

Serious Game Mechanics, Workshop on the Ludo-Pedagogical Mechanism

T. Lim¹(✉), S. Louchart¹, N. Suttie¹, J. Baalsrud Hauge², J. Earp³,
M. Ott³, S. Arnab⁴, D. Brown⁵, I.A. Stanescu⁶, F. Bellotti⁷,
and M. Carvalho⁷

¹ Heriot-Watt University, Riccarton, Edinburgh EH14 4AS, Scotland, UK
{t.lim, s.louchart, n.suttie}@hw.ac.uk

² Bremer Institut für Produktion und Logistik (BIBA), Bremen, Germany
baa@bib.uni-bremen.de

³ Consiglio Nazionale delle Ricerche (CNR), 16149 Genoa, Italy
{jeff, ott}@itd.cnr.it

⁴ Serious Games Institute, Coventry University, Coventry CV1 2TL, UK
s.arnab@coventry.ac.uk

⁵ Serious Games Interactive, 2100 Copenhagen, Denmark
djb@seriousgames.net

⁶ National Defence University “Carol I”, 50662 Bucharest, Romania
ioana.stanescu@adlnet.ro

⁷ University of Genoa, 16145 Genoa, Italy
{franz, Maira.Carvalho}@elios.unige.it

Abstract. Research in Serious Games (SG), as a whole, faces two main challenges in understanding the transition between the instructional design and actual game design implementation and documenting an evidence-based mapping of game design patterns onto relevant pedagogical patterns. From a practical perspective, this transition lacks methodology and requires a leap of faith from a prospective customer in the ability of a SG developer to deliver a game that will achieve the desired learning outcomes. A series of workshops were thus conducted to present and apply a preliminary exposition through a purpose-processing methodology to probe various SG design aspects, in particular how serious game design patterns map with pedagogical practices. The objective was to encourage dialogue and debate on core assumptions and emerging challenges to help develop robust methods and strategies to better SG design and its interconnectedness with pedagogy.

Keywords: Game mechanics · Learning mechanics · Ludo-pedagogy mapping · Pedagogically-driven game design · Patterns

1 Introduction

Serious Games (SGs) design is fundamentally different to Entertainment Games (EGs) design [1] and the impact of game-play design needs to be understood with regards to the pedagogical nature of SGs and their ability to facilitate learning. SGs and EGs arguably share the same medium of expression, in that they are developed using

common or similar technologies (Unity SDKs, Android Game APIs, etc.) and use common engagement processes and concepts in their designs (e.g. game mechanics, flow). As a result, it is often difficult to identify the role, place and space in which the key aspect of learning can or does take place besides the obvious specific learning content of SGs. Yet, learning has to be supported if it is to be implemented efficiently as common, well-known pedagogical practices and methodologies suggest [2]. In the case of SGs this could be achieved through the use of game mechanics (GMs), in the same way player engagement is structured in EGs.

The notion of Serious Games Mechanics (SGM) stems from findings on SG literature [3], workshops [4–6] and SG analysis. One important aspect of the work on SGMs, thus far, relates to the distinction between SGMs and GMs. One could rationally argue that there is no real difference between a GM used in a EG, and a similar or identical GM used in a SG, and negate the need for a distinction to be drawn. Conventionally agreed and recognised GM for EGs do not in most cases map onto education practices and do not offer a generally suitable fit for quick and efficient SG design solutions. GMs represent the tools through which educational content is implemented in SGs but their understanding in this context is limited and overdue. The SGM concept considers GMs within the specific context of learning and the acceptance that context determines whether or not a GM can be regarded as a SGM or not. The duality of GM/SGM is an important factor in determining the use of GMs in education as it recognises that the distinction is in essence contextual rather than the form. In this article, we identify SGMs as GMs expressed within the remit of educational purpose, learning process and educational content structure.

2 Bridging the Ludo-Pedagogical Design Knowledge Gap

Identifying SGMs is complex in the sense that it needs to overcome the two main challenges that stem from the transition between the instructional design and actual game design implementation and the insolvency in evidence mapping of Game Design Patterns onto relevant pedagogical patterns. These represent the main gaps in knowledge in Serious Game design from both academic and industrial perspectives (Fig. 1). From the discussions with a number of Serious Game designers it was clear that this transition lacks methodology and requires a leap of faith from a prospective customer in the ability of a SG developer to deliver a game that will achieve the desired learning outcomes.

Game mechanics are core components of any game design as it governs the dynamism of play and, in turn, influences the engagement of the learner-player. The general construction of game mechanics involves rules that control processes not only for interactivity but which also link other gaming mechanics into a system of systems. This poses a granularity problem as it can be all too easy to over generalise or get over analytical with regards to game genres, agenda or contexts. In order to avoid the risk of getting endlessly entangled in the attempt to characterise, structure and represent the whole GM spectrum in its entirety, it is evident that an alternative is required so as to provide deeper insights into serious game design patterns and instructional/pedagogy-driven design elements.

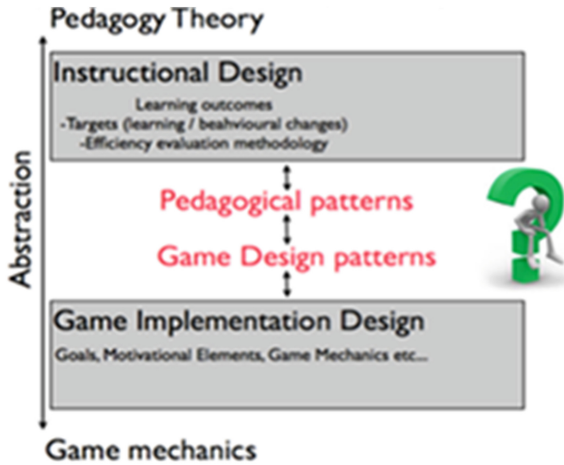


Fig. 1. Knowledge gap in serious game design.

2.1 Pedagogical Patterns

In a desire to bridge the gap identified above, workshop attendees proposed to investigate potential links between Pedagogical patterns and game design patterns so as to develop a “toolbox” for serious game designers in order to inform the process of game design from a pedagogical perspective without having to deal with the high-level theoretical background. Details of pedagogical patterns can be found at the following links [7–10].

Since these patterns are directly relevant to the practitioner one could presume that they are therefore organised in a way that should also be relevant to Serious Game developers. Pedagogical patterns (see Table 1) focus on a wide variety of pedagogical approaches such as active learning, feedback, experiential learning, perspective taking etc. From a Serious Game production perspective, it is crucial to understand how pedagogical patterns could be used to inform design decisions for Serious Game design.

2.2 Game Design Patterns

Past works [11–13] on Game Design Patterns could also be relevant to SGMs if it could be mapped out onto relevant pedagogical patterns. From a process perspective, the workshop attendants concluded that a potential approach towards identifying the missing link between instructional design (learning outcomes) and actual game implementation design could follow the process illustrated in Fig. 2.

These findings suggest that applying a process-oriented method to align educational and game design perspectives would provide a more definitive explanation of SGM. The solution presented in Table 1 imply that delving deeper into the nuances of educational game design patterns in conjunction with a learning mechanic and game mechanic (LM-GM) mapping framework [6] would be necessary.

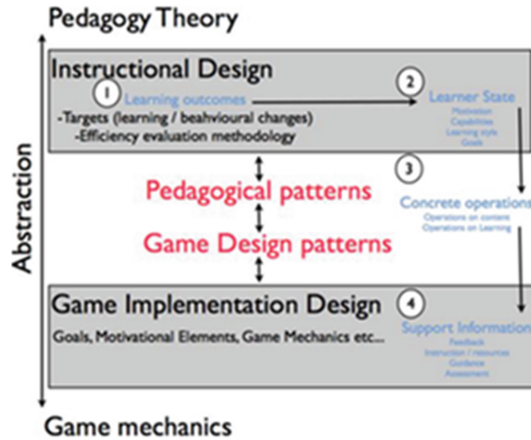


Fig. 2. Identifying the missing link between instructional design and game implementation design.

Table 1. Pedagogical pattern example

Source:	http://csis.pace.edu/~bergin/PedPat1.2.html#earlybird
Name:	Early Bird
Thumbnail	The course is organized so that the most important topics are taught first. Teach the most important material, the “big ideas,” first (and often). When this seems impossible, teach the most important material as early as possible.
Audience/context	This has very wide applicability to almost every domain. If design is more important than programming, then find a way to do design as early as you can. If functions are more important than if-statements in programming then do them first. If objects are more important than functions, then do them first.
Forces	Students need to see where they are headed. They need to see that detail presented early in the course will relate to important ideas. Students often remember best what they learn first. This can be both positive and negative, of course. Important (big) ideas can be introduced early, even if they can’t get complete treatment immediately.
Solution	A course is mined for its most important ideas. These ideas become the fundamental organizational principle of the course. The ideas and especially their relationships are introduced at the beginning of the course and are returned to repeatedly throughout the course. Order class topics in order of importance and find ways to teach the most important ideas early.
Discussions/ consequences implementation	The most important things in a course or curriculum receive more focus from the instructor and the students. Students can be made more aware of what is paramount.

(Continued)

Table 1. (Continued)

Source:	http://csis.pace.edu/~bergin/PedPat1.2.html#earlybird
	<p>Implementation is difficult. Often only simple aspects of an important idea can be introduced early. Sometimes it is enough to give important terms and general ideas. Some “big” ideas are thought of as advanced. It is difficult to introduce some of these early. Hard thought and preparation are needed in curricular design. Sometimes a really big, but difficult, concept can be introduced incompletely. Then as other material that relates to it is covered, the relationship to the big idea is carefully explored.</p> <p>Professors need to be able to analyse deeply what are the consequences of developing material in a particular order. It is often helpful here to have a forum in which ideas can be discussed and refined. It is also often necessary to develop your own materials, which requires time and effort.</p>
Special resources	Time and deep thought are clearly required. Discussion groups with other educators who share similar ideas about the most important concepts in a domain are very helpful.

3 The SGM Approach

Serious Games, like games in general represent a complex system of intertwined experiences influencing on one another so as to motivate a player not only to play and engage with a proposed experience, but also to express and reflect on a gaming activity during and after experiencing it. These activities correspond to various levels of GMs including motivational elements, competition, challenge which are all inter-related elements through which a gaming experience can be defined. Purposeful learning is in itself an aspect specific to Serious Games. The methodological approach towards identifying SGMs is to focus on the nature of Game Mechanics associated with the specific aspect of purposeful learning. All of these elements can be described in terms of Purpose, Process and Structure, in the sense that SGMs elements are designed for a reason and have a purpose with regards to a gaming and learning experience.

The element of competition for instance could be defined at an abstract level as a process into which a player is provided with a task (score goals, collect things), presented with a challenge (score more goal than an opponent, collect things in a defined period of time) and ultimately made to review his/her performance (leader board, final score results). From a structural perspective, there are many elements determining the actual nature of the challenge and specific GMs can be identified as clear patterns for defining competition. For instance, a player Vs player competition will require specific elements that are not necessarily present in other types of competitions related games. For instance a player vs player approach could be looking at mechanics related to a duel or a direct competition. A massively on-line multiplayer game will, however, implement different elements such as a leader board for instance. A leader board would serve no purpose in the player Vs player approach but would act as an essential mechanic in a multiplayer game. Finally each game or SG element has

to have a purpose bounding the actual gaming system framework and set of activities to the player experience. In the case of a player Vs player approach, the purpose would be to provide a safe competitive environment for friends to interact or a framework to support social connection (i.e. the concept of party games etc.).

SGMs are thus viewed as the relationship between pedagogical patterns and game design patterns. The process of investigating the links between the two lies between the instructional design requirements and the actual game/game-play design. This is not obvious and direct links between the low-level game implementation aspects and high-level instructional design aspects of SGs remain obscure.

A three-step approach termed purpose-processing methodology (PPSM) was devised to explore SG elements and specifically identify SGMs. The PPSM could then be used as a design tool or an evaluation tool for SG design.

4 The SGM Workshops

The SGM workshops constitute the main activity of the research on Serious Game Mechanics (SGMs) for the fourth and final year of the GALA EC project. A series of workshops were conducted at different venues to disseminate, collect and validate currently developing knowledge in the area of SGMs. The first workshop ran in the UK followed by first international workshop at GameDays 2014 (Darmstadt, April 1–4) then at GaLA Conference'14 (Bucharest, July 1–4). The next workshop was conducted at the Summer School for serious games (Pori, July 22–24) followed by the ACM meeting on Serious Games (November 3–7, 2014). The workshop was designed as follows:

1. *Introduction to Serious Games Mechanics and Pedagogy (SGMs)*

SGMs are seen as the relationship between pedagogical patterns and game design patterns (Suttie et al., 2012). The process of investigating the links between the two lies between the instructional design requirements and the actual game/game-play design. This is not obvious and direct links between the low-level game implementation aspects and high-level instructional design aspects of SGs remain obscure. This session will provide a definition of SGM and suggest a purpose-processing methodology (PPSM) to identify the link. This talk will also introduce the use of the PPSM towards identifying the role of narrative as a motivational and reflection tool in SG design. The PPSM could then be used as a design tool or an evaluation tool for SG design.

2. *Game Play Session*

During this session the participants will try out the presented methodological approach and framework. Participants will be divided in groups working with two different aims: (1) to analyse (and provide suggestions to improve) existing games; (2) to design new gameplays. All workshops will use with *Playing History – The Plague*, a serious games developed by Serious Games Interactive (SGI).

3. *SGM Card Game*

This activity is based on the board game “cards against humanity”. The intention is to encourage participants to be creative and analytic at the same time. This session is used

Game-Play		Learning		Statement	Statement
<p>1. Achievement</p> <p>Definition: A virtual or physical representation of having accomplished something. These are often viewed as rewards in and of themselves.</p> <p>Example: a badge, a level, a reward, points, really anything defined as a reward can be a reward.</p>	<p>2. Appointment Dynamic</p> <p>Definition: A dynamic in which to succeed, one must return at a predefined time to take some action. Appointment dynamics are often deeply related to interval based reward schedules or avoidance dynamics.</p> <p>Example: Café World and Farmville where if you return at a set time to do something you get something good, and if you don't something bad happens.</p>	<p>1. ACT</p> <p>Definition: Intervene, do something and reflect on the outcome (as opposed to being passive)</p> <p>Agent of the action:</p> <ul style="list-style-type: none"> • learner • environment • either of these 	<p>2. ADVANCE</p> <p>Definition: Undergo cycle of new learning, automatization, undoing automatization, and newly re-organized automatization</p> <p>Agent of the action:</p> <ul style="list-style-type: none"> • learner • environment • either of these 	<p>If I want to _____ I need to be able to _____ Otherwise all I can do is _____</p>	<p>I ask myself what opportunities are there _____ to _____ here.</p>

Fig. 3. Example SGM cards

as a basis to identify and formulate new SGMs and their required elements given a theme. Sample cards are shown in Fig. 3.

4. Reflection and Conclusion (Games and Pedagogy)

Based upon the result of the game play session, an expert panel will analyse, discuss and show how different aspects of the proposed methodological approach and framework can effectively support the design process, increasing the quality of the outcome and decreasing the time to market. The panel will also discuss typical challenges in the design process as well as challenges in finding the right SGMs for specific purposes. Participants were also asked to complete a Systems Usability Report, which is a self-report using a Likert-type scale of 0 (fully disagree) to 4 (fully agree) to rate the PPSM.

5 Outcomes, Challenges and Opportunities

The SGMs workshops were targeted to gain insights about the effects of game mechanics via the identification of SG specific mechanics for a pedagogical purpose. The activities were designed to reverse engineer SG development from the game design to the learning benefit provided through instructional design and to pro-actively identify and generate SGMs from the learning outcome from a game design perspective. Given the ambitious aims set for the workshops, a number of objectives were required to be met. Two of the key objectives are presented:

1. Positioning SGMs with regards to other SG design/analytical frameworks

One important aspect of the workshop is validating the PPSM against related State-Of-The-Art methodologies in this area. SGMs are a very specific aspect of SGs and therefore only a very limited range of applications and approaches are related to this work. Current work to establish pedagogical transmission factors vary in its diversity and mainly comprises:

- a. Specific adaptable learning approaches such as the case method in which one specific approach is modelled within a gaming environment for game design in a number of different topics (GenCSG - Generic Case Study Game [14])
- b. Classifications of games by design approach or game mechanics. Djaouti's [15] gamebrick classification is particularly useful in the context of SGMs as it relates to

the ludic elements present in SGs. It does not cover the purpose of the game mechanics despite describing it. However it is very relevant to the PPSM approach as it provided a bottom-up description of linking elements between learning and playing.

- c. Platform facilitating the design of simple SGs based on a limited set of design elements.
 - d. SGM design workshops in the vein of triadic game design. The aim was for participants to design SGMs as part of their SG design. The SGM card game was highly promising as a generative approach, although the SGMs generated may potentially be few due to them being limited to the design of one particular game.
2. Evaluating the efficiency of the Purpose, Process, Structure methodology (PPSM)

From the research perspective of SG design, it is difficult to relate to any other comparative practical contexts to gauge the usefulness and applicability of SGMs (both the pedagogy and the structure of game design). A number of SGMs have already been identified via a case study exercise during the workshop on the topic of narrative SGMs. This served as a benchmark for the understanding of SGMs and later validated at a generic level through the activities of workshop participants. SGMs are meant to be generic, thus these should be applicable in a number of different topics and fields. A direct comparison of SGMs oriented tool or exercise is still possible even though there is a no single tool that compounds the characteristics of SGMs. The workshop provided the opportunity for designers, developers, researchers and academics to express their expertise and domain knowledge on SGM-type analytics to identify a quantitative/qualitative comparison evaluation methodology.

6 Conclusion

The SGM workshop clearly indicated a need for a more common vocabulary on the relationships and associations of ludo-pedagogical mechanisms, in the anticipation of resolving some of the many dichotomies between game designers and educational/instructional designers. These are critical components that for the defragmentation process that can be currently observed in the SG field. Even more important, the current dichotomy between game design and pedagogical practices should be regarded as a serious obstacle in the uptake of SGs.

Developers and end-users revealed that having a pragmatic means to enable the formalisation and transition of SG methodologies to deliver aligned learning outcomes is clearly needed. While there are many methods/frameworks for SG design and implementation, there are very few that encapsulates the SG design process. SG researchers and professionals are yet to put forward a design methodology in which pedagogical purposes and the epistemic values of game structures to a learning procedure or process are both encompassed in a single homogeneous structure. The question of how to design and implement the internal game mechanisms to ensure learning is not simply a tangential outcome of an incentivised programme through gameplay and it is yet to be fully and comprehensively answered.

Independent assessments of the PPSM suggests it to be a pragmatic tool which can be used to untangle the overall dichotomy between pedagogy and game design in terms of practice-based patterns and specific Serious Games frameworks. PPSM could potentially identify which game mechanics can be used to encourage particular ways of learning to achieve specific kinds of pedagogical goals, also including assessment of curricular content knowledge or skill acquisition. Early work indicate that key narrative elements (narrative SGMs) that give consistency and meaning to SGs could be structured to be reusable and made interoperable. As a forefront for an SG design toolbox, the PPSM has shown to be a generic, yet systematic, means to establish game-pedagogy implications and potential benefits of associated pedagogical practices.

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