, which needed actual actors and settings. A first idea, supported mostly by one of the members (a girl), was to use a video of themselves acting out the story and then edit the video with professional software. The group rejected this idea as overly ambitious and time-consuming, and proposed the use of Pixton as an alternative. After some turbulence and disagreement, the members agreed on this solution and worked on their final draft in a rather cooperative than collaborative fashion. They assigned each member to work on a number of frames online in Pixton. This was an asynchronous activity that led to the pre-final draft. Then they made final, commonly-agreed changes and synchronised the sound and narration.

« 49 » The group's idea of sustainability also evolved from initially adopting a rather naturalistic approach, to proceeding further to a more socio-environmentally and economically balanced view of current reality. Moreover, the students tried to address various aspects of sustainability and to talk about awareness, participation, and collective action as important prerequisites for attaining sustainability.

« 50 » One interesting feature of their conceptualisation of sustainability was their idea to relate it to actual contexts (Elefsina) and situations from their everyday reality. They went a bit further, to view sustainability as connecting with the out-

burst of Greece's economic crisis. A genuinely imaginative element in their thought was the idea that a crisis is connected not only with negative outcomes but also with opportunities for attaining sustainability in the other two dimensions, a suggestion also supported in the literature (Schneider, Kallis & Martinez-Alier 2010).

S1: "The most important thing is that the way we thought our story to deploy is by connecting it with our current reality. We used our current reality, we identified real facts and situations, we talked about the economic crisis, we put dilemmas regarding nature protection and new jobs... These are facts we come across in the cities nowadays."
S2: "We have integrated our story in an everyday context of Athens. It is very close to our reality." (Excerpt from the transcribed focus group interview)

« 51 » Another noteworthy element of their approach towards sustainability is the recognition that it is connected with the existence of some hard-to-resolve dilemmas (Bugliarello 2006). The students actually focused on such a dilemma: "Should we adhere to economic development through industrial expansion leading to the creation of new job opportunities, or should we prioritize the protection of the natural environment and cultural heritage through restrictions placed on industrialisation?" However, although they thought of and posed this dilemma, they did not avoid applying some simplistic and overoptimistic suggestions as to how to tackle it.

« 52 » An impression of a satisfying level of collaboration within the group was initially given. However, midway through the project, some observed incidents of misunderstandings and communication failure disturbed the flow of collaboration. These can be attributed, at a first level, to a member's persistent character and tenacity towards an idea the other members did not seem to embrace (the video shooting). At a second level, there seems to have been previous conflict among two of the group members before embarking on this collaborative endeavour. It is important to mention, though, that all members of this group expressed and supported their ideas, despite tension and disagreement at times.

Conclusion

« 53 » Our study provides some noteworthy evidence that collaborative creativity viewed from a constructionist perspective can be used as an appropriate framework for designing learning activities addressing the difficult concept of sustainability. It has been designed and tried out with the aim of assisting in gradually developing a theoretically firm and practically enriched lens of how to turn the inherent complexity, elusiveness, and context-specificity of a sustainability-related issue into a pedagogical advantage. Of course, the evidence provided by this study, although promising, has to be taken as still standing on a preliminary basis, while more research is absolutely necessary before any sufficiently supported claim is put forth. Nevertheless, it can be claimed that our present endeavour adds to a substantial argumentation for the need for and value of expanding the realms of constructionism beyond those of mathematics, science, and technology education to the interdisciplinary fields of social sciences. However, as already noted, this is an early and still immature effort towards developing a steady theoretical framework on this question, and it needs to be buttressed by many more cases of implementing it in practice and studying it empirically.

« 54 » Fostering collaborative creativity for the construction of digital stories about urban sustainability has proven to be a demanding venture. It entails, for researchers / educators, although not presented here, the use of techniques for inciting and maintaining inspiration and supporting collaboration within the groups as well as the invention of mechanisms to shed light onto the practices employed and the artefacts produced. What is worth noting about the outputs of the process is the variety of digital tools used to construct the digital stories and the diversity of techniques employed by participants to grapple with the constraints and trade-offs of available digital resources and time limits.

« 55 » In terms of meaning generation, several ideas were exchanged in the process of the groups' endeavours to achieve a deeper understanding of the complex and elusive concept of urban sustainability as a

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prerequisite for devising their story scripts and for deciding on several technical and aesthetic features of their created artefacts. These ideas and insights are attached to a wide array of approaches to urban sustainability, which need to be further analysed and discussed as to their epistemological status and ideological origin. However, this was not within the scope of the analysis reported in this article. What we tried to address here was the produced outcomes (the digital stories) of these processes through their three constituent dimensions: the story, the technical characteristics, and the conceptual representation of urban sustainability as the main construct involved.

« 56 » Further research could shed more light on the ways specific ideas on urban sustainability evolve in the course of constructionist activities that make use of expressive media for co-construction of meanings as the process and products of a creative learning process.

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EDUCATIONAL RESEARCH CONCEPTS IN CONSTRUCTIONISM

Open Peer Commentaries

on Maria Daskolia et al.'s "Learning about Urban Sustainability"

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Studying Complexity: Creativity, Collaboration and Learning

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Upshot · Creativity, collaboration and learning are fascinatingly messy and interconnected processes. Does knowledge develop by engaging in a collaborative creative process, or does existing knowledge allow us to create more creative artefacts? Does one build upon the other in a bricolage process, familiar to constructionist learning experiences? If so, how can we best facilitate this type of learning? This OPC raises a number of questions that it does not attempt to answer but raises them to draw attention to the complexity of the phenomena under investigation.

« 1 » Maria Daskolia, Chronis Kynigos and Katerina Makri's target article presents an example of constructivist principles employed to provide the theoretical foundation for a learning experience designed to provide learners with an opportunity to develop their knowledge and understanding of the conceptually complex area of "sustainability." Rather than employing a simulated environment or microworld for learners to explore and develop their own explanations of the outcomes they observe, the creation of digital stories asks the learners to consider in a personally meaningful way the micro impact of macro systems they have previously been introduced to, whilst simul-

taneously developing their understanding of the complexity and interconnected nature of these systems.

« 2 » Three complex and interconnected areas are encountered in this article: creativity, collaboration and learning. Daskolia, Kynigos and Makri suggest that "a constructionist design entails a genuine pedagogical potential for enhancing collaborative creativity in students' learning" (§3), taking a mini-c and middle-c approach to creativity, asking the question:

" How is collaborative creativity manifested in terms of new ideas and understandings generated out of the groups' collaborative processes, and embodied in the digital stories produced?**"** (§29)

« 3 » The key component of this question and initial statement of potentiality is "*collaborative creativity*." Collaboration is often confused with co-operation, when learners act together to achieve personal goals. While in collaborative activities, learners work together on a single-shared goal, creativity is an often intangible concept: it can be as difficult to identify a creative act or artefact as it is to identify the process through which it occurred.

« 4 » Creativity has long been associated with learning (Guilford 1950), but how to identify creativity is often contested as there is no single definition of creativity that is agreed upon across and even within disciplines (Kleiman 2008). Commonly, there are three clear aspects of creativity discussed in the literature: the person, the process and the product. Particularly relevant to this article is the fact that design is often a collaborative and social process involving groups of designers (Warr & O'Neill 2005). These ideas and concepts are shared (with

or without the support of physical artefacts) and both the creative process and creative product become socially mediated, which is reflected in the findings of this article. However it also raises important questions about Group 3, who are characterised in the article as co-operating rather than collaborating. What are the implications for creativity and in turn the co-construction of knowledge? Does learning occur at the individual level or at the level of the group?

« 5 » Focusing on the design, it is interesting that each digital story in this article presented a problem scenario to be resolved (which was not a requirement in the initial brief). To begin with, a problem is a common aspect of models of creativity that not only prompts the generation of ideas but allows learners to evaluate their ideas. Andy Warr and Eamonn O'Neill describe the idea-generation phase, which follows the analysis of the problem, as "the more specifically creative phase of the creative process model" (Warr & O'Neill 2005: 121). From a constructionist perspective, it is likely that it is at this point in the creation of the digital stories that learners take ownership of the project and it becomes personally meaningful: a powerful constructionist idea. Therefore if learning is associated with creativity, it is perhaps the initial development of the problem and generation of ideas that need to be examined in depth.

« 6 » The creation of knowledge artefacts is a key feature of constructionist learning activities. They need not be final, as they are created to explore, test and extend understanding. It can be anticipated that these artefacts may be developed or even destroyed and created anew to encompass new/developing knowledge and understanding. For example, it appears that Group

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1 created their second digital story for just this reason, stating that their first digital story only addressed one aspect of sustainability whilst the second covered all three. However, it is unclear whether this is development of knowledge through collective engagement with a creative act, or whether this was knowledge they already held that they used to develop a more creative artefact.

« 7 » I would argue that there may be evidence of both within the one group's work and it is essential to examine the discussions between students to help illuminate this process of moving from one to the other. It is also worth considering how much of the creativity was driven by the technology and how much by collaborative knowledge construction.

« 8 » To explore the complex interconnected nature of creativity, collaboration and learning, it is ▪▪▪ essential to understand the wider lea▪▪▪ context in more detail. Real-world (non-lab-based) learning environments are messy places for research. It is this complexity that the educational researcher must relish if we are to develop the initial insights gained from this study further. Case studies are particularly powerful for developing an understanding of phenomena under study as they provide a rich description that researchers and educators use to inform their understanding of the implications of the research in their own contexts.

« 9 » One aspect of this study that remains unclear is the content and timing of the taught component of the module. There can be no assumptions as to what concepts were covered, what examples were given or even the mode of instruction. There can also be no assumptions made as to the level of student engagement in this more traditional section of the module, nor what they have learned from it. In developing this study, it would be valuable to consider whether the discussions that occurred as part of the workshops would have usually taken place in seminars (with no knowledge artefact created) and if so, would the same level of conceptual development have been achieved? This leaves us with some important questions: What is the role of existing knowledge in any apparently creative process or final artefact and does this mediate whether or not it is actually creative? Finally,

considering the research question that is the focus of this study: Are "new" ideas and understandings generated and to what extent are they new at a group and individual level?

« 10 » The work of Daskolia, Kynigos and Makri demonstrates one way in which educators can support their students to develop these new understandings through constructionist learning activities, simultaneously providing researchers with several routes to explore the complex interconnected nature of creativity, collaboration and learning.

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Tool Selection and Its Impact on Collaborative Learning

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> Upshot · Daskolia, Kynigos and Makri's article offers us a view into potential applications of constructionist learning theory to help students conceive of and collaborate on solutions to today's complex problems. This work in many ways parallels the efforts of those investigating systems thinking and highlights the importance of digital production in that process. While many efforts rely on simulations and models, the authors place centrally the role of digital production in understanding complexity. This, in turn, calls our attention to the affordances and limitations of our current tools for facilitating learning and collaboration, and ultimately to the need for new tools.

« 1 » The expansive and often vague conception of urban sustainability is a particularly ripe area for exploration using con-

structionist means, given that constructionist learning is at its most efficacious when learners are brought together in a social context to create and share a personally meaningful text (cf. Papert 1980; Papert & Harel 1991) as well as illuminate "powerful ideas" such as sustainability and complex systems (Papert 1980). The approach explored in Maria Daskolia, Chronis Kynigos and Katerina Makri's target article sits well at this intersection and helps expand the constructionist literature beyond the typical domains of science, computer science, and mathematics. In particular, their study helps us envision how this lens on learning and engaging with the world can shape our understanding of large, complex societal issues from within the domain of digital storytelling.

« 2 » Urban sustainability is a particularly powerful idea to explore, as it necessitates the awareness of and synchronicity between countless moving parts. In this article, the authors reference the three pillars that support most urban sustainability initiatives – economic, ecological, and societal concerns – and appear to challenge the students in their study not only to consider the *interrelationships* between these factors when collaborating on a solution to urban challenges, but also the most elegant way to *represent* these solutions in a short, multimodal narrative. A running thread through the group projects in this article, which included narratives about pollution and the environment, urbanization and public spaces, and the tension between eco- or historical preservation and economic growth, concerned the use of microcosm to symbolize the intersections of large, vast systems. Each group seemed to struggle at first to devise a project that acted as personal story, "issues" piece, and call to action. And, yet it was very clear in the end that each of these digital stories demonstrated an understanding that the circumstances of the individuals in their communities are shaped and influenced by greater systems in motion.

« 3 » An understanding of how systems like those depicted in these group projects work offers students a powerful lens for seeing, engaging, and changing their world (Jacobson & Wilensky 2006). There are numerous well-articulated approaches to teaching systems thinking in the classroom,

including the use of computer-based modeling (Collela, Klopfer & Resnick 2001; Wilensky 1999), dynamic simulations (Collela 2000; Danish et al. 2011), and connections to social and biological sciences (Jacobson & Wilensky 2006; Hmelo-Silver & Pfeffer 2004), to name a few. However, the vast majority of these efforts involve students exploring models of existing systems rather than designing their own. This article echoes the work of Linda Booth Sweeney and others, who have argued that stories can offer an important avenue into systems thinking for young people (Booth Sweeney 2001). Booth Sweeney's work, in particular, calls our attention to the potential impact that stories have on our understanding of systems and traces a potential cause of our misconceptions of systems thinking to our children's literature. She notes that many Western children's stories exhibit linear causal thinking while there is a minority of notable stories that exhibit systemic ideas (e.g., Dr. Seuss's *The Lorax*) that can be leveraged to help young people develop systemic outlooks important to sustainability. Daskolia, Kynigos and Makri harness the power of storytelling as a means to support systems thinking, conveyed through the constructionist activity of digital storytelling.

« 4 » One of the challenges that the authors cited in their study was the translation of the groups' conceptual and narrative ideas into the technical dimension, the "digitalization" of their stories. The first group referenced in the article went so far as to change their project concept entirely because of their lack of familiarity with Windows Movie Maker, and members of the third group shot down an initial proposal from a team member to shoot and edit a short film because it would be too ambitious to do so. In constructionist learning, much attention is paid to the tools in use (in this case, the computer and the media applications utilized) and how the tool shapes our thinking (Papert 1980). In this respect, we see the impact that the range of media tools currently available for digital media production has on the idea construction and constraints of the learning space. Our choice of tools is important not only for their ease of use but also for their ability to support the design goals, in this case digital storytelling. In addition, many issues around sustainabil-

ity and systems thinking are particularly apt to nonlinear and interactive forms of digital storytelling, which are particularly efficacious for digital stories concerning systems concepts.

« 5 » As part of an effort to promote systems thinking through engaging in design with digital media, we created a curriculum centered on digital storytelling using the Scratch programming environment (Peppler et al. 2014). Scratch is a media-rich visual programming environment designed to be an accessible space for young people to engage in the creation of interactive stories, video games, and simulations through the use of command blocks and drawn or imported media "sprites" (Resnick et al. 2009). Enabling interactivity in a digital story not only engages young people in major systems thinking concepts – including interconnection, system components, feedback loops, and leverage points – but allows the viewer similarly to have an impact on the storyline through their choices. Scratch's particular affordances – remixing existing media, creating interactivity, non-linearity, and multimodality – made it an amenable environment for the creation of digital stories about systems. Moving forward, future research and development efforts should examine the impact of the tool on constraining and enabling the learning space. As evidenced by the three group projects in this article, the groups' choice of digital storytelling tool shaped the projects in consequential ways, having a profound impact on the genre, narrative, and aesthetic of the story being told, as well as each group's ability to collaborate in the design process.

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Narrative Learning for Meaning-Making, Collaboration and Creativity

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> Upshot · The target article by Daskolia, Kynigos and Makri shows the great potential of narrative learning to foster general learning skills, such as meaning-making, collaboration and creativity, while facilitating the construction of disciplinary content knowledge. This learning approach has much to recommend it, especially from a constructivist perspective, because it supports the implementation of collaborative and creative learning processes apt to promote reflective dialogue as a basis for knowledge construction, capitalizing on students' previous knowledge and experience.

« 1 » The target article by Maria Daskolia, Chronis Kynigos and Katerina Makri provides an interesting example of narrative learning, and shows how this approach lends itself to fostering general learning skills while facilitating the construction of content knowledge. This is, indeed, the educational aim of these authors, who specify they have "a focus on activating the students' creative potential for developing new understanding." Let us see why the use of stories appears to be the right tool to achieve such a learning aim.

« 2 » Narrative learning consists in letting students make use of narratives of any kind (from invented stories to narrations of personal experiences), meaningfully related to assigned learning tasks. This approach to learning has been increasingly raising the interest of educational research because scholars of diverse orientations have recognized its learning potential, which derives from its characterizing features (Dettori & Paiva 2009; Dettori et al. 2006). Narrative is a natural expressive form: from early childhood and throughout life, human beings appear to be endowed with "narrative intelligence" that leads them to naturally formulate and understand the meaning of stories (Bruner 1990; Mateas & Sengers 2002). Moreover,

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CONSTRUCTIVIST FOUNDATIONS

Special Issue

Constructionism and Creativity

Editors: Chronis Kynigos and Gerald Futschek