

# Production and Post-Production Phases of the Game SCRUM for the Development of an Adapted Sports Digital Game

Guilherme B. Domingos\*    André Luiz Brandão †    Alexandre G. Szykman ‡    João Paulo Gois§

Federal University of ABC, Center of Mathematics, Computing and Cognition, Brazil

## ABSTRACT

The Agile Methods can be seen as a set of procedures and routines for software development. In particular, Game Scrum is an Agile Method based on iterative and incremental cycles for managing the game development. In this study, we report our experiences with a two-year game development in the academic environment of adapted sports as well as their athletes. In the second year of the project, we employ Game Scrum tools, fitted to the undergraduate students' routine, to the production and post-production of the game. We show how Game Scrum was a benefit to our project, allowing us to achieve not only the goals of our approach but also some future works.

**Keywords:** Scrum, adapted sports, serious games, participatory design

## 1 INTRODUCTION

Game Scrum, an Agile Method, is currently the most popular Software Engineering framework to manage the development of digital games [9]. Despite its success for the development of digital games, Agile Methods are not usually applied in long-term academic projects that require multidisciplinary teams, although Agile methods for software development was reported in academia for short term projects [10].

In our experience when we refer to undergraduate courses, specifically in Computer Science, the focus is often on the development of individual projects. Team projects, in general, are executed, and limited, to the scope of the disciplines, which comprise short term periods, restricted to a few weeks or a few months.

Pathak and Pal provide an environment in universities and colleges where students and teachers could follow the agile methodology for the development of the small software project [10]. They present a study case to justify the success of agile development in software project development at the academic level. The authors conducted the study to verify if the identified practices could increase the efficiency of the project development work for academic small projects. On the other hand, multidisciplinary long-term projects, as for the production of digital games, involve the knowledge of different areas, such as sound, design, modeling, and programmers.

The contribution of this study is the report of our experiences with the use of the Production and Post-Production Phases of the Game SCRUM in the development of a game about adapted sports and their athletes. Our development team was mainly undergraduate students from the Computer Science Program. We also show how we fit the specificities of Game SCRUM to the undergraduate students' routine.

\*e-mail: guilherme.begotti@aluno.ufabc.edu.br

†e-mail: brandao@daad-alumni.de

‡e-mail: alexandre.szykman@aluno.ufabc.edu.br

§e-mail: joao.gois@ufabc.edu.br

Our proposal indicates that not only the targets of the project were achieved but also some future goals were also accomplished.

The use of the Game SCRUM method was applied in the development of the *ParaJecripe Game* [1]. The *ParaJecripe Game* is a digital game about adapted sports, encompassing three modalities: athletics, swimming, and tennis. All the characters in the game are real athletes who support the project.

It is worth to mention that, the Public Brazilian universities have goals in the tripod based on Teaching, Research, and Outreach. Teaching comprises the courses inside graduate and undergraduate programs. Research is supervisions of graduate and undergraduate students to run research projects. Finally, Outreach is composed by initiatives that overcome the university's borders. The *ParaJecripe* project was run in the context of an Outreach Project of a Brazilian public university. The game was developed in a long term period so it was necessary to apply Software Engineering methods to not only to develop the application, but also to make it robust and prepare to future extensions.

The benefits of Game SCRUM in the academic routine and the results presented in our study show that there is an important field to be explored in the development of multidisciplinary academic projects.

This paper is organized as follows: In Section 2, we overview concepts related to Game SCRUM, including each phase that compose this Agile method. We describe the first year of the *ParaJecripe* game development in Section 3. Section 4, include the characteristics of our context and some features that we considered to run our project. Section 5 we describe how we applied the Game SCRUM method in the development of the *ParaJecripe* game. The digital game that we developed is described in Section 6. We discuss some lessons learned in the development of our game in Section 7. Finally, conclusions and future studies are discussed in Section 8.

## 2 GAME SCRUM

From the 2000's until 2017, a considerable number of game developers turned to the dynamic software development approaches, which we refer in this study as the *Agile Methods*.

The Agile Software development methods rely on iterative and incremental steps. In each iteration, developers must deliver an improved version of the program [2, 9, 12]. Agile is tailored to the developers focus on features that improve the value of their products for consumers instead of applying efforts among all the software features. In our case, the software that we work with is a digital game of adapted sports and their athletes.

It is very usual in the game industry short deadlines. In this sense, the knowledge of which features have to be prioritized has proven to be essential to developers [2, 9, 12]. Two popular Agile approaches for game development are the *Extreme Game Development* and the *Game Scrum*.

Extreme Game Development focuses mainly on the programmers' workflow, whereas Game SCRUM provides guidelines for many roles in the development. Due to games development often require multidisciplinary teams, Game SCRUM has been the most used Agile framework for this purpose [9].

Game SCRUM aims to improve incrementally the value of the product based on knowledge of previous experiences. The *development timeline* in Game SCRUM is divided into the *Sprints*, which last from two to four weeks. It is mandatory that each Sprint starts and finishes with meetings. The starting Sprint is to plan tasks, in which the ending Sprint aims to review the team's efficiency. The knowledge acquired from the efficiency review is used to program tasks that possibly yield better results in the next Sprint. Those meetings take from half to one work day. Similarly, there are shorter, daily meetings in which teams discuss next daily tasks and review the efficiency of the previous day. Those meetings are often time-stamped to fifteen minutes [9].

In Game SCRUM, multidisciplinary teams work on functional and independent slices of the game. An example of a vertical slice is a completely developed stage of a game, containing all the necessary features for conducting gameplay. Examples of game features can be character mechanics, environmental art, and physics [9]. Usually, each team contains from seven to nine people, composed of technical developers, one *product owner*, and one *SCRUM Master*. The main role of the product owner is to conduct discussions among developers and take decisions in case of conflicts. The role of the SCRUM Master is to guarantee that the team follows the best practices suggested by the Game SCRUM framework. The group of technical developers is often formed by programmers, artists, and game designers.

Game SCRUM can be divided into four phases: Concept, Pre-Production, Production, and Post-Production. In the Concept, the team drafts the main elements to guide the development of the game. The team uses those elements in the development of preliminary prototypes in the Pre-Production Stage, which is refined in the Production phase. In the Post-Production stage, the team performs several tests to assure the quality of the game. In the following, Game SCRUM is most important to developers mainly during the Concept and Pre-Production phases. Those phases allow developers to highlight features that make the game, during the development, valuable or entertaining. Along the development timeline, the Game SCRUM phases can overlap each other. As an example, the team mainly perform Concept tasks during the Concept phase. However, the team can refine those tasks during the Pre-Production or Production phases [9].

The Concept phase involves a brainstorm between the development team and stakeholders. The brainstorm results in a set of structured sentences that taking into consideration the users' needs. Those sentences are denominated User Stories. With the Users Stories, the team can preview features that add value to the game that is under development, increasing either players' experience or developers' workflow. The development team prioritizes User Stories by estimating their value. After the prioritization process, the stories are converted into tasks for the development. The team store the tasks in a product backlog distribute them into the Sprints according to their prioritization level. As a consequence, the team performs the most important tasks in earlier Sprints [9].

The development team attributes weights to the stories according to the estimation of how much time will be necessary to finalize each of them. Keith [9] suggests that the attribution of weight follows the Fibonacci Sequence, *i.e.* a user story can be weighted as 1, 2, 3, 5, 8 and so on. Those weights are converted into work hours. Sprints are filled with user stories according to how much work hours the team can accomplish. The speed of the development is measured by a Burn Down Chart of how many stories are implemented by a work day. The number of work hours that a task contains is usually composed of the number of hours that the team works on the project times its efficiency coefficient. Usually, the efficiency coefficient for mature teams is around 0.5. In the Sprint Review Meeting, the team revises the Burn Down Chart and decides if the next Sprint should have more or fewer user stories to be implemented [9].

### 3 FIRST YEAR: CONCEPT AND PRE-PRODUCTION OF THE PARAJECRIPE DEVELOPMENT

In its conception, the development team of the ParaJecripe game was composed by six students of the Computer Science undergraduate course, where five was senior students and one was freshman. These students were selected to be part of the project by a professor, who was the coordinator of the project. The selection was run through a six months study group related to the development of independent serious games in the academic context. The students not only learned about game development and software engineering, but also investigate games with relevant social contributions [8].

The project started, and in the first months, all the group's efforts turned to learning about adapted sports, discovering how the topic could be approached in the game and how information would be presented in a playful way. Also, the team was looking at some game development methodologies. New students were included into the project where they added more knowledge about artistic and technical aspects of digital games. Those new students were from Game Design program from an outside university.

Simultaneously, the team had effective contact with people with special needs, from using a wheelchair to sharing stories about difficulties and overcoming. The team had also been very familiar with the life-style and routine of both high-performance Brazilian and amateurs athletes of various adapted sports categories.

After several immersions, research and discussion, the group condensed all the ideas into an interface document and a flowchart of screens. The flowchart can be seen in Figure 1. A navigable prototype was then sequenced, but with no methodological support from software engineering specification processes and coding standardization, which eventually became the basis for project programming and production.

Figure 2 illustrates the prototype's first menu, with basic buttons and interactions. In this window, one can observe that the colors as well as the buttons that we used were very basic just to illustrate the appearance of this menu.

The students experienced how game design processes worked and the whole group was divided in specialized teams. In that way, the tasks of programming, modeling, texturing, animation and content production were done concomitantly. At the end of the first year, the game was functional with modalities and other functionalities implemented and some graphic elements already established. Figure 3 shows how was the appearance of the athletics mini-game prototype. In the current prototype for instance, the guide of the blind runner was not included. The user interaction tests were under development.

The first year of the project was then finalized. As a result, there was a functional version of the game however, there were bugs that happened with the interactions of three-dimensional objects. There was still no standardization, both in programming code and in graphic items. The user experience still did not consider difficulties that could exist for navigation and in-game control.

Because there were several things to improve in the game and we had one more year to finalize our application, we decided to use a Software Engineering method to continue to develop the ParaJecripe game. We selected the Game SCRUM method, described in Section 2. We had to identify which phases were already done and which phases we had to complete. We considered that the Concept and the Pre-Production phases of the Game SCRUM method were already done. The Concept was done because it was clear that the application was a sports game with text information included such as history, curiosities, data about the athletes, etc. This game had four mini-games, a quiz, and a digital store implemented. There was already a functional prototype that should be finalized in the second year. However, some features of our context were considered. The following section describes our second-year development context.

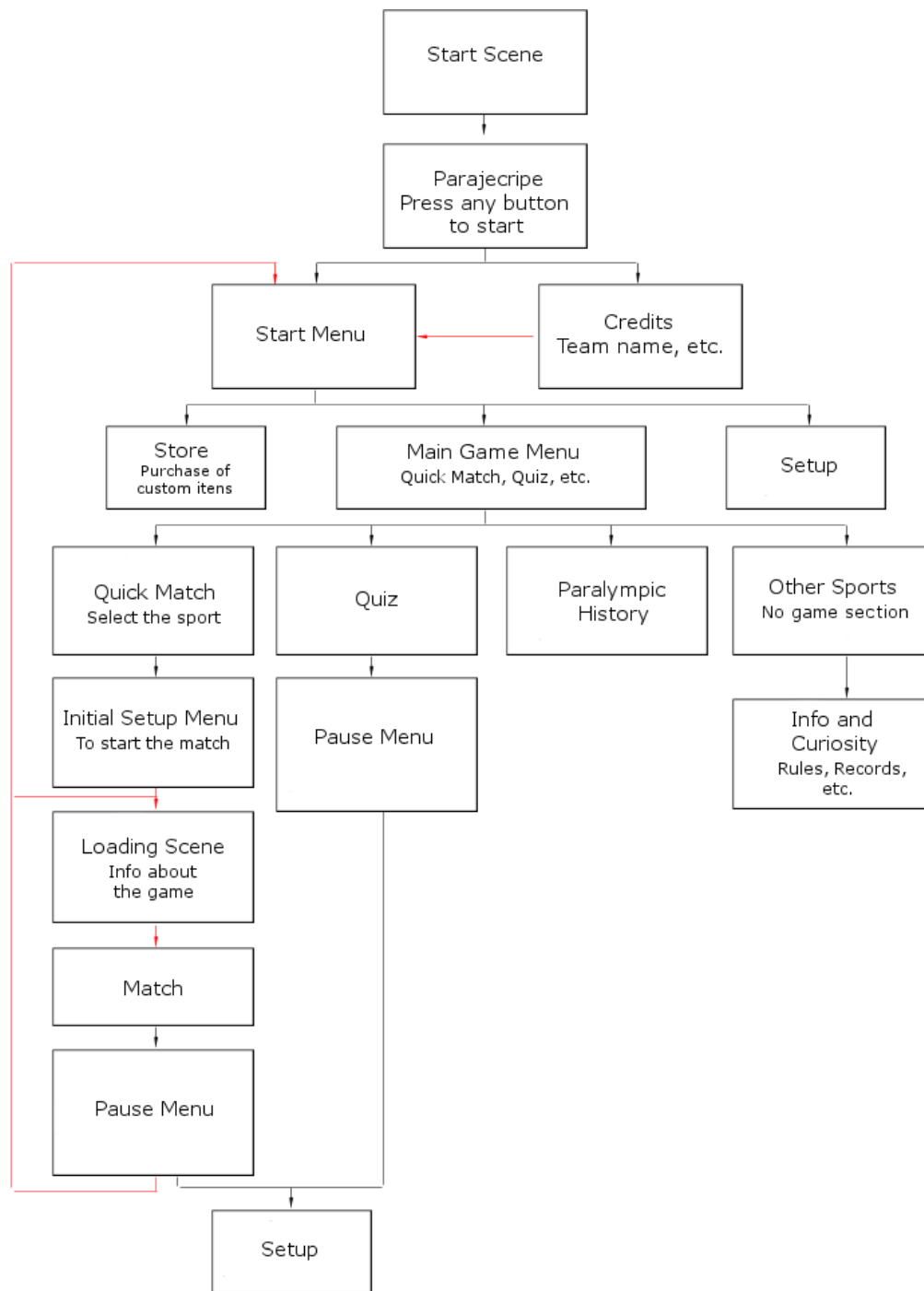


Figure 1: Concept Phase: Game flowchart of the game windows.

#### 4 GAME SCRUM TO OUR ACADEMIC ENVIRONMENT

Keith [9] describes procedures of SCRUM that considers, among several aspects, a multidisciplinary team from 6 to 10 people and a game developed by SCRUM progresses from two to four weeks (the *Sprints*). Specifically, in our project we considered monthly sprints (4 weeks) and the team in the second year (production and post-production phases of the SCRUM) composed of 6 to 7 people.

At the beginning of each sprint, there must be a planning meeting,

where the team selects a number of resources from a priority list (*product backlog*). The team should then estimate how much time each item in this list will consume. After that, the tasks should only be produced in the sprint whether every team judges them achievable. All these processes were done, unmodified, by the team.

We needed to consider adaptations to the daily SCRUM meetings for the ParaJecripe project to fit into the undergraduate students' routine. According to Keith [9], daily meetings should take place within a defined time frame within 15 minutes where each group

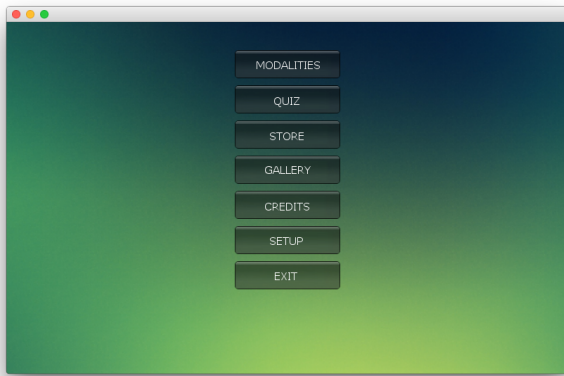


Figure 2: Initial game window (prototype).



Figure 3: Prototype: Preliminary version of the Track (400 meters) minigame.

divides the progress of their activities. In our methodology, there were no daily meetings with the group, but weekly meetings of 15 minutes with each member, but with the same purpose of the daily meetings, making the following questions [10]:

- What have you done since your last SCRUM?
- Was there any impediment for you to complete your current SCRUM?
- What will you do on your next SCRUM?

This adaptation, based on Schild *et al.* [13], was necessary to fit the academic life of the participants, who, in addition to the project, were engaged in other undergraduate activities that took a considerable time, making it difficult to meet everyone physically all in one place.

Concerning to the establishment of the SCRUM roles, we based the team divisions according to Pathak *et al.* [10], Schild *et al.* [13], Gestwicki [5], Felker *et al.*, [4], and Pinto *et al.* [11]. One of the team members became the SCRUM Master, assuming the position of project manager, running and explaining all parts of SCRUM to the team. The development team became the team and the project coordinator became the owner of the product participating in sprint

delivery meetings and identifying which features would be best used in each sprint as needed by the project.

## 5 PRODUCTION AND POST-PRODUCTION PHASES OF THE GAME SCRUM IN THE DEVELOPMENT OF THE PARAJECRIPE GAME

Since the beginning of the project, all the group, including the coordinator, met weekly to discuss and present the activities of each student. Everyone should dedicate 20 hours per week to the project, and the meetings also consumed part of that time. Thus, in each meeting, there was a document where it was described specifically the tasks of each the member to facilitate the writing of the individual reports, necessary to the administrative processes of the university.

However, the individual reports did not produce effective documentation of the software, and for the team, they did not seem to reflect all the time spent and the significant process of evolution of each member. Also, the scarce time began to become an important aspect in the discussions held among the students in the preliminary meetings.

The team also realized how long it had taken them to organize the activities and spent a lot of time preparing to produce the game, but not actually developing, leading to similar issues such as those described by Pathak and Pal [10], where they noticed increased complexity. Consequently, the the project would not be delivered on time. The Agile development [9] was quickly considered by the group, as much by the experiences of other projects of the students and coordinator, as of other colleagues who were part of the university and social environment.

Communication and collaboration are cited in Keith [9], Godoy *et al* [6] and Pathak *et al* [10] as very important points within an Agile development and that are easily employed through the SCRUM. However, the ParaJecripe team – since from the beginning – was well intertwined and intercommunicated, also, through other means, and the weekly meetings were sufficient for the more general exhibition of the project. Schield *et al.* [13] still reports other advantages in SCRUM, in the emphasis of resources on systems, people on processes, and iterative design.

Because the team wanted to optimize the development of the game and be able to achieve more goals, coding faster and more standardized, checking and using the best available time and improving the performance of the applied work, Game SCRUM was presented, discussed and applied together. As a result of the application of the Game SCRUM method, we finalized the ParaJecripe game. In the following section, we describe each of the mini-games, the Quiz, and the Equipment Store.

## 6 THE PARAJECRIPE GAME

The 2016 Paralympic Games took place in Rio de Janeiro, immediately upon the Olympic Games of this current year. As argued, there are digital games that deal with sports themes, but few of them approach Paralympic sports. Further, no digital game on multiple modalities of Paralympic sports has been found in the Portuguese language to provide further clarification on sports for people with special needs.

Having in mind the low number of digital games with such features, the *ParaJecripe* game initiative was launched. It was a two-year project developed mainly by professors and undergraduate students of Computer Science.

The ParaJecripe digital game provides interactive learning about Paralympic sports. The target audience of ParaJecripe (2016 ed.) comprises people of all ages. Its main purpose is to provide an opportunity for the game players to get in touch with the adapted sports and with some important Brazilian athletes of different modalities in order to deliver information in a playful virtual environment. ParaJecripe aims to induce the players to explore deeply about the universe of the adapted sports.

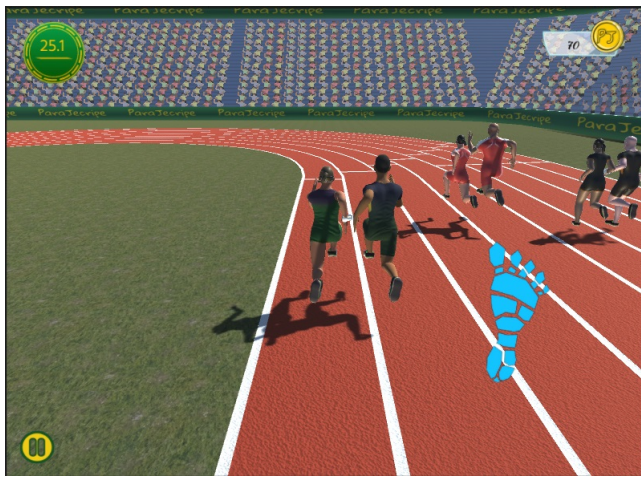


Figure 4: Track (400 meters) minigame.

This study had the support of different Brazilian athletes from the adapted sports. The athletes provided information about their sports modalities. They also accepted to be presented in the digital game as the main game characters. The sports modalities covered in the 2016 version of ParaJecripe are Athletics (with the 400 meters guided track and the long jump); Swimming (by means of the 50 (fifty) meters free swimming); and Tennis.

Further, the digital game additionally features a Quiz and an Equipment Store. The following sections present each of the parts, we call *mini-games*, of the game that makes up the ParaJecripe.

Beyond all minigames *per se*, the game player can access, through the menu system, information about the athletes, sports curiosities, and history of the sports.

### 6.1 The Athletics Minigames

The ParaJecripe presents the track tests of 400 (four hundred) meters and long jump. In the 400 meters, the athlete character is represented by Terezinha Guilhermina, with her guide Rafael Lazarini. She participates in the T11 category, destined to the athletes with total blindness in track [3]. Figure 4 illustrates both the athlete and her guide. The interaction with the player in the minigame of the race occurs through the use of the arrow keys (right and left), in which they must be alternately pressed, repeatedly and quickly, until the end of the match.

The other athletics minigame is the long jump. The main character is Veronica Hipólito. She is a track athlete, in the T38 category, for those ones with cerebral palsy [3]. Figure 5 illustrates the character of the long jump mini-game. As in the racing minigame, the long jump uses the alternation between the keyboard arrows so that the character of the game runs. However, at the moment of the jump, there is a maximum limit, which is signaled by the game. Once this limit is reached, the player must press the space key to jump.

### 6.2 The Swimming Minigame

Clodoaldo Silva is the character's swimmer of the ParaJecripe. He belongs to the S5 category, referring to athletes mainly with spinal cord injuries [3]. Clodoaldo has already won more than 10 Paralympic medals [7]. In ParaJecripe, the player controls the character with the arrow keys and the space bar. The strokes are performed by alternating the arrows (right and left). However, in this mini-game, the player will see an element of the user interface, located in the upper left corner, referring to the amount of oxygen available at any given moment. After a few strokes, the level of oxygen decreases and the player should breathe. Breathing is performed through the space bar. Figure 6 displays a screen of the swimming minigame.



Figure 5: Long Jump minigame.



Figure 6: Swimming minigame.

### 6.3 The Tennis Minigame



Figure 7: Wheelchair Tennis minigame.

Have occurred since 1976, wheelchair tennis expanded in the 1980s, with a significant increase in the number of practitioners [3]. In 1992, at the Barcelona's Paralympic Games, the modality was one of the adapted sports of that current edition. The only required adaptation is the allowing of two bounces of the ball into the court. Functional classification is simpler compared to athletic and swimming modalities. Specifically, for tennis, they are: *open*, referring to athletes with deficiency only in the lower limbs; and *quad*, for

athletes with deficiencies at three or four extremities [3].

Historically, in Brazil, the wheelchair tennis had received more attention since 1986, with the beginning of activities in the city of Niterói (RJ). The first participation of Brazilian athletes of tennis in Paralympic Games occurred in 1996, in the games of Atlanta (USA). The athlete Marcos Vasconcelos is the character of ParaJecripe. Marcos has been among the top ten in the Brazilian ranking of the sport since 2012. The interaction of the player, when controlling the character of the tennis, is given by means of the arrow keys. The player plays against an opponent controlled by an algorithm. The character who wins two tennis-games wins the match. Figure 7 illustrates the minigame of wheelchair tennis.

#### 6.4 The Quiz Minigame

In all modalities, there are information about the athletes, curiosities, and history of the games. The contents presented in the modalities are approached through the Quiz. Thus, the player, when practicing each of the minigames of the sports, keeps in touch with relevant information useful to answer the Quiz questions. In each practice of the minigames, the player earns coins, but if the player accesses the Quiz questions, he can earn even more of those coins if he correctly answer the questions.

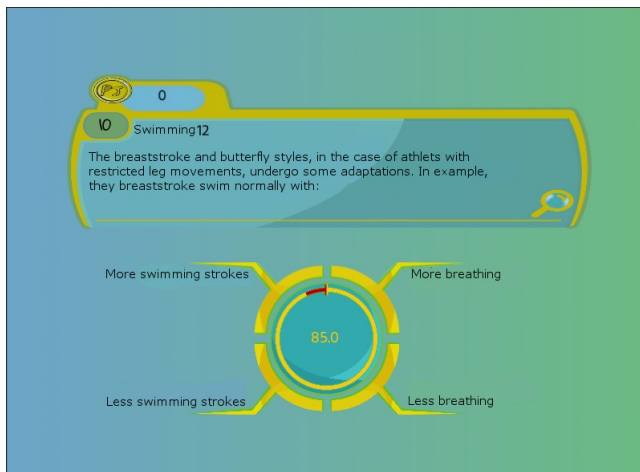


Figure 8: A quiz about swimming.

Figure 8 illustrates an example question, related to the swimming game, present in the ParaJecripe Quiz sessions. As can be observed, at the top of the screen, a number of coins obtained by the player are displayed. Below a number of coins, the question of one of the contents covered in the game is presented. In the middle of the screen, the timer is displayed, which starts with ninety seconds. Around the time of the stopwatch, the four possible answers to the question are located. After clicking on one of the answers, the player will see the next question. Each quiz session in the quiz contains ten questions.

#### 6.5 The Equipment Store

The player earns coins while playing the the minigames (sports and Quiz). Once the player earn coins, he can access the Equipment Store to buy gadgets that customize each of the main athletes of in the game (Fig. 9).

The Store allows the player to buy different items according to each of the sports modality. Each purchase leads to customizations of the athletes. Thus, the next time the player accesses a certain mode, the character of the sport will be changed, depending on the purchase of one or more items from the store.



Figure 9: Customization: sunglasses and swimming caps can be purchased in different colors.

## 7 DISCUSSIONS

In this section we discuss how the Production and the Post-Production Phases of Scrum acted in our project.

Concerning the Production Phase, its main purpose relied on the integration of the sport minigames (athletics, tennis and swimming) as well as the Quiz with the Equipment Store. Specifically, coins issue integration and Equipment Store delivering items were tackled. In the prototype version of the game, once the player won coins in a specific minigame, it was not stored in a global inventory of the game in order to be used in the Equipment Store. Also, if a player bought items at the Equipment Store, it was not applied to the Athletes in the minigames. All the minigames as well as the Equipment Stores were developed, at the prototype version, independently and with no integration.

Thus, to conduct a robust integration of all minigames and the Equipment Store, Development Testing was conducted.

The Development Testing are software tests ran by the software developers. It considers all the all testing activities carried out by the team while developing the game [14]. This means that all the tests were conducted by the programmers.

In the Post-Production Phase, the game firstly was exposed in Outreach Actions and Events. Namely, the game was exposed in (i) a Fair Course of the University, where the undergraduate programs are exposed to teenagers; (ii) a Technological Museum, where the public were junior school students; and (iii) the Olympic Torch Relay, where the target public was from all ages.

We took advantage from these three events to do informal user testing. Several bugs were identified and solved. We also collect qualitative feedbacks from these potential users.

During all the development phases, we notice the importance of including a larger number of sport modalities. We not only contact athletes to learn about their modalities, but, once further athletes knew about our project by means of their colleagues, they contact us and asked to include their modalities in the ParaJecripe game. Due to restrictions (time and resources), in the Post-Production Phase, we only were able to develop an extra minigame, the Canoeing. It was also integrated with the ParaJecripe and currently was in under user testings. After concluding the testing, the ParaJecripe with the Canoeing will be available.

## 8 CONCLUSIONS

In this work we presented the application of the Production and Post-Production Phases of the Game Scrum in the development of



Figure 10: Canoeing: extra minigame developed during the Post-Production Phase.

an Adapted Sports Digital Game, named ParaJecripe.

This project, which was run in a two year period, in the academic environment. Specifically, the team was composed by undergraduate students and researcher professors in a Brazilian Public Federal University.

In the first year of the project, the mini-games were independently developed without any integration between each other. They were functional, we receive the agreement of the athletes to use their names in the game as well as being the main game characters. The athletes and they coaches also support the ParaJecripe Project by propagating the game.

However, in the first year, we did not apply any Agile Software Engineering Approach. Because we had issues related to integration, and bug solving and development testings, we had the necessity to apply Software Engineering method.

We selected the Game Scrum since it was the most used Agile Method for game development. We mapped the activities of the first year of the project into the two first Phases of the Game Scrum, *i.e.*, the Concept and Pre-Production Phases.

The second year we focused on the Production and Post-Production Phases of the Game Scrum. Our proposal was the development of four minigames of three modalities (two of athletics, tennis, and swimming), a Quiz and an Equipment Store. We developed all this items and also developed an extra minigame, the canoeing. However, despite this last minigame is integrated to the ParaJecripe, in 2017, it still had to be tested by potential users.

The application of the Game Scrum in our academic environment allowed us not only to complete our proposal, but also to deliver an extra minigame. The students that composed the development team were able to harmonize their course activities with the ParaJecripe project. We observed that Agile Methods provide a potential topic to be explored in the academic environment in long-term projects.

#### ACKNOWLEDGMENTS

The authors of this study would like to thank Pro-Reitoria de Extensao e Cultura of the Federal University of ABC (UFABC) for

financial support that allow the execution of this project. Also, the authors thank the others participants of the ParaJecripe Team: Alan de Aguiar, Ana Flavia de Araujo, Rafael Carneiro Soares, Barbara Mayrink, Caue Massi e Romeu Miguel, from UFABC, and Daniel Alves and Rodrigo Nunes, from Universidade Anhembi.

Finally, a special thank to the athletes Terezinha Guilhermina, Rafael Lazarini, Veronica Hipolito, Clodoaldo Silva and Marcos Vasconcelos for accepting being characters of the ParaJecripe game and for helping in the concept part of our system. A special acknowledge to the head coaches Ciro Winckler (athletics), Leonardo Tomaselo (swimming) and Cassia Lorenzini and Rosemary de Almeida (Tennis).

#### REFERENCES

- [1] A. L. Brandão, A. de Aguiar, A. F. de Araujo, G. B. Domingos, and R. C. Soares. Parajecripe: Um jogo sobre esportes adaptados. In *Proceedings of the XIV Brazilian Symposium on Games and Digital Entertainment*, SBGAMES '16, 2016.
- [2] M. Brhel, H. Meth, A. Maedche, and K. Werder. Exploring principles of user-centered agile software development. *Information and Software Technology*, 61:163–181, 2015.
- [3] M. T. de Mello and C. Winckler. *Esporte Paralimpico*. Editora Atheneu, 2012.
- [4] C. Felker, R. Slamova, and J. Davis. Integrating ux with scrum in an undergraduate software development project. In *Proceedings of the 43rd ACM Technical Symposium on Computer Science Education*, SIGCSE '12, pages 301–306, New York, NY, USA, 2012. ACM.
- [5] P. Gestwicki. The entity system architecture and its application in an undergraduate game development studio. In *Proceedings of the International Conference on the Foundations of Digital Games*, FDG '12, pages 73–80, New York, NY, USA, 2012. ACM.
- [6] A. Godoy and E. F. Barbosa. Game-scrum: An approach to agile game development. *Proceedings of SBGames*, pages 292–295, 2010.
- [7] C. P. Internacional. Results for clodoaldo silva, Junho 2016. <http://ipc.infostradasports.com/asp/lib/theasp.asp?pageid=8937&sportid=514&personid=681216&refreshauto=1>.
- [8] M. H. Kankaanranta and P. Neittaanmäki. *Design and use of serious games*, volume 37. Springer Science & Business Media, 2008.
- [9] C. Keith. *Agile game development with Scrum*. Pearson Education, 2010.
- [10] S. Pathak, P. Pateriya, and P. Pal. A case study on software development projects in academic knowledge centers using scrum. *International Journal of Computer Applications*, 43(10):20–24, April 2012. Full text available.
- [11] L. Pinto, R. Rosa, C. Pacheco, C. Xavier, R. Barreto, V. Lucena, M. Caxias, and C. Maurçcio. On the use of scrum for the management of practical projects in graduate courses. In *2009 39th IEEE Frontiers in Education Conference*, pages 1–6, Oct 2009.
- [12] D. Salah, R. F. Paige, and P. Cairns. A systematic literature review for agile development processes and user centered design integration. In *Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering*, page 5. ACM, 2014.
- [13] J. Schild, R. Walter, and M. Masuch. Abc-sprints: Adapting scrum to academic game development courses. In *Proceedings of the Fifth International Conference on the Foundations of Digital Games*, FDG '10, pages 187–194, New York, NY, USA, 2010. ACM.
- [14] I. Sommerville. *Software Engineering*. Pearson. Addison-Wesley Publishing Company, USA, 9th edition, 2010.