https://doi.org/10.2478/tjcp-2022-0008

Participatory digital gameplay narrative design for public space sustainability management: empirical research with primary school children

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Abstract This paper reports results of completed research with primary school children which took place in Athens, Greece. Children engaged in designing the play experience of digital mini-games corresponding to episodes/missions of an entire plot. The games were coded by the school teacher on low-end mobile phones using AppInventor and were then played by children designers and testers. The game plot concerned restoring management rules for a public space (an urban park), along sustainability principles. The results focused on the participation processes of children in critical game narrative design, and decision-making about public space management alternatives to embed in game narrative design.

Keywords participatory design, gameplay narratives, public space, children-led design, children participation

INTRODUCTORY REMARKS AND RESEARCH DESIGN

Children are active users of immersive environments like digital games. Play in such environments is mainly guided by players' abilities, emotional readiness and game structure, which may broaden or delimit the depth of involvement. Changing the role of children from individual players to collaborating designers of games brings participation into the picture and opens up radically different involvement dynamics. Play is still the objective, but fun passes through a harder effort of more self-investment. Moreover, designing games for managing public spaces in a sustainable manner exposes children designers to concepts from complex agendas which they need to embed in gameplay design.

In this research, following collaborative and participatory processes, we examine the way that primary school children themselves created playful content, in the form of gameplay narratives, in order to play digital games. This exercise has shed light on the barriers and patterns for the ways that children interpreted fun, actions of play, and meanings of iconic representations in a digital game environment. Additionally, the digital games which were created to accommodate children's opinions about sustainable management of public space are considered as cultural artifacts, and allow reflection on the possibility of studying participatory children-led gameplay design as a form of cultural participation. The key research questions guiding this effort are:

– RQ1: What are the challenges of having primary school children collaborate in designing gameplay narrative for digital games?
– RQ2: How could this process and productions lead to learning for both children designers and for other primary school children involved?

RESEARCH METHODS

Gameplay design, in the context of this research, has been based on a story built using Propp's (1928/2000) morphology. The story model was developed through a playful process during which children were guided to develop narratives about public space in successive stages, from free story building in the first stage, to binding stories with specific themes in the second stage, and on to bringing stories together in a collaborative way in the third stage. Two groups of children took part in this exercise, comprising 24 and 21 K-12 pupils respectively, coming from two different public primary school classes at an urban municipality of the metropolitan area of Athens, Greece. The first of these groups has been designed as the creator group, and the second one as the assessment group. The mission of the creator group was to create the game story and participate in the design of mini-games. The mission of the assessment group was to be exposed to the game content, play the games and perform a multidimensional assessment.

This research has been part of a broader effort about mini-games creation with and for primary school children, using low-end mobile devices, in the context of educating for sustainability. The research focus was twofold: (a) to explore the ways in which K-12 pupils may create story content as a basis for designing games that have fun and learning potential at the same time; and (b) to examine the structure, meaning and fun of game stories from the point of view of the children as creators as well as through child peer review. In order to strengthen the validity of data, both groups of children involved had similar characteristics, identified from a prior sample research that explored, among others, gameplay experience, preferences for game design patterns, and preferences for narrative patterns. Gameplay experience, which concerned the types of games preferred and used, allowed the construction of a sample representative of the total population of 620 pupils. In this study, four groups of children emerged: experienced players, frequent players, occasional players and rare players. Each group shared individual characteristics and a common interpretation of game environments. Boys were represented at 1.8% more than girls, and there were no significant gender differences in the number of experienced and rare players. Additionally, the research design was guided by an effort to handle multifactorial and unstable results with appropriate flexibility in data analysis for effectively interpreting the field of action. Following this line of thought, multimodal research approaches (Bazeley, 2004; Harwell, 2011; Hopkins, 1995) were chosen based on embedded design and intensive collection of qualitative and quantitative data throughout the research process. The Grounded Theory Method (Bryant, 2017) was selected to frame the overall research focus on the usefulness, applicability and practicality of ideas, highlighting the importance of action in order to validate ideas.

Multiple research tools were used for data collection, comprising digital questionnaires used at the end of every research part and paper-based questionnaires used at the end of a lesson plan, focusing, among others, on pupils' a) satisfaction about the narration, fun patterns adaptation in mini-games and playability patterns; b) opinion about the way narration core elements are embedded in the games' environment; c) opinion about the collaboration developed in each part of the process; d) meaning perceived from game playing; e) playability feedback; and on the f) key concepts having emerged from the games. Observation had a three-fold focus: a) to identify instances of collaboration; b) to look for hints used by teams of children in order to overcome difficulties; and c) to monitor the design process map. Focus groups comprised team members and were managed by the research facilitator. They were designed based on the data collected as above in order to drill down and reveal new issues. Additionally, focus groups were conducted about the games' effect on fun, meaning and story and the way that the combination of them may support reflection and willingness to take action in real life situations. Personal interviews were used for further clarification of matters revealed, and an action diary was filled up at the end of each action following a short reflection on what had

happened. The story productions and research data content were analyzed using content analysis (Krippendorf, 1980; Neuendorf, 2002). A particular focus has been placed on issues of boundaries of words and identity, which were explored based on the word usage approach of Gee (2018). The overall research procedure is presented in Table 1. The total duration of the research effort, including intervals of preparatory and analysis work, was two school years, and effective story creation with the participation of school children lasted a total of four months.

Action taken	Research tools used/ purpose	Data analysis	Types of data used (A)	Types of data used (B)	Combined data used (A+B)
Free story	Observation: collaboration Questionnaires: collaboration, collective opinions for story patterns that support fun Content analysis: use of verbs, nouns and adjectives Phrases support sustainable concepts Phrases support fun elements	Define groups of common data characteristics Story structure discipline, fun patterns, story facilitation patterns	Combine and compare in various ways groups of data in order to create distinctive categories of fun, conflict, resolution, and redemption patterns	Define collaboration procedures like team members' contribution, types of contribution, verbal, written, ideological pluralism and others	Content and collaborative procedure Define the terms of story development
Free thematic story	As in previous action and additionally: Content analysis: Phrases and words define terms of public space	Define groups of common data characteristics Story structure discipline, fun patterns, story facilitation patterns, public space presentation patterns	Compare groups of common data characteristics with the previous action Define new groups related to public space	Additional improvements on collaborative characteristics like rounds of support, effective roles acquisition, rate of decision taken and others	Content and collaborative procedure Focus on the thematic restriction and its effects on the terms of story development
Games support story	As in previous action and additionally: Content analysis: Phrases and words define urban park Focus groups: Examine the perception of collaboration in every stage, the meaning of the created content, as well as highlights from the procedure so far	Define groups of common data characteristics Story structure discipline, fun patterns, story facilitation patterns, urban park meaning patterns	Compare groups of common data characteristics with the previous actions Define new groups related to urban park created perception	Define the whole collaboration procedure Create a holistic collection of fun narrative patterns Define how pupils interpret created content to game mode	Define the terms of a new collaboration basis for mini-games creation

Table 1. Research process and story analysis

In the first part of this research process, the free story development process was observed intensively in order to clarify a) the way Propp's model was used, in terms of traces of structure; b) the way that pupils' ideas were embedded in the model; c) the levels of pupils' contribution; d) pluralism of viewpoints and variety of ideas contributed; e) cases and ways of dealing with deadlocks, and the solutions proposed. Alongside this process, the researcher also intervened to the minimum level required, in order to facilitate content interpretation and creation of fun elements.

The main aim of the questionnaire was to clarify the topics observed, and establish a basis for cross-checking the procedure and terms of collaboration in general. In addition, the questionnaire

instrument was targeted at helping to reveal collective thinking about fun elements and to determine story patterns that promoted fun.

Content analysis has served to a) categorize verbs, nouns and adjectives according to positive or negative meaning, b) locate phrases referring to sustainability concepts and c) locate phrases supporting fun.

Compared data from observation, questionnaire and content analysis have been used to establish distinctive categories of fun, conflict, resolution, and redemption patterns (A).

Compared data from observation and questionnaire have served to explain the ways collaboration occurred, focusing on different types of contributions and on detailed descriptions about the ways final results were achieved (B). Compared data from (A) and (B) have served to reveal story elements containing fun, sustainability concepts and rich content for visual representation.

The same research tactics have been used in the second part of the research process, on the free thematic story, with focusing on two additional issues: to identify forms of representation of public space, in general; as well as to spot changes having occurred in collaboration procedures.

These research tactics have been again applied in the third part of the research process, on the games support story, with an additional focus on forms of representation of an urban park, in particular. The results obtained were cross-checked with data gathered from focus groups and comments from participants. The data finally gathered were distributed along four categories: collaboration; urban park meaning; narrative patterns for visualization as game parts; and fun patterns supporting engagement.

NARRATIVE AND DIGITAL GAMEPLAY FOR LEARNING

An extended corpus of research about the way games should be designed (Fullerton, 2014; Macklin & Sharp, 2016; Rogers, 2014; Salen & Zimmerman, 2003; Schell, 2008; Sellers, 2017; Zubek, 2020) reveals that game creation is influenced by a great number of parameters. The fundamental view of Crawford (1984), that the creator of a digital game should manage highly anticipated artistic goals alongside incredible volumes of code in order to develop the thematic core of the game, still holds true today. On the other hand, game design for learning goals connected with a pedagogy framework has also been researched extensively (Aldrich, 2005; Braad, Žavcer & Sandovar, 2016; Carvalho et al., 2015; de Freitas, 2006; Frank, 2007; Harteveld, 2011; Hunicke, Le Blanc, & Zubek, 2004; Kalmpourtzis, 2019; Mitgutsch & Alvarado, 2012; Winn, 2008). Different approaches from the literature, depending on different design strategies and guiding theories, show that a number of design tactics is possible, especially when the learning content and context of gameplay are highly focused. Still, a problematic issue that always appears is the way in which learning goals are embedded in a game.

From reviewing the above literature, we consider that narrative may serve as a common basis for all game design methods. We share, in this respect, the views of Lebowitz and Klug (2011) who state that "*Although no verdict has been expressed that a digital game requires a story to be effective, in any case if the game manages to be fun, then it will be played even if it has no story. At the same time, however, almost every digital game can be improved if there is a good story that supports it*".

In this line of thought, the research reported is based on narrative as the participatory game design basis to be employed with primary school children, given that narrative is familiar to primary school children; uses familiar and common language for everyone, player or not; supports adventurous features that arouse children's fantasy; lends itself to reflection, and facilitates the expression of the children's experience; supports modifications and adaptations in an easy manner; allows adaptations at specific parts of the design, without the need for extended corrections and modifications; has potential for easy extensions or reductions, based on collaborators' capabilities;

supports creation of fun patterns that can be transformed into game design patterns; and, last but not least, supports embedding educational goals without spoiling playability and fun.

Two common ways in which digital games expose players to narrative are to present a story in a way that is either complete from the beginning, or emerging as the game evolves. In both cases, this story shows the world in which the game exists and helps understand what is happening. Again in both cases, however, a design concern is the risk of the story breaking away from the game, with players watching or reading the story instead of interacting with it through gameplay (Anthropy & Clark, 2014; Crawford, 2003).

Independently of this concern, the plot of a game may offer different ways of using narrative: linear or branching story lines, abstract information, game objectives, and space information are some of the tactics that can be used to manage the flow of narrative (Novak, 2012). Narrative in our case was used as a basis for the creation of digital games, mostly for creating a reason for action. Design followed adaptations to the children's opinions, without being limited by the content of narrative. Consequently, story parts worked more like an umbrella covering game parts, rather than as an exact plan for games creation. The actual game creations mostly adopted fun elements of the story and gave the necessary motivations for action.

With these considerations in mind, the research reported has used Propp's morphology as the specific model of narrative on which game design is based. This approach was chosen because the modular structure of Propp's morphology lends itself to practically all of the narrative management tactics outlined above. At the same time, the very origins of this morphology from traditional magic folktales, in which attention is constantly caught by the desire to discover what follows and to make sure that the forces of good will prevail, encourage more active participation in the evolution of the story. Thus, in case this story evolves within a game through player agency, this motivation of more active participation minimizes the risk of the story breaking away from the game, being passively watched or read rather than interacted with.

It is not by coincidence, in this respect, that Propp's morphology could be applicable in many modern stories (Fairclough & Cunningham, 2003), whereas many digital games and role-playing games such as Final Fantasy have been subjected to analysis through this model, connecting the stages of narration with it (Bostan & Turan, 2017). At the same time, Propp's morphology has several references of narrative analysis in games like World of Warcraft (Sutcliffe, 2013) and Skyrim, especially in the way heroes develop (Gabelica, 2017), whereas a considerable number of modern digital games are designed with semantic and morphological features which refer to this model (Gelfand, 2010). Last but not least, as Ryan (2001a, 2001b) has observed, game elements related to Propp's morphology highlight competencies, convey the feeling that the hero is acting autonomously, and give players the impression of integrated and physical goals while taking actions.

Based on the above, a process for collaborative story creation has been designed in the research reported, with the objective to build a unified and at the same time easily modifiable story that could be turned into a game for participatory sustainable management of public space, in our case an urban park. The final collaborative story that has been produced in this manner incorporates structural, narrative, expressive, cultural and cognitive patterns that appeared in the interim individual stories from which it has been synthesized, thus achieving a pluralism that mirrors the ideas of the creator group.

PARTICIPATORY STORY CREATION ON PUBLIC SPACE SUSTAINABLE MANAGEMENT

Participatory design (PD), which we have applied to story development in a primary school setting, focuses on immediate interaction with the participants and develops fruitful processes of

reflection and adjustment. In educational contexts, as the relevant literature states, pupils as active members of the school community should be called upon to contribute to the development of their own educational environment, thus increasing a sense of ownership and enhancing motivation (Stukalina, 2010; Woolner, Hall, Wall, & Dennison, 2007). This approach, at the same time, leads to quality improvements, since end users participate in the planning process, and ensures democratic participation in all aspects of design (Schuler & Namioka, 1993). The fundamental ideas and features of PD have been applied to educational research, especially for the creation of innovative teaching and learning practices, technological objects and tools, in the context of educational reform attempts (Cober, McCann, Moher, & Slotta, 2013). The advantages of this approach are discussed in a number of surveys (Danielsson & Wiberg, 2006; Katterfeldt, Zeising, & Schelhowem, 2012; Masse, Pounds, Church, Waters, & Souders, 2014; Moser, 2013; Yip et al. 2013;), which also encompass applications on digital games, as well as on story creation (Ekelin, Elovaara, & Mörtberg, 2008; Johansson & Linde, 2005; Kucirkova, 2019; Ozcelik, Terken, & Terken, 2012; Pata, 2011).

Our own participatory story creation process has been based on Propp's morphology, and was structured in three stages with ten parts in total. At the outset, pupils started to participate as individual storytellers. Then, as the process progressed, they gradually followed a collaborative procedure which evolved to participatory story creation.

The first stage of the process, consisting of five parts, is focused on free-topic story creation, in order to provide familiarity with the model. Initially, each pupil as storyteller points out the basic elements of a story that (s)he has drafted and realizes the hero's actions towards the objective. Subsequently, pupils are introduced to Propp's morphology and compare their own stories with the model. Then, they are asked to find and decode the elements of the model in selected Greek and Russian fairy tales. Following this part, each pupil is asked to make a free-topic story following the model structure. And lastly, the resulting stories are assessed by the pupils themselves.

The second stage of the process is focused on specific-topic story creation according to the model. In this stage, stories need to be bound to the theme of public space, for which some more or less abstract contents are provided by the educator. The educator encourages pupils to engage in a word-sorting game, with the objective of arranging words from a list in three groups according to their affinity with public space, and then of comparing the pupils' choices in plenary. This stage aims to facilitate the pupils in expressing their perceptions and ideas about public space, as well as reveal the knowledge that has been acquired for this theme from previous experience. In practice, this stage has also worked as a common pool of thinking. Fun, story and knowledge patterns, as well as specific thematic areas about public space, were drawn by the pupils from this pool later on, and used for the final story.

The third stage of the process is focused on the creation of a single story about participatory sustainable management of an urban park. This story was meant to form the basis for the creation of mini-games later on. This stage comprises four parts: in the first part, pupils as heroes determine their names and characteristics, the place and time of action, the problems for which solutions are absent and the starting point for problem solving. In the second part, story segments are created at four circles connected to Propp's morphology: (1) initial status and introduction, (2) main story, (3) donor circle and (4) return of the hero. In the third part, the pupils present the story segments connected to each of these circles, and are asked to modify them by relating them to more functions from the repertoire of the morphology, which encompasses 31 functions in total. During this part, story segments may be adapted, changed, enriched, and logical impasses may be creatively resolved, whereas segments that do not meet fully the pupils' ideas and/or do not satisfy the class emotionally may be completely removed. Finally, in the fourth part, pupils are asked to present the final story and record it using their own voice. Propp's model facilitates this procedure by having the same building structure as a basis throughout the stages. Using narrative elements between the three stages enriches the final story in a collaborative and creative way.

During the implementation of this stage, six pupil groups were formed. Group design was based on the class sociogram. In this way, pupils with high popularity were spread among the groups, and each group incorporated pupils with different popularity status. Pupils worked on worksheets that presented the functions of the model in italics and provided free space to write text. The educator operated as facilitator who could offer guidance; and, based on a previously agreed procedure, each group had the opportunity to ask for help or to submit an idea from one member of another group during each working hour. Still, this opportunity was rarely used. On the contrary, it proved that in plenary sessions improvements, additions and modifications were more acceptable to the class as a whole, and the story content was more easily transformed when pupils were aware of what their classmates did. Plenary sessions were organized when an important part of the story had been created. Groups presented their progress when they were emotionally ready and, in some cases, after motivation from the educator. In addition, during this process, pupils pointed out the model functions that had been integrated and the descriptive patterns that made the story more interesting, as well as the model functions that had not been used. The Storybird platform[1] was used during this effort as a common space for interaction and as further exposure to the story content. The thematic focus of the final story on an urban park originated from the specific references to public space in the stories of the second stage, where most of the stories developed referred to an urban park. Furthermore, a questionnaire was distributed before the third stage in order to understand pupils' perceptions about public space and, on that basis, it was possible to differentiate elements based on pre-existing views about this theme as well as distinguish new ones.

Overall, the third stage of the process was the hardest one to accomplish, because plenary sessions were frequently needed and each group worked on a part of the story that had to be based on some standards which were pre-decided by the whole class together. The detailed procedure for this stage comprised the following steps:

- Each group suggested seven heroes and their characteristics according to Propp's morphology.
- All groups had, at the same time, to work on the beginning of the story and to create a narrative pattern for absentation.
- A plenary session was held in order to build consensus on a common start of the story, based on a combination of narrative patterns from all groups as well as on heroes' abilities and characteristics.
- Final naming of the heroes was done through e-voting, based on the names that groups had suggested.
- Four teams worked with random selection at one of the four story development circles according to the model, and two teams worked on the same circle with two others, in order to have more than one perspective on a specific group of functions of the model.
- Each story circle was associated with the "Star Model", a model for public space assessment introduced by Varna (2014).
- Group communication and educator guidance were the same as in previous stages. In plenary sessions, as the segments of the story were developed, names of heroes were noted and there were discussions about which candidate names fitted better to the story elements.
- The story that emerged was presented and discussed in plenary. In this step, several unrelated points were connected in ways that were proposed in the plenary meeting by the pupils, whereas some others were connected through educator facilitation, making sure that there were no disagreements.

The final story that emerged from this participatory process subsequently served as the narrative of the mini-games that were developed on mobile devices.

1 https://storybird.com/

ANALYSIS OF THE STORIES PRODUCED, FUN AND CULTURAL ELEMENTS

In this section, we present in a stage-by-stage manner selected elements of the primary school children's story productions that came out of this participatory exercise, and discuss common and different story features that emerged, alongside selected fun and cultural elements that the children put into their story productions.

At the first stage of the process, the stories managed to adopt basic elements of Propp's morphology like the notions of hero, assistant, villain, sender, donor and magic medium. The children presented contexts which lacked some elements that led to uncertain battles ending with the hero's victory. Some half of the stories that supported these representations were based on known cartoon scenarios or fictional adventurous movies, and were distinguished from others in terms of greater coherence and completion. The battle between good and evil was observed as a dominant element in the stories produced, still without having an elegant description, and fun appeared in various moments of this battle. Additionally, in some cases, the children attempted to relate fun to names of story figures, but generally name choices influenced by known movie or cartoon production were not really successful. The battle descriptions involved funny moments. Still, these descriptions, although related to film experiences in general terms, were closer to videogame battle moments at the level of detail, as pupils were asked to express their inspiration sources. As content analysis showed, only a third of the stories produced were found to employ more complex narrative patterns, like sets of triple actions which support fun and uncertainty. Fun also emerged in some cases when a hero appeared to be of great familiarity to one or more members of the group working on a story. Overall, it was observed that story evolution at different times and places (the kingdom of the desert, the kingdom of fire, the kingdom of the north, towns somewhere on earth, Lilliput Ocean, a mystic lab under the High Mountain) seemed to attract most pupils. However, for about 1/3 of the children the contemporary world was more attractive: they mentioned Silver the thief, Space cat, Cobra and Boa, villains who act after escape from jail, in cities such as Cowtown, a rural village where a close friend of James will give the necessary information if they help to catch the fox who is attacking the hens. Story endings were not always smooth; in half of the stories they came abruptly, for instance "*Steve with the three diamonds made a super weapon and became stronger.*"; "*Tom was also eaten by the dragon.*"; or "*Steve married Carmelita and they lived well and we lived better.*", and only 1/3 of the stories produced gave the perception of a better future and action to be continued. For instance *"Harry then told them to organize an event in the park where Justin and Shakira would sing and those who came to listen to the concert would help clean up as volunteers. Everyone went to the event and had a great time. 'We must not mess up the parks, they are a source of life'"*.

When listening to the stories in plenary, groups were observed to have fun and enjoy their creations. Additionally, they gave explanations for their choices, and supported these with comments from fellow pupils from other groups.

At the second stage of the process, where a story about public space was to be developed, some half of the stories were out of topic in the beginning, and educator guidance was required in order for thematic harmonization to improve. In this part, data collection worksheets were used and, when groups reached a satisfactory level of progress, they were asked by the educator to provide comments before proceeding to the next part. The satisfactory progress level, at this point, was mainly related to how far the story had been developed according to Propp's morphology, and not to the actual story contents, since some half of the groups encountered difficulty to understand the topic even though they had been pre-exposed to a questionnaire for knowledge about public space. The stories produced at this stage seemed like different versions of the stories developed at the previous one, having all the characteristics already mentioned. Public space, in the majority of them, was simply

referred to as a lateral concept, without actually being dealt with in the core part of the story. Still, in most of the stories funny moments could be identified that related to penalties for public space misuse. Moreover, compared with the previous stage, story productions were more successful in hero naming, and they presented improved fantasy and fun. For instance, the narrative pattern of a team changed from Stage 1: *"Cobra and Boa escape and sink into the shelter in a sea cave. Using magical remote controls for entering, they need to move a stone that blocks the entrance"* to Stage 2: *"The Sleepless guard at home was a giant! Who was Liliana Chioti. Like saying in other words, my blackened legs. After many hours of monitoring they discovered that it is made of iron and screws. They succeeded and took out three screws and then saw coming out a lot of blood that was wine…"*). Their characteristics, as well as the narrative scenarios, were more elegant and interesting, following an analysis similar to the one presented in Table 1. Still, overall story presentations could not yet be considered successful.

More precisely, stories focused mainly on the adventurous part that adopted fun and increased interest. They were rich in narrative scenes and well built according to Propp's morphology. They did not yet appear to be so well connected with public space matters but, in any case, they managed to set a problematic issue about public space that was related to urban parks and free urban spaces in general. Waste management and cleanliness (*"…down there was a huge swamp devastated by human rubbish… Bad Joe and his pigeon infected a public park in the town of Tzatziki"*), as well as corruption and deception, were related in the stories to the important role of the municipality Mayor (*"…The Mayor owed a lot of money to the state. That wasn't true but it was spread by the villain's assistant who presented himself to the inhabitants as a psychologist… The abduction of the mayor, leads to the desire of another mayor."*) The time and place were mostly imaginary, and narrative evolution looked as if heroes were wandering in digital spaces like those guiding the hero of a video game. Battle scenes were still similar to those of shooting and action games.

During this stage, the narrative patterns that were found to promote fun and story evolution were highlighted by the educator and confirmed by pupils in plenary sessions in order to be used as appropriate patterns at the final stage of collaborative story creation.

Some samples of such patterns are as follows, translating from Greek: hero abilities: "*This elf is as fast as the wind. He has laser eyes and listens to everything!*"; hope and disappointment: "*Mysterikos says it is a deserted ship! Everyone shouted together: We are saved. But this ship was driven by desert pirates and barbarians.*"; accident consequences: "*Tries the horizontal bar, falls down and a bump like the Eiffel tower appears on her head.*"; curse results: "*As he leaves, he sees an old woman and says: If you do not turn it over, a small reptile will appear and the city will be lost.*"; punishment verdict: "*The court decided that Jo-Jo had to clean up for forty years the elephant's impurities at the zoo, and so the city came to a proper maintenance.*"; and, among others, the very common pattern of transformation: "*Avgulah appeared dressed as a simple passerby.*"

The lack of a more diverse set of ideas around the subject of public space and urban parks was the most important finding from this second stage of the research effort. Still, the stories produced had over the course become good enough in terms of structure, fun elements and heroes' motives and emotions. In this respect, the third and final stage of the process aimed at keeping the successful story production elements, and improving the accommodation of problematic issues and reflection on public space in the collaborative story to be produced. The context chosen for this collaborative story was an urban park. This choice was supported by findings of an exercise in which pupils, when asked to argue about public space, revealed that they had more lived experience of urban parks than other public space types. Additionally, comparison of the narrative elements between the three different stories was aimed, on the one hand, at identifying and collecting narrative patterns that would be suitably transformed into digital game design patterns according to Propp's morphology and, on the other hand, at highlighting elements that would facilitate the introduction of educational objectives.

The final collaborative story that has been developed in the third stage is considered successful, as it managed to accommodate eighteen of the thirty-one functions of Propp's morphology and in that way offered rich thematic content, encompassing elements of fun that could be transformed in games. In addition, this story managed to integrate four out of the five areas of public space assessment that Varna's Star Model provides, and facilitated expansion for the fifth area (participation). This last area develops through the whole story, since the main characters are active and act for the solution to the problem that has arisen. Table 2 provides a correspondence that has been formulated between the public space assessment areas proposed by Varna's Star Model, elements from Propp's morphology that support integration of these areas within the story productions, and notions from the sustainable management agenda.

Varna Star Model **public space assessment concepts**	***Propp Morphology*** **elements supporting the main concepts and story connections**	***Sustainable management agenda***
ownership	who has it	economic, social & environmental factors sustainability status
physical configuration	how can I make it	
animation	feeling good participation	
control	how do I take care of it	
civility	politeness	

Table 2. Model for development of story parts, based on Propp's morphology, the Star Model (Varna, 2014) for public place assessment, and sustainable management concepts

In this respect, the final story that was produced comprises four topical parts based on Propp's morphology functions, and presents a thematic variety on topics according to Varna's model. Politeness constitutes a topic perceived throughout the story and also recurs as an open story part at the end, laying the ground for further extensions and additions for the Propp functions that were eventually not used. In that way, time and space were combined effectively as the story developed across time and space was the basis for games development. Table 3 presents the evolution of narrative patterns among stories, collaboration process and fun loci, whereas Table 4 gives an example of the way in which segments of a designed procedure were combined.

In particular, the final story

- has an interesting plot and allocation of actions between the heroes, is enacted by the children themselves as main heroes behaving like active citizens and strikes a satisfactory balance between real and the imaginary elements, in terms of structure;
- highlights human weaknesses and obsessions in a pleasant and funny way, and incorporates narrative patterns that evoke feelings of joy, in terms of emotions;
- contains symbolisms and references to topics that give rise to environmental issues, in terms of contents;
- places value on teamwork, collaboration and the struggle for achieving a goal, highlights change of behavior as a means through which everyone can help her/himself and society, and promotes volunteering and the view that participation and cooperation with institutions and organizations is feasible, in terms of values; and
- allows for expansion and additional discussion with pupils, and has structure and contents appropriate for being utilized as a narrative basis for development of digital games, in terms of dynamics.

a. Following the evolution of narrative patterns

Example 1

Story 1 element: *He pretends to be the butler and asks the rich man for a job. He hires him.*

Story 2 element: *Joe-Joe found the mayor, tricked him as he is considered to be a respectful citizen and took him to* ***the park*** *to show him his problem. Back in his office a pigeon hit him with a pan…*

Story 3 element: … *when they tried, they met the "firefighter", who is a crazy scientist who thinks there is oil in* ***the park*** *and wants to control it in every way.*

In the above transformed patterns of the villain, we examined the quality of words used, as well as the evolution of the patterns. Transformation to someone else has happened in three distinct points: via simple description, as a narrative-based result and as both in the final story.

Example 2

Story 1 element: *... find the beam weapon on a mountain. To get the light beam he has to beat him in a card game and he finally succeeds.*

Story 2 element: … *find the radius beam in the villa of Alexandros Millionaire or otherwise G.M. which means gases of millions and she asked him if he could take the gun and he replied that he would give it if he beat him in a Uno game. She managed and took the gun. Then we arrived at the park, triggered a light beam and became something of a miracle and all the rubbish that bad Joe was infecting me with disappeared.*

Story 3 element: *The mad scientist is furious, having seen them from cameras dressed as firefighters. He uses the gun with the ice-beam that freezes those who try to approach him and targets the Mayor. But before the first citizens can be frozen Natalia, who is hiding behind a garbage tank, throws banana peels and the crazy scientist stumbles and falls down before the ice-beam does something bad.*

On these transformed patterns of fight, we examined the combination of verbs and nouns and the meaning in the narrative pattern building, as well as the evolution of the pattern itself. Fight patterns generally followed usual fight motifs from cartoons and kids movies and, as in the example above, three different tactics: simple reference with fun elements; narrative-based result with further details to support fun; and increased complexity supporting a fudge factor and adopting an interesting solution for the final story.

b. Collaborative process

(data gathered from observation, questionnaires, action diary and focus groups)

Example 1

In the first story, the topic developed from a single-child proposal and silent agreement of the rest of the children, with little modification effort in each section.

The second story was mostly developed in the same way, but there were two or more alternatives for each topic, based on discussions about types of transformation, and the citizen, policeman, and municipality clerk figures.

In the third story, pluralism emerged more clearly, and more than two alternatives were discussed in each topic. Discussions included the firefighter, the policeman, the municipality clerk, the scientist, and features like crazy, greed, genius, madness, cruel, profit-oriented. The collaborative process engaged more than 70% of team members during its course, and all of them at the end, when the story finished.

Example 2

The collaborative process was quite similar to the above mentioned example, but in Example 2 the initial fight ideas had more than one contribution and they formed with more details with the contribution of all team members.

c. Content promoting fun

The Transformation-Covering topic evolved from an imaginary identity in the first story, to an identity with more realistic features supported with fun action in the second one, and finally to a dynamic identity with more capabilities in the final story.

The assessment of fun always followed the children's opinions.

Table 3. Evolution of narrative patterns along stories, the collaboration process and fun loci

The analysis of research data collected through the story production exercise shows that pupils considered participation important or very important for teamwork, with only two pupils noticing that they had a minor role in their groups. Naming of heroes and allocation of titles to story parts have been a major discussion topic, and a funny procedure for the majority of the groups. About two thirds of the pupils involved participated in more than one way in story creation by writing, adding ideas, modifying and guiding group work. The interest of the remaining pupils was focused only on parts of the procedure that were considered fun, like naming. Heroes' abilities had different meanings for the pupils; the majority of the pupils enjoyed the heroes' general presence, whereas some pupils noticed their funny names and the fun that they had in general. Two pupils considered the helper and one the villain hero as more interesting and, in a further exploration, they made a better effort in designing these heroes. The opportunity to collaborate was the most important part of the process for the majority of the pupils, whereas freedom in writing and the opportunity to hear others were also noted as important. Three pupils provided remarks on the plan for story creation. If they were to rewrite the story, a third of the pupils would try to adopt more funny things, with the rest of the pupils not mentioning the need for modifications, except for one pupil who wished a total change.

Pupils' opinions about the quality of story could be realized from a sample of their own phrases: "*Everyone was saying their opinion, the good ideas came in and we finally made something beautiful…*"; "*Everyone, we tried in some cases a lot to finish the story and we did it well…*"; "*In the last story we all did our best and the best result came out…*"; "*Of course there were disagreements, in some things, some may not have participated in giving ideas, but we all participate in the final result…*"; "*I really liked the final story because not only my group but all the groups worked together and parts from everyone came in and it became an incredible story!*".

It is worth noting at this point that in the feedback collected from the pupils, the quality of the outcome and the quality of the process seem intermingled. No feedback was collected mentioning a bad process but a good outcome, or vice versa. This, in our view, is an important testimony of the value that lies in the process of participation, which may be even more important than the value that lies in the results.

Similarly, it is also noteworthy that the following phrase depicts perhaps the single most important fact for the overall process: "*All the children without being ashamed gave ideas that suited their character*". This feedback reveals that groups worked to their maximum potential for the given school class context, while at the same time following the normal curriculum program. It was on this basis that fun and cultural elements were effectively incorporated into the story productions, even if some parts of the story contents are imperfect and could be improved in a second or third round.

When asked to recall the contents of all the stories produced, pupils focused on three elements: fun in general and specific funny scenes, names, and actions taken in order to solve problems. More detailed feedback was provided by a minority of pupils, and when asked to deliberate on the final story contents, pupils revealed a variety of funny scenes with high dispersion among their preferences. Furthermore, pupils agreed that (1) funny things and (2) their own personal touch were the best part of the story: "*I liked it was funny, we all put one of our personal elements, it was a nice story it was our story and I think we could not have done it otherwise*". Additionally, pupils explicitly referred to the procedure and pointed out that their ideas could be embedded without feeling any external pressure: "*I really liked the details we had put in and the way they were connected as well as the solutions we introduced*". Groups approached the subject matter concepts they worked on in order to understand some key features. Not all of them effectively formed advanced views about these concepts and arrived at being fully aware of the choices one makes and the resulting consequences, but a few of them did achieve this. Finally, for some pupils, it was very important to them that they liked the ending of the story, to the extent that otherwise they would have rejected the story. In

their own words: "*The end was important because it was good and nice and the bad scientist who was destroying the park became kind and friendly to others*".

As a result of this overall process, we arrived at a collaborative story about participatory management of an urban park which incorporated narrative patterns that can also be seen as digital game design patterns. Seeking the pupil's own opinions about the features that a story should have in order to serve for designing games, an exercise which was done by the educator, has revealed a spectrum of attitudes. Cooperation, fun, friendship and knowledge are noticed as important story features by the majority of pupils, whereas fantasy and story evolution are also noticed, but to a less important extent. Two pupils did not have a clear aspect on this issue. Finally, two pupils deemed that this process resulted in them missing their usual lesson, but they were satisfied to participate nevertheless.

FROM STORY NARRATIVE TO GAMEPLAY DESIGN

This section briefly reports on the design of digital mini-games, using the collaborative story that was developed above as a design basis. The design of mini-games was also performed in a participatory and collaborative manner, as described below.

The design of mini-games took place in hourly meetings once a week, with pupils again organized in groups and coming together in plenary discussions. The story produced, which formed the design basis, was separated into segments as indicated in Table 2 and, according to story building, each pupil group worked with one of those segments. The basic idea was simple and clear to all: each narrative segment of the story produced was now to be transformed into a mini-game (or a series of mini-games).

At the outset of this process, pupils were asked to recall scenes from their favorite digital games and present them as narrative parts. Thus, working in the opposite way, from games to narrative, they realized what they had to do with the part of the story they had at hand. This reverse exercise helped them discover what the game interpretation of a narrative part practically means, i.e. discover the fact that, in gameplay terms, using the possibilities one has in order to reach a goal and achieving this goal is done through a mission, in which the player will have to overcome various obstacles. This understanding helped to reveal a simple model of work for designing games that comprised goals, movements and rules. Based on this model, a large number of game parts were recorded. At plenary sessions, the best parts were connected with specific story parts, whereas the rest were kept in a repository as ideas which would possibly be used for other story parts.

When a considerable number of mini-games ideas had been established, the phase of game creation for mobile devices, using AppInventor as an engine, was launched. Each session in this phase had two parts, one for developing new games, and one for assessing the games developed, thus scheduling games assessment as a parallel process. Mini-games consisted of heroes, movements and action space without other elements. Visual representations of game elements were chosen by pupils following a simple majority rule on their preferences. The games assessment part was further structured in two rounds, the first one concerning games that had only interactive features, like casual games, and the second one concerning complete mini-games that corresponded to narrative segments from the story. The rule, here again, was simple and clear to all: if a mini-game obtained the acceptance of players at the first assessment round, then it would be developed and re-assessed in the second round; otherwise, it would be rejected.

Games assessment, in this exercise, is based on an adapted version of a questionnaire from the literature on playability. The original questionnaire was developed (Korhonen & Koivisto, 2006) for the assessment of digital games by experts, and focused on the gaming experience (gameplay) that is achieved through usability (Federoff, 2002; Isbister & Schaffer, 2008), in order to achieve fun.

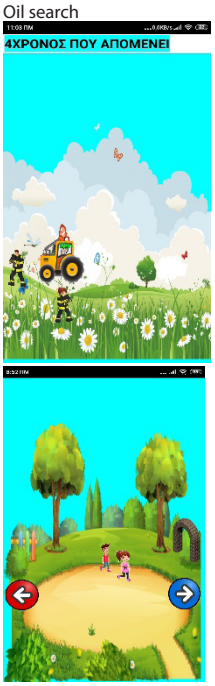
Varna's model topic: Ownership	Propp's model topic: The villain acts	Game representation	Fun elements	Sustainability issues
Who is the owner of public space Balance between the ideas of private and public	The firefighter is looking for oil under the ground of the park with the help of an electric car, so as not to make noise, hoping to get the space since the mayor said he couldn't fix it. In addition he intends to sell the space to a famous ship-owner. In order to be able to do this he calls and informs those who used the space before, children, the elderly, families, people with pets, shopkeepers, security guards, scavengers and tells them that he is going to rebuild the park and they have to leave in order to facilitate him. Some of them do not want to. The scavengers and the guards are looking for the mayor because they think that they will lose their job…	Oil search  Heroes illustration : boy and girl act together	Vehicle management Hunting oil well Game patterns used: collecting items, timer, vehicle management, avoidance, destroying objects	Human needs and Nature transformations
		Groups managing the place: ownership status 	Select groups of people Games patterns used: god game pattern (where players act as gods), management options pattern, avoidance-selection	Groups involved & sustainable strategy

Table 4. Example of using Varna's model elements in a Propp's model-based story, selecting fun elements for games creation and supporting sustainability concepts

Usability, and consequently playability, were identified as notions particularly pertinent to our own context, due to the fact that the mini-games were developed for low-end mobile devices, in which usability requirements are critical. To measure fun at the same time, we used the Fun Toolkit (Read & MacFarlane, 2006), which is a toolkit aimed at children established to assess the relationship between children and technological environment artifacts (Read, 2008). These research tools have been used both by the educator and by the pupils participating in the games assessment group. The data gathered focus on five aspects: a) problematic playability or usability characteristics, rated

from minor to important, and suggestions by the players for solutions; b) a general verdict about the game, selected from five levels from bad to perfect; c) locating the strongly fun points of game content; d) players' opinions about how they perceived game orientation from fun to sustainability matters, by thinking in terms of e) a positive or negative replayability statement. An analysis of the feedback collected through these research tools and through interaction with the assessment team has yielded a number of findings.

In terms of acceptance, the pupils showed a general acceptance of their game creations. This acceptance, however, varied significantly between different game parts. Comparing the three major game parts according to the reference line, namely physical configuration, control and ownership, the findings show a gradual reduction of playability elements. Fun elements were poorer in the ownership game part than in the other parts, specifically in the sense of lower variety / higher repetition in game patterns. This lack of fun elements is also due to the difficulty of the concepts that this game supports. Overall, playability reached up to 75%, depending on the game part. The difficulty in the concepts supported by each game was found to be a determining factor of the levels of fun experienced by the pupils with this game: it was less fun when the concepts supported were more difficult. This fact was found to mostly characterize the game creation group.

Concerning player guidance, games were initially developed with no instructions. Still, as it proved that instructions were important for a minority of pupils, in some cases they were added after assessment.

In terms of player engagement, some pupils tended to ask for a more commercial-like game environment, giving comments about speed of gameplay, movement choices for heroes and speed of response to each choice. Games were found to be boring for those pupils who did not play games at all, as well as for those who played only shooting games. At the same time, pupils who did not want to play again focused on the learning content and considered the fact that they were not dealing with real (sic) games.

Fun was shown to occur in two dimensions: firstly, as easy fun, in cases where there was no difficulty in interaction with the game content; and secondly, as fun related to the games' environment. All pupils described some game part with which they had fun and were satisfied. Still, when pupils were asked for non-fun game parts, it was easier for them to mention a part of a game that needed improvement rather than propose a solution for that part.

With regard to learning, playing the games led to the emergence of three groups of pupils: a group that decoded learning concepts correctly, independently of their representations; a group that interpreted these concepts solely focusing on their in-game visual representations; and one more group that approached these concepts in a middle mixed way. Still, in overall terms, correspondence of game design with learning content managed to involve pupils with subject matter issues and create a basis for further reflection. Gameplay also raised concerns about actions of volunteering, participation, solidarity and cooperation. Most pupils took into account such in-game actions aimed at sustainable management of the urban park. Moreover, a satisfactory number of pupils came to realize the interdependence of actions, as well as the range of possible outcomes in a public space system such as the park. Here again, three plus one distinct groups of pupils emerged: one group which promoted volunteering action for better functioning of the park; one group which prioritized working together for achieving sustainable results; a third group which focused on the belief that group members are able to take action to support park operations even if they are children; and a fourth smaller group of pupils who formed a synthesis of the above views.

Last but not least, with regard to interpretations, it was found that for a significant group of pupils, interpretation of the issues that games dealt with was driven by the visual representations of the game story. A critical number of students were found to focus on the games' visual representations,

playability elements and fun, rather than reflect on the whole game content. The part of the story recorded with the pupils' own voices, which was incorporated in the introductory part of gameplay, functioned as an attractive fun element leading to involvement with content in this respect.

That said, however, the game story seems to have created more steadfast perceptions with respect to sustainable management of the park for the game design group, as compared to the assessment group. For the design group, an ex-ante interpretation of issues about sustainable management of public space has been observed. This means that, according to research findings, some of the ideas initially embedded in the story were not transformed through the slightly or highly different educational goals embedded in mini-games. On the other hand, the assessment group has found it easier to deal with educational goals, as compared to the design group whose members had developed strong ties with their core story building ideas. This observation gives rise to one more important finding: the view that children are better equipped to make correct interpretations when they actively participate in cultural artifacts as designers, than when they are more passively involved as consumers, or even as evaluators. Especially the fact that the evaluation role was not shown to lead to more informed interpretations, and, in this respect, may be attributed to the possibility of considering evaluation more from the user (i.e., consumer) standpoint than from the designer one. Therefore, here again, the role of participation in *making* artifacts, rather than in consuming or evaluating them, is highlighted.

All-in-all, the transformation from the story produced to mini-games has been considered successful, even if there was a natural fatigue for both the game design and game assessment pupil groups from repetitive processes and accumulated effort. This exercise has finally created an interactive digital cultural artifact incorporating important parts of perceptions, ideas, fun patterns, story patterns as well as sustainability concerns that all together reflect the pupils' participation along multiple forms of involvement with the content. Furthermore, pupils from both groups, reflecting on the content while playing the games, stated their willingness to take action for caring about and managing an urban park along topics such as managing an urban kitchen garden; interviewing users and locating problematic uses of the park; acting voluntarily to support the park; managing a shop to support park maintenance; or over the course of some days, playing the game of changing roles with those who take care of the park.

Table 5 depicts the overall procedure that this research project has been developed along.

DISCUSSION

Having illustrated the overall process above, some crucial points can be highlighted. Firstly, fun patterns based on human weaknesses and obsessions, funny fight moments, use of vehicles, symbolic representations and competition have been observed.

Secondly, playability has mainly been based on story content, on the personalities of heroes like an engineer, a seller of wristwatches and women working for the park, and on the actions undertaken by these heroes. In particular, one of the core motivations for engagement with game content has been the way in which the main heroes (boy and girl) acted together to confront the villain, became separated, and then came back together. Pupils, in general, worked intensively on the heroes' characteristics.

Thirdly, the pupils' collaboration process had peak and hollow periods. At the early stages, pupils were motivated according to their personal interests, and some of them withdrew from the process when they felt that the content discussed would have to wait until the thematic story was created. The creation of the final story and mini-games gradually helped re-motivate pupils and this brought them back, fully engaged again. At the end, the common perception was that everyone had offered the best possible help despite circumstantial disagreements over the content, and

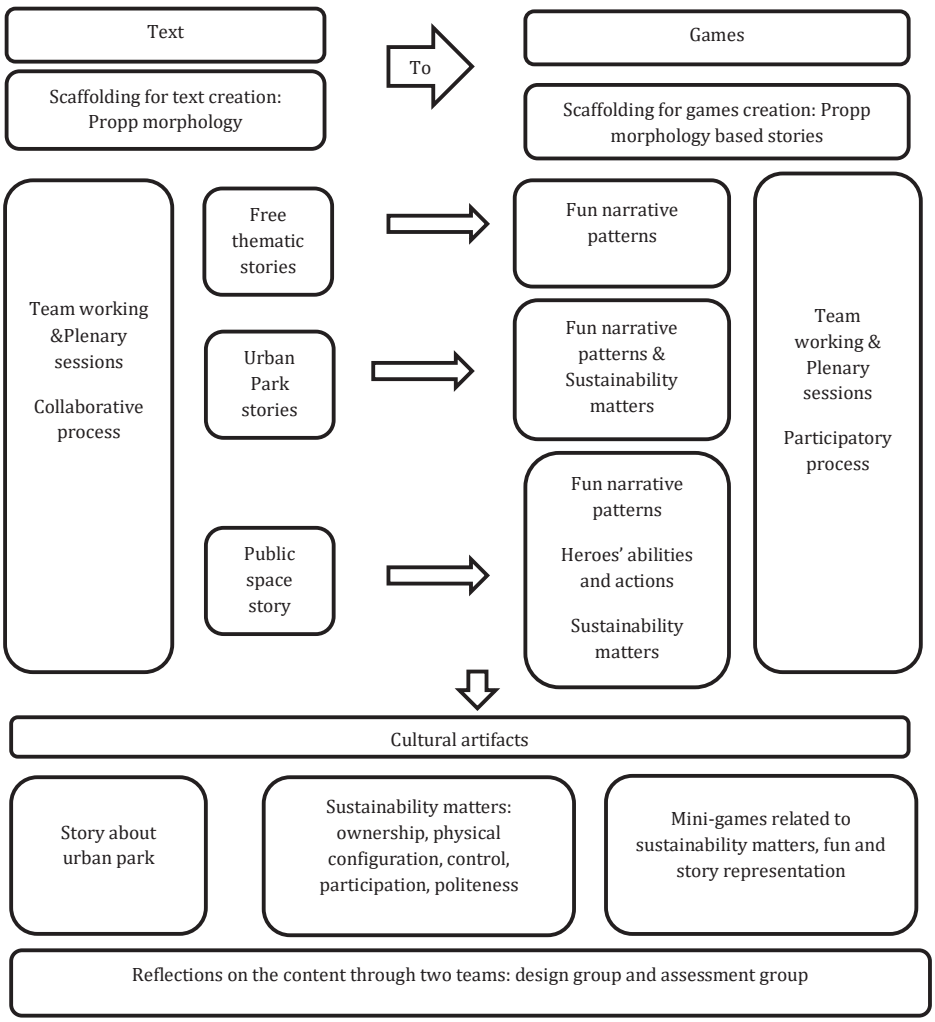


Table 5. Project development procedure

the opportunity for collaboration was considered as the major highlight of this project. It is worth mentioning that only one pupil expressed boredom.

As a fourth point, although learning outcomes appeared in the form of multi-dimensional achievements, they mostly converged on the important issue of sustainable management of a public park. There has been a significant shift of attitudes observed, from the initial general view that park management is connected to "faceless" public authorities or to some undefined "others", to the idea that groups connected with the use of a park should collaborate for a management to benefit all, while always keeping in mind the need to adopt the right sustainable policy. Moreover, pupils were observed to be aware of the fact that the field of authority that each group applies in a collectively managed park, as well as the number and diversity of groups involved, could change the sustainable management decision. In this line of thought, pupils came to realize that a democratic collaborative basis could best lead to desirable results.

As a last point, looking for potential metacognitive outcomes, it is to be noted that all pupils developed the belief that, based on the help of adults, children could play a role as active citizens. This has been testified by a large number of proposals for children volunteer actions to support sustainability and, beyond that, by pupils expressing their willingness to obtain a stronger, more autonomous role, like, for example, taking responsibility of park management for a day or a week.

CONCLUDING REMARKS

The research reported in this paper has been based on primary school pupils' capabilities to create a transmedia cultural artifact, i.e. a story transformed into mini-games, through a participatory process. In this exercise, emotional involvement of the pupils occurred in various ways: with narrative development, game design, game interaction, action initiatives and participation per se. Pupils proved able to create cultural artifacts related to contemporary issues and negotiate these artifacts with their peers. Involving pupils in story and game making as well as in story and game assessment revealed important issues for visual and content representations, as well as design, playability and fun matters from a child's perspective. The type of role, degree of involvement and previous experience of the children emerged as factors affecting how they develop attitudes and interaction patterns vis-à-vis the content.

Furthermore, the research reported brings forward a different way for which collaborative creation of narrative patterns can contribute to participatory development of educational mini-games. Taking into consideration the importance of narration for educational games content (Dickey, 2006; Huynh-Kim-Bang, Wisdom, & Labat, 2010; Kelle, Klemke, & Specht, 2011; Letonsaari, Selin, & Lampi, 2017; Masse et al., 2014), and the variety of methods and principles that have been introduced in the literature to combine narration and educational goals effectively, the approach reported in this paper introduces a continuous and peer-to-peer process for assessment of game content. Such a process allows the cultural artifact finally derived to obtain additional value, whereas at the same time it helps to validate interim design options. Moreover, such a process offers flexibility for adaptations, and accommodates proposals from the research corpus that already exists. Additionally, this process has been shown, in our case, to offer good support for sustainable development learning, by pushing pupils to apply critical thinking and make decisions based on results, thus avoiding the usual micro-behavior change outcomes which appear in many research efforts in this field. It is clear, however, that further research is needed in the domain of pupil-centered design processes.

With respect to research question RQ1 (What are the challenges of having primary school children collaborate in designing gameplay narrative for digital games?), the main challenges that the research reported has identified and tried to respond to have been 1) to have the story and mini-game creation process include all the different attitudes and perceptions of the children; 2) to provide opportunities for humor expression through narrative and game patterns; 3) to make the way in which learning content is introduced in formal education settings more engaging; 4) to expand pupils' creativity; 5) to enable pupils' democratic collaboration through sustainable decision-making; and 6) to involve pupils in technology, collective making, and the aesthetics of both.

With respect to research question RQ2 (How could this process and productions lead to learning for both children designers and for other primary school children involved?), the work reported has brought forward evidence that 1) mini-games as a cultural artifact, and mini-games with a narrative designed by primary school children, in particular, can positively affect subject matter learning processes and outcomes of both children designers and other primary school children involved as players; 2) the way in which and the degree to which game content may positively affect learning processes and outcomes depend significantly upon player involvement. This means that fun

patterns or narrative design patterns which have been shown to gather the highest levels of player involvement could allow pupils to navigate different parts of learning content and, possibly, more challenging parts of learning content; 3) for the majority of the children involved, a crucial level of the learning required to support children's participation and democratic collaboration was achieved as a lateral outcome of the research process.

In this respect, further research is necessary in order to shed light on peer-to-peer children-led participation tactics for creating narrative and game cultural artifacts that incorporate multiple aspects of our social and technological world, and on the ways in which such tactics and artifacts may affect children's interpretations of subject matter, and competencies for collective making.

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