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Combining Business Process Models into Digital Games Design: A Literature Review

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Abstract. Digital games are used often in many areas as tools able to teach something. Also in business process management there are some proposals of training stakeholders and simulate process models from the use of digital games. In contrast of that (use games to support teaching and learning), this paper argues the opportunity of the use of process models into some moment of digital game design. Thus, this paper aims to show the results of a systematic mapping of the literature in order to seek and analyze researches about that. Beyond that, with the searches findings, check the context where the process models were applied. As conclusions, are presented some opportunities and a research agenda to business process and game design areas.

Keywords: Digital Game Design, Business Process Model, Systematic Literature Mapping.

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1 Introduction

Independently of the business nature, organizations need to perform a set of related activities to deliver products or services to their clients. These connected activities compose the organizational processes. In order to get competitive advantages and perform the processes more efficiently, organizations often seek to review and improve these processes, applying approaches such as Business Process Management (BPM) [DUMAS et al., 2013]. Public institutions, have also been held down to promote the improvement of their processes [BRAZIL, 2016a][BRAZIL, 2016b], and many of them have been adopting BPM technologies as an attempt to service innovation and to improve dialog with society [PFLANZL et al., 2016].

Dialog between citizen and public institutions is a challenging task, once public services aren't necessarily conceived to citizen interaction, and in most part, they are built without society participation, creating problems for their acceptance and comprehension [WINTERS et al., 2014]. There are many proposals to bring citizens closer to services through the use of technologies [CLASSE et al., 2017][CLASSE et al., 2016][CLASSE e ARAUJO, 2016], but process understanding by citizens is a challenge that needs to be overcomed, allowing society to have a positive experience when using services while being able to discuss and criticize them [ARAUJO e TAHER, 2014].

One attractive way of approaching citizens to processes can be through digital games, specifically by serious games, enabling citizens that play these games to understand how the services are internally performed, having a glimpse of their difficulties, particularities, and features [CLASSE et al., 2017]. Serious games have been used as learning tool in many areas, due to their immersion and teaching properties [SALEN e ZIMMERMAN, 2003]. According to BENNIS e BENHLIMA [2015], building serious games isn't a simple task. Each game has unique objectives and requirements which need to be balanced with recreational elements that go beyond traditional game design approaches found in the literature [THILLAINATHAN e LEIMEISTER, 2014][DE GLORIA et al., 2014]. When it comes to games based on processes, their design is even more singular, because they use a business process as the primal source.

This paper presents a literature review aiming to find and analyze research proposals that use process models in game design. As a result, few papers were observed, and opportunities of research on business process and game design areas are presented and discussed. The paper is organized as follows: Section 2, the background theoretical bases. Section 3, details of the literature review. Section 4, the analysis of review results. Section 5, opportunities for research and conclusions about this work.

2 Backgrounds

This section addresses the ground concepts of this research regarding digital games and process modeling. Moreover, is presented a view of the citizen's movement toward the public services processes.

2.1 Game Design

Digital games are computer systems based on rules, whose basic purpose is to solve conflicts in a virtual environment, supported by digital devices [SCHUYTEMA, 2007]. The literature on game design [SALEN e ZIMMERMAN, 2003][ADAMS e ROLLINGS,

2007] is often based on classical software engineering processes - conception, pre-production, prototyping, production, and assessment. According to SANTOS et al., [2012], as there are different kinds of software that need different ways of development, there are also different genres of digital games (adventure, action, sports, simulation) that need different design methods. Due to the lack of a consensus about how to do that, some methods gain visibility such as: SCHELL et al., [2009]'s proposal of building games supported by 4 pillars (Narratives, Mechanics, Aesthetics and Technology); the MDA framework [HUNICKE et al., 2004] that think games as Mechanics, Dynamics and Aesthetics; or even the MDA variation for serious games, the DPE framework [BRIAN, 2008], that focuses on Design, Play and Experience, via layers based on learning, narratives, gameplay and player experience.

2.2 Process Models

One of the most important steps of BPM is the process modeling, which is characterized by the representation and description of a process in terms of goals, actors, activities, flows, rules, resources, products etc [DUMAS et al., 2013]. There are many process modeling languages (BPMN, EPC, UML, etc.), besides their metamodels (BPDM, XPDL, etc.) [FAHLAND et al., 2009][OMG, 2017] that give meaning to process elements. In addition to modeling languages, a process can be described by documentation and narratives which provide details on how a process is performed.

2.3 Rapprochement of Citizens and Public Services Processes

The research and innovation group in Cyberdemocracy (CIBERDEM) of the Federal University of the State of Rio de Janeiro (UNIRIO) performs research related with government, electronic democracy and social participation as means of creating social changes in the public sector and organizations in general, looking forward to understand how to narrow the distance between citizens and public institutions, building solutions to improve it. One of CIBERDEM's research themes, "digital games to citizen participation in public services process delivery", looks forward to build methods, tools, and knowledge about how to systematically design games, bringing to the players (citizens) the particularities, features and challenges of these services (Figure 1). It is argued that process models provide elements to game design, for instance: considering the language BPMN, lanes originate characters and locations, process's activities are tasks, and so on. From this work, the need to perform a literature review rises, in order to seek research about how process models are being used combined with digital games design.

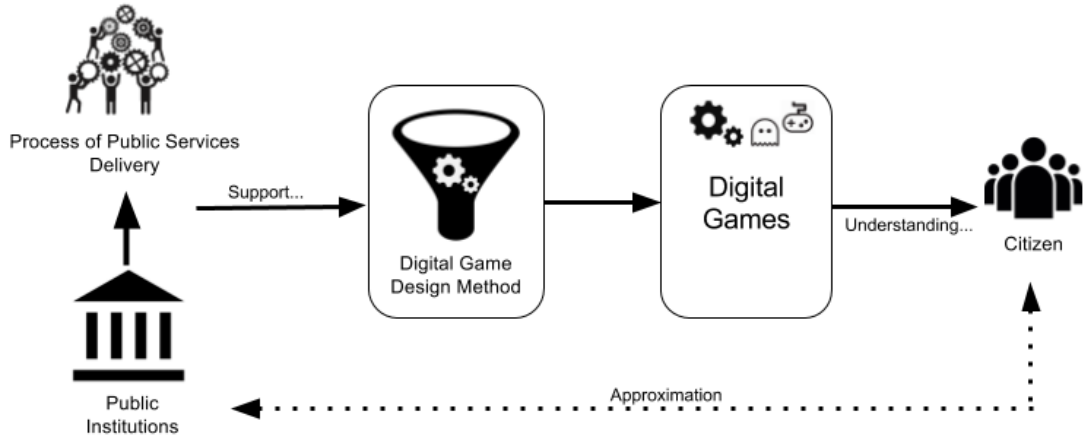

Figura 1. Digital Games based on Public Services Processes Delivery [CLASSE et al., 2017].

3 Literature Review Protocol

In 2015, [CLASSE e ARAUJO, 2015] performed a literature review in order to ascertain the existence of research that concurrently approach: digital democracy, business process management, and digital games (including gamification and serious games), but at the time, no research based on the three themes was found. This paper conducted a new literature review [PETERSEN et al., 2015] and its protocol is described as follows[1].

- **Context, Research Objectives and Restrictions**

The goal of this review can be described as: to identify and evaluate studies related with the use of process models combined to digital game design, from the researcher's point of view, in digital game design contexts. The research encompasses the period of years since 2007 (the first documentation about the language BPMN (BPMN v.1.0[2]) was published), and a literature review by Crookall was also made, establishing serious games as a research field from the creation of The Serious Games Institute Coventry University [WILKINSON, 2016].

- **Research Questions**

  - **RQ1:** Is there research that approaches the use of process models as a basis for digital game construction and design?
  - **RQ2:** What approaches, methods, techniques, and technologies involve the use of process models in digital game design?

- **Scientific Database Sources and Keywords**

The scientific databases used in this research were: ACM Digital Library, EI Compendex, IEEE Xplore, ISI Web of Science, SciElo, Science Direct, Scopus, Wiley & Sons, e Google Scholar (Portuguese). Google Scholar was used only for publications in Portuguese because the main Brazilian conferences have their papers indexed by it (we were concerned with Brazilian literature since the research being conducted is contextualized into Brazilian public services). The same wasn't done to publications in English, because Google's research engine doesn't allow field selection (title, abstract, for example), returning thousands of results that, when analyzed in samples, were seen to have no relation with this work.

To perform the searches, we used as keywords (also their variations and synonymous): "game design" (population) and "process model" (intervention). In each scientific database, specific research strings were used, due to their particularities. Furthermore, to portuguese language sources, a variations of research string for that language was applied.

- **Selection Criteria and Data Extraction**

The selection of works passed for two phases:

> **F1 - First Filter (Selection):** the first phase aimed to discard (exclusion criteria): i) duplicated papers; ii) papers written in languages apart from English or Portuguese; iii) publications prior to 2007; iv) publication's full text unavailable online; v) the keywords (or variations) aren't in the publication, other than sec-

[1] Parsif.al: https://parsif.al/

[2] Business Process Model and Notation Specification Version 1.0: http://www.omg.org/spec/BPMN/1.0

tions as keywords, acknowledgement, references, etc.; vi) the keyword context isn't related with game design.

F2 - Second Filter (Acceptance): the remaining papers from the previous filter passed through a complete reading. After that, the accepted papers were those that somehow used process models in the digital game design process (RQ1) while also following the criteria (exclusion): i) the publication doesn't refer to digital games; ii) the publication didn't associate process models and digital game design.

All information about abstract, goals, results, publication place, comments and decision (accept or reject - second filter) were extracted and judged from each scientific paper, and have been included as accepted work at Parsif.al.

4 Literature Review Execution

The review protocol was performed in 2017, between the last week of November and the first week of December, returning 168 papers, as seen in Table 1. The majority of these papers was in the Wiley & Sons database. The first filter (F1) removed a great part of the papers, mainly based on exclusion criteria like doubled papers (i), publication year (iii), and keywords context (vi). The remaining articles which passed through the first filter (F1) had their titles and abstracts read along with keywords search through the text, ascertaining if there was some sort of mention to digital game design and process models. We observed that only 18 (a little over 10%) of the papers left were considered suitable for the second filter (F2).

Tabela 1. Systematic Mapping Seeks and Filters Results.

Scientific Source	Found (Seek)	Removed (F1)	Included (F1)	Rejected (F2)	Accepted(F2)
ACM Digital Library	0	0	0	0	0
El Compendex	17	16	1	1	0
Google Scholar (Portuguese)	11	8	3	1	2
IEEE Digital Library	0	0	0	0	0
ISI Web of Science	7	2	5	4	0
SciElo	0	0	0	0	0
Science Direct	5	5	0	0	0
Scopus	22	20	2	1	1
Wiley & Sons	106	99	7	7	0
Total	**168**	**150**	**18**	**15**	**3**

Figure 2A shows the distribution of the 18 publications resulting from the first filter related to their scientific sources. It is possible to see once again that most of the papers are in Wiley & Sons (39%) and Web of Science (28%). However, from the 106 papers found in Wiley & Sons, just 7 (6,6%) were selected to the second filter, while from the 7 papers in Web Of Science, 5 (71,4%) followed to the second filter. The 18 papers underwent a complete reading in order to verify if RQ1 and RQ2 were answered. After the second filter analysis, only 3 papers (16,67%) were considered suitable (Figure 2B).

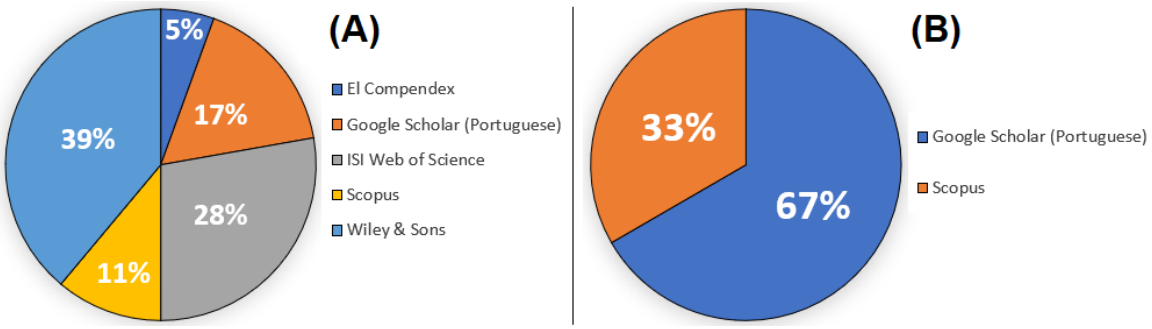

Figura 2. A) Papers Selected After the First Filter. **B)** Papers Selected After the Second Filter.

5 Results of Systematic Mapping

The research made by RODRIGUES e KRONIG [2010] proposes an approach of applying BPM concepts in the game development flow, where from that flow, it proposes to perform the modeling of the stages involved in game design with BPMN models. The author organized the game design in a model flow, unlike the research of [CLASSE et al., 2017] and [SOLÍS-MARTÍNEZ et al., 2015], that use process model as an effective part of the digital game design.

SOLÍS-MARTÍNEZ et al., [2015] proposed the VGPM notation (Video Game Process Modeling), which is based on BPMN patterns to define important features of the logic within games, and from that notation, it also suggests an approach on how to build such games. According to the authors, the process of digital games development is costly, and the game editors currently available in the market don't offer amongst their functionalities ways of building game cycle development. In addition, they also proposed the creation of tools capable of assisting in the modeling and generation of source code for mobile platform games.

In [CLASSE et al., 2017], it was performed an exploratory study about the digital game design based on public services processes. In general lines, from a real public service process model a digital game was built, allowing many insights as the possibility of systematization of this game type design through a proper method (game design method); and within that method, it was also perceived that the elements of the public service process model used could be converted to useful design game elements, and this could be supported by a proper tool system for the process-based game design.

6 Conclusions

From the literature review, 18 studies were selected for a detailed analysis, but only 3 were accepted albeit only one mapped a BPMN proposal of game design. The other two approached the use of process models to help and support game development (one of them is our own paper).

In this sense, the lack of literature about the use of process models combined with game design can point to a research opportunity both in BPM and digital games area. Studying how the process model elements can relate to elements of many game genres can contribute to the way these games are designed, and regarding the processes, it is possible to get opportunities and even suggestions on how to improve the public services processes, and how they can be modeled. However, there are several game gen-

res, each with its particularity, and to relate process models elements to each of them is a challenging task.

In public services processes, beyond representing the processes themselves, and how they are performed, it is necessary to understand why they exist and why they were created, as well as what values they transmit - human, institutional, personal. These values need to be present in the game, so the player can come to understand how the service is performed and its bottlenecks. Along with the design of these games, it is necessary to create assessment methods to evaluate them in the game quality settings, as well as in the comprehension of the process and the values therein.

In technological terms, opportunities arise for the construction of tools to support the design of games based on processes. Tools which, given a game genre, could suggest game design elements based on a business model, and also create, document and store game projects, as game design documents (GDD) for example.

As this paper is part of a large research about game design based on public services processes delivery, a research agenda to consider should be: i) the creation of a method to map process and game elements; ii) the performing of studies and evaluations of these reviews, including case studies, and possible game development from these studies iii) the hopeful construction of tools to support the review and the game design method; iv) the discovery of ways to find process values and transmit them through the games; v) the development of a game design method capable of systematizing the game design based on public services delivery processes; and vi) the creation of ways to evaluate these kinds of digital games.

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