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Towards a Design Process for Didactic Game Development: experiences and proposals of the Edumóvil project

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Abstract

Even though there are many kinds of software the development processes are mostly defined for general purpose. Didactic games have characteristics that distinguish them from other types of software and this is not reflected in the actual processes. Furthermore, no relevant development process for computer games is known. In this paper we present an initial proposal of a process for the development of didactic games and some experiences in the area that influenced our proposal.

1. Introduction

The time we invest in the generation of an *ad hoc* methodology or process for game design, and further didactic game design will not be wasted time. As in [1] we think that the value for researchers is to develop a canon of theories that can be referenced, and extended; the value for educators is to train students using a set of documented theories and techniques; the value for industry is to define an explicit set of design methods that can be used for training, management and tool creation, as well as for improving the design process itself. With this in mind, in this document we present a first approach of a process for the development of didactic games.

The following section presents the reasons for developing our proposal and some characteristics that we think have to be considered. Section 3 describes the Edumovil project, which was the motivation for this proposal. In section 4 we depict the development process. Finally, section 5 presents our conclusions and future work in this subject.

2. Background

There should be not doubt about the boom and increasing importance of game development. Game design, still in its relative infancy, has not yet produced theories to explain and direct creative process [1]. The process of game design is still implicit in the minds of game designers. This situation adds an extra complexity if didactic games need to be considered.

The field of software engineering is still in an empirical phase. For instance, it was just a few years ago that experts in the area worked together to create a guide to the software engineering body of knowledge (SWEBOK) [2] and a set of recommendations in software engineering for undergraduate education [3]. In this context, software development processes are still in a very early stage of maturity. Development processes are still too general and, even though a level of customization is considered by some of them, this customization is usually focused on the size of the project. To be fair, there is also the possibility of adapting the process, adding or taking away artifacts of the process if, according to the experience of the development team, these artifacts are not relevant for the project. Even so, there are no considerations to adjust the process in correspondence with the type of software to develop. With the exception of the processes that include elements to represent features of the business model in the design of software [4, 5].

Initially we have consulted information we have at hand and although we know we have to do a more exhaustive reviewing, this section presents some initial considerations, proposals, and process we have found interesting in relation to the task we have been doing.

2.1. The usability aspect

Brinck et al. [6] mention a design process called the pervasive usability process: In Figure 1, evaluation is shown below to indicate that similar types of evaluation can occur at different stages of design. In this process evaluation helps to ensure that design is on track to satisfy the goals of the design, and include usability evaluation, client review, quality assurance or technical feasibility evaluation among others.

Evaluation is in fact part of what makes usability pervasive, and we think evaluation is indeed the basic principle in which development should be based, and will be a key element to be considered.

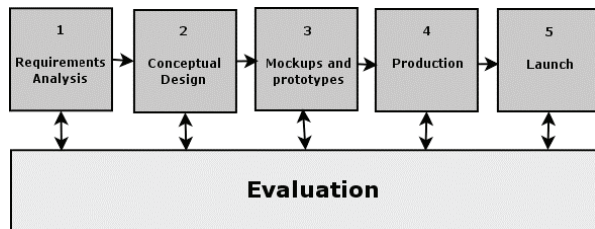


Figure 1. The pervasive usability process [6]

From our perspective, the pervasive usability process is an improvement of the waterfall process; however, there are tasks that should be considered and included as well, as conceptual design, mockups and prototypes generation, and permanent evaluation.

From usability point of view videogames are not a typical software application because they are often designed to elicit a negative emotional response, such as frustration or fear, the antithesis of usability [7]; however, a didactic game should be designed to accomplish the opposite emotional responses.

In [7] the authors argue that game design typically involves four distinct stages: concept development, pre-production, production and post production. These stages have some similarities with traditional waterfall process, but they are *ad hoc* with the User Centered Design process. Some of these ideas will be considered as well.

2.2. The game development process

The game development process mentioned by Collins [8] consists of several stages. The problem here is that there is not a game development process; instead, the author just says that game development is like any form of software engineering (Although in [7] the authors argue that this is not true), describes the design document, some development hints and some testing considerations, that is all.

Perhaps the most interesting thing in proposal presented by Collins is the design document section, and we incorporate these ideas with our own perspectives and experiences in our approach.

In [9] the author describes the Game Waterfall Process and the Game Unified Process based on his own experience in game development and management.

In the Game Waterfall Process the author identifies ten larger categories:

- Conception
- Game specification
- Art bible / story bible
- Technical specifications
- Construction
- QA system test
- Play testing
- Alpha testing
- Beta testing
- Golden master or final release

Each category is described and discussed based on the experiences of the group managed by the author.

The Game Unified Process is indeed a mixture between the waterfall process, the Rational Unified Process [10] and agile software development [11]. Some of these ideas will be also considered in our proposal.

Although these two proposals argue interesting elements, their weakness is lack of formality. Wider evaluation is needed in order to conform a more formal, suitable and robust process which is our overall short term objective.

In [12, 13] the authors describe the application of a methodology for game genre and player experience innovation called player-centred design. This process is probably the most formal and it is also based on the user-centered design process (UCD) [14] and proposed by the *Games User Research group at Microsoft*. This process first stresses understanding the fundamentals of how games work on multiple levels. Games are formal systems of rules that define and restrict player actions: objectives, procedures, mechanics, etc. In addition, games are also emotional experiences that challenge players to achieve their goals. These considerations are quite interesting and should be considered in game design as further information.

2.3. The development process for educational software

Educational software may use a direct approach showing the information from the subject wanted to teach in an interactive and multimedia style, or the software may employ a different approach, via

videogames to teach the user in the style of “learning as you play”. The first approach is commonly used for education in formal environments and usually with mature students such as, for example, virtual universities implementing distance learning using the Internet [15]. The latter approach is used normally with children in order to create a diversion from the original aim of learning.

As far as we know, there is no formal process considering the production of didactic games.

3. The Edumóvil project

The Edumóvil project intends to be a didactic alternative for basic education in México, in order to enforce traditional teaching and not to be a substitute of traditional teaching [16, 17]. The Edumóvil principal goal is to incorporate mobile information technology into the class room for the improvement of individual and collaborative learning. In its first stage, Edumóvil has been developing in PDA's [18].

Initially, Edumóvil considered the identification of key areas where children have learning difficulties or problems. These problematic key areas are the cornerstone of Edumóvil, and the basic education teacher plays a fundamental rule in their identification.

Once problematic key areas have been identified, the proposal of Edumóvil is the development of games running on mobile devices to complement and improve individual and/or collaborative learning.

Currently there are three finished games:

1. “Observa y Aprende (Watch and Learn)” [19] (Mathematics)
2. “¿Quién se come a quién? (Who eats whom?)” [20] (Natural Sciences)
3. “Leo (Text viewer)” [21] (Spanish).

Additionally, there are currently four didactic games under development, and there is expected to be more in the following months. Table 1 resumes the current state of the Edumóvil project.

Recently, Motorola Foundation has given a donation of \$35,000 USD for the Edumóvil Academic Initiative project. This brings to the Edumóvil project the possibility of acquiring PDA's, mobile phones, equipment, and some items needed for developing and testing, as well as some furniture for the creation of the kid's club. This club intends to be a place where the child feels comfortable and it will be similar to the child's traditional class room in their elementary school.

Table 1. Didactic games and their classification by subject and grade [16]

Subject / Grade	1	2	3	4	5	6
Spanish			Leo (Text viewer) ^{1A}			
Mathematics	WL ^{1A}	Count _{1B}			TR _{1B}	Count _{1B}
Natural Sciences			Who eats whom? ^{2A}			
History			Timelines ^{2B}			

¹ Standalone application

^A Finished

² Collaborative application

^B Under development

WL: Watch and Learn, TR: The relationships (Names of the Games)

As an additional aspect, mobile phones are a short term objective for the next stage of the Edumóvil project, and at the moment there are not results at all.

4. Learning as you play

In this section we present our considerations towards a design process for didactic game development. In essence, we describe the roles identified, the structure of the design document and the general process.

4.1. The identified roles

First of all we would like to say that, in our experience, a didactic game development should be an interdisciplinary task, and the development staff should be formed accordingly.

For the didactic games developed the following roles have been identified:

- User
- Graphic designer / artist
- Programmer
- Observer (for testing)
- Expert in the field (e.g., teacher)
- UML advisor
- Usability advisor
- Wireless communication and networking advisor

Each role realizes the activities with which it is most familiar, and leads specific tasks in the development process.

4.2. The design document

A good design document could be one of the most helpful tools for any game developer, because it helps to develop a solid idea on which the game could be based.

This section shows our proposal about design document. The design document should contain at least the following:

- **General Overview:** this section should cover the game story line, the main characters, time-line and staff required (designers, developers, etc.)
- **Screen and user interface:** this section should cover menus, GUI's mockups and prototypes, icons, etc.
- **Storyboard specification:** this section should specify artwork, scenes, events, character moves and so on.
- **Technical specification:** in this section developer(s) should specify how the game is going to run. Use case, activity, interaction and state diagrams (at least) are highly recommended.
- **Testing specification:** this section should specify group sessions to demonstrate the play and the didactic characteristics of the game, as well as usability and validation & verification techniques that will be used for play testing.
- **Politics of use:** this section should include how the didactic game can be used as well as copyright and a disclaimer.

This document should be reviewed and analyzed in order to improve it. All updates and corrections should be documented in new document versions, and additional to software components repository, progressively build the Edumóvil's base of knowledge.

4.3. The process

Despite some differences, essentially all the process discussed in section 2 follow a similar process, including our proposal: the iterative process. Figure 2 illustrates as activities the phases involved in the overall process.

Actually, the response of new techniques such as agile proposals, Rational Unified Process, and other hybrid process was in order to address the waterfall process's problems. Although there are differences between these approaches, they all have essentially the same theme. They all recognize that the software development process is iterative and not linear, and as a consequence our proposal assumes the same considerations, because in a didactic game the creative feedback loop is an excellent example of the need for frequent collaboration and iteration. In fact, a good iterative solution is the Fountain Lifecycle, proposed by Henderson-Sellers and Edwards [22] and used, for

instance, in the Discovery Method [23, 24], which is an object-oriented process for developing medium-sized applications. The Fountain Lifecycle is defined as incremental, iterative and parallel, where each activity of the process is being developed and delivered incrementally and, if errors are detected or changes requested, it is possible to go back to the activities to update them.

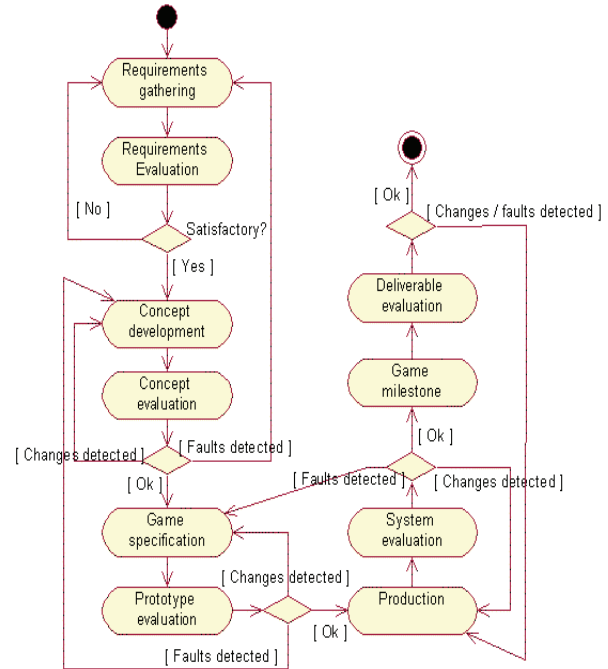


Figure 2. Activities for the didactic game process

Figure 3 shows the phases of Figure 2 in more detail. Logically, these activities are in a close relationship with the contents of the design document.

The evaluation sessions should occur a number of times during the testing cycle and be pervasive during the whole process, in order get quality assurance from the initial stage until the end of the process.

Additionally to these aspects, we try to adopt the ideology mentioned in [25] about player-centred design instead of user-centered design. Player-centred design is design and technology at the service of the player experience. In this context the game designer creates the rules of playing, based on the key areas where children have learning difficulties or problems in order to improve learning, which is indeed the cornerstone of Edumóvil and our proposal.

Finally, the current set of activities grouped by phase is listed as follows:

- Requirements gathering
 - Analyzing and understanding learning difficulties

- Analyzing and understanding collected data
- Defining non functional requirements
- Defining/reviewing schedule
- Evaluation: formal validation of functional requirements

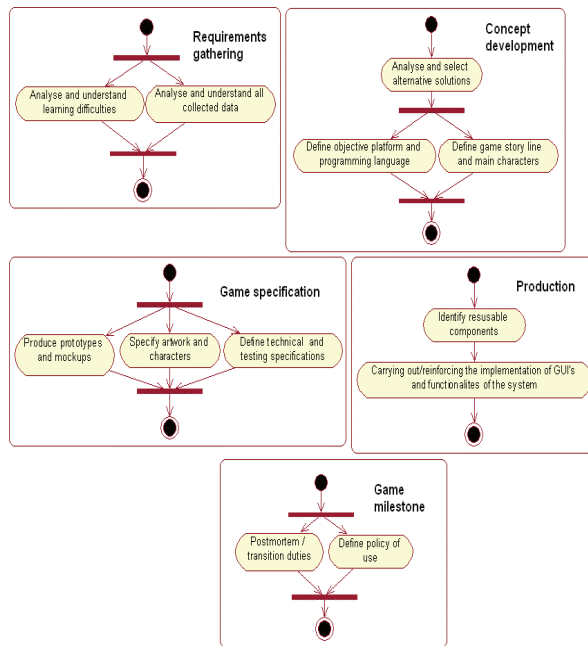


Figure 3. Some sub activities already identified

- Concept development
 - Analyzing and selecting alternative solutions
 - Defining game's storyline and main characters
 - Identifying didactic goals
- Game specification
 - Producing prototypes and mockups
 - Specifying artwork and characters
 - Defining technical and testing specifications
 - Defining didactic metrics
 - Defining navigation diagram
 - Defining some estimation: function points
 - Evaluation: Wizard of Oz test
- Production
 - Identifying reusable components
 - Implementing/improving GUI's and game functionalities
 - Evaluation: unit, integration and usability testing
 - Configuration management duties
- Game milestone

- (Re)Defining policy of use
- Updating knowledge repository
- Transition duties

5. Conclusions and future work

The development processes are mostly defined for general purpose without consideration of the type of software which is being developed. The didactic games have characteristics that distinguish them from other types of software and this is not reflected in the actual processes. Furthermore, no formal development process for computer games has been found. In this paper we presented an initial propose of a process for the development of didactic games and some experiences in the area that influenced our proposal.

Our process is going to be used and tested in further developments. The intention is to recognize new activities and refine the already identified tasks as well. Activities related with the different stages of evaluation will also have to be identified, and because our process has pervasive evaluation as the cornerstone, the identification and further specifications of these activities are the shortest term objectives of our investigation at this time.

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