Building a digital educational game supported by Socially Aware Design

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***Abstract*—This is a full paper research about building of a digital game. Traditional ways of teaching, based on theoretical explanations, make it difficult for students to learn related content, mainly in Software Engineering (SE), since connecting theory with practice is made more difficult in such approaches. The use of educational games emerges as a possibility to support a kind of teaching and learning process that changes the student's status from passive to active, and uses playful activities as a motivational element, since students learn by playing, in addition to allowing the simulation of problems and search for solutions. The objective of this article is to present the development of a digital educational game by students to support SE teaching and learning, using Socially Aware Design (SAwD), considering elements for the construction of learning objects, such as characteristics of learners and instructors, adoption of learning theories, activity sequencing, scope definition, granularity, instructional content, and evaluation criteria. SAwD seeks to discover characteristics of the social, cultural, environmental, economic, legal, and regional context, to build interactive and inclusive systems, one of its pillars being design for all. The methods for developing the work involve a life cycle model for learning object development, semi-participatory design workshops with brainstorming and braindrawing techniques, and prototyping. The prototype was finalized, applied as a didactic instrument and evaluated. It is expected to contribute to the expansion of the production and application of games in the teaching and learning of SE as well as the dissemination of SAwD.**

***Index Terms*—Educational Software, Software Engineering, Socially Aware Design**

I. Introduction

Excessive theoretical content, a lack of integration between academic subjects, the introduction of tools and technologies that are not aligned with those used in industry, a lack of practice, and a lack of student interest are all problems encountered in the teaching of Software Engineering (SE), according to research [1], [2].

The excess of theoretical classes is a limiting factor since it demotivates students to remain attentive to what they are learning, in addition to the difficulties of connecting interdisciplinary knowledge from other SE areas [3]. Traditional teaching methods based on theoretical explanations hinder the assimilation of the contents of SE, since the theory, approached in this way, is not connected with the practices necessary for a proper understanding of the techniques and tools proposed by SE [3].

Changes in the teaching and learning process of SE are evolving, allowing students to acquire knowledge and skills that replicate reality through inspiring practices, since theoretical lectures are insufficient for this purpose [1], [3], [4], [5].

Problem-based learning, an automated integrated environment for SE processes, software projects, educational games, language activities, and multidisciplinary content management are some of the suggestions for improving the teaching and learning process in SE [1], [2].

Educational games have been suggested as an alternate practice technique for SE teaching because they engage students to participate in the teaching and learning process [5], as well as the ability to simulate real-world problems in order to adapt theory to practice [1].

Educational games are distinguished by their ability to provide enjoyment and leisure in a strictly educational context, with the primary goal of enhancing traditional teaching techniques in order for students to master complex skills, particularly in higher education [6]. They must be interactive, in the sense that the student (player) must communicate, dialogue, and interact with the game, and this necessitates a thorough examination of the context in which it will be used, as well as an assessment of the impacts, problems, and challenges that its use may entail [7].

In order to innovate in the teaching and learning process, it is required to use strategies that are distinct from traditional teaching methods, which are incapable of supporting an effective interactive learning process due to their emphasis on content rather than on people. Thus, an alternative would be to

use a social approach to build educational software, including digital games, boosting social interaction — coupled with the use of educational technologies [8].

Socially Aware Design (SAwD), which has design for all and Organizational Semiotics its pillars [9], proposes that criteria connected to the social, cultural, environmental, economic, legal, and regional context, among other significant elements, be included in the building of interactive and inclusive systems. SAwD highlights the necessity of understanding the human values, feelings, affections, sociability, beliefs, conventions, and rules of the group of people who will use and be influenced by the system, which must be considered during system design and implementation [8].

A bibliographic search using Systematic Literature Mapping revealed a wide range of approaches, procedures, and frameworks for developing educational games [10], [11], but no works mentioning the use of SAwD in the design process. SAwD can be confirmed in the context of education in [12], which created a socio-constructionist environment for early childhood education called CPES (Programmable Collaborative Environment for Storytelling). It may also be confirmed in the context of game creation in [13], which implements SAwD's semio-participatory design workshops in the idea of a game to assist children in speech therapy exercises.

Thus, the objective of this work is to present the development of a digital educational game by students to support the teaching and learning of SE, with emphasis on the design process that applies the concept and techniques proposed by SAwD. Following that, the game was used as a teaching tool in three undergraduate courses in the field of information technology in the subject of software project management.

Section II describes the materials and methods, section III reports the execution of the project. Section IV presents the results and discussion, and section V addresses the final considerations and proposals for future work.

II. Materials and Methods

This section is intended to present the methods, techniques, and tools used in the construction of the game, as well as to briefly explain each of them.

A. SAwD

SAwD was chosen to incorporate social context in the design process in which the game will be inserted by conducting semio-participatory design workshops.

The approach proposed by SAwD contributes to clarify a given problem and search for solutions, in such a way that they can be understood at different levels of abstraction and formalism [14], since it is linked to Organizational Semiotics [15], in the areas of the Culture Building Blocks proposed by [16], in the Value Theory of [17], and because of its application in participatory design [18]. SAwD assists designers in the creation of interactive systems that are integrated with social realities as well as future users' human and cultural values [14]. The semio-participatory design workshops, as coined by SAwD and based on organizational semiotics and participative design, are highlighted.

SAwD proposes solutions in the construction and use of more humanized and sustainable interactive technologies in three different levels, informal, formal, and technical. At the informal level, it aims to discover requirements, within a social group, in which the interaction of people or technology users, daily life, culture and human values are observed. At the formal level, it represents how society is organized, based on laws, rules and models; at the technical level, the technological artifacts built with the data from the previous levels are represented, involving the different types of users in the construction process [19], to produce a system that is sustainable, inclusive, and avoids negative impacts to the users [9].

A graphic representation was created by SAwD containing the levels in which it acts, called Semiotic Onion (Fig. 1), which illustrates the interaction between the informal, formal and technical levels, society and design [9].

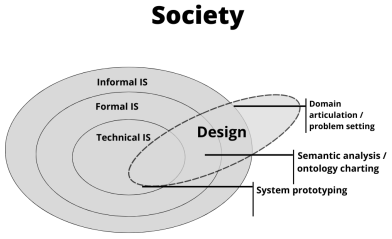

Fig. 1. Semiotic Onion. Adapted from: [9]

Artifacts and techniques proposed by SAwD [19], generated during the execution of this project are shown in Fig. 2.

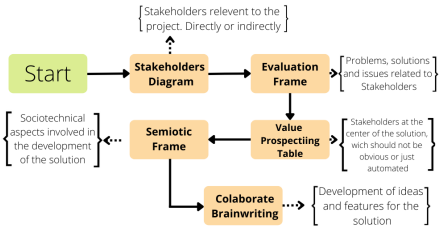

Fig. 2. Artifacts generated by SAwD. Adapted from: [13]

B. Life cycle for Learning Objects (LOs)

In order to collaborate with the construction of the game, a life cycle model for LOs was used, considering that educational games can be formed by one LO or a set of several LOs [20]. The life cycle model proposed by [21] is based on prototyping and is capable of involving a multidisciplinary team to create the instructional project, an element that precedes the construction of the LO. It employs an agile cycle that can be repeated as many times as necessary to complete the tasks. This cycle is composed of six actions, which are depicted in Fig. 3.

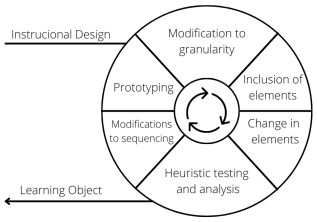

Fig. 3. Life Cycle for LOs elaboration. Adapted from: [21]

The instructional project must be created considering the learners' and the instructors' characteristics, and the learning environment; the scope and its granularity must be defined as well as the learning theory that will be adopted, and the sequence of presentation of the content [21]. SAwD will be introduced in this model to find and include features of the social, cultural, human, legal, and technical context in the design.

C. Techniques and tools

The selection of tools and techniques to support the construction of the game is divided into management, design, implementation, and evaluation.

The project management was based on the Kanban technique, used to control production flows by using cards. It is a lean method for managing work in human systems, balancing demands with available capacity and improving the treatment of bottlenecks in the task system [22]. Kanban is often used in game studies, favoring communication, quality, and the discovery of fun resources 23. The tool used to apply Kanban was Trello [24].

The OpenDesign platform [7] was used to conduct the design workshops. It enables the creation of artifacts based on SAwD by applying techniques for the elaboration and improvement of system design, such as brainstorming, brainwriting, and braindrawing, in a collaborative way.

By using drawings created by each participant in a design workshop, the braindrawing technique tries to determine the preferences of people involved in a project [10]. The people involved in the project are users, designers, developers, and other professionals, who can contribute to the construction of the software in a way that it can be used by the largest possible number of users. In this technique, each project participant creates a drawing linked to the subject under investigation, which they then pass on to another member after a certain time or an alarm. Everyone can express their thoughts on each participant's drawing by agreeing, disagreeing, or adding things. The ideas are gathered into a single drawing at the end of the round [25]. The brainwriting technique follows the same principle, but in a textual way.

The OpenDesign platform [7] allows the execution of a participative design workshop, including braindrawing sessions held remotely, through the Online Braindraw functionality.

The prototyping was applied in the implementation of the game from the production of models that evolved to the final version [26] developed using the tools Unity [27], Adobe Photoshop, and the programming language C# [28].

In order to evaluate the game, we selected the MEEGA+ tool, a questionnaire model developed for the evaluation of educational games for Computer Science teaching [29].

III. Execution

In this section the details of the execution of the project, participants, activities, and objectives are reported, as well as the implementation of the workshops and design workshops, use of the game as a teaching tool, and evaluation after its use in the classroom.

A. Participants

The participants of this research are divided into: researchers, project team, stakeholders, and target audience. The researchers looked into incorporating SAwD into the game production process and proposed it. One of them led the project team, which included two scholarship students from the Computer Engineering and Electrical Engineering programs who were chosen through a call for proposals to create open educational resources (multicampus and multidisciplinary), all of whom were new to educational games. Stakeholders are those who helped with the project in some manner during the design workshops, and the target audience is comprised of Software Project Management students who played the game during the course.

B. Activities

In order to achieve the objective of this work, which is the construction of an educational game to support the teaching and learning of SE applying the SAwD, proposed activities were distributed over a period of four months for design and five months for coding and testing were proposed. The project started in March 2021 and was completed in November of the same year. In March 2022, the game was applied as a didactic instrument in the Software Project Management subject in undergraduate courses in Computer Science. Tab.I shows the activities according to time (1 to 4 = March to June/2021, 5 to 9 = July to November/2021, 10 = March/2022), participants, objectives, and techniques.

C. Workshops

Due to the COVID-19 pandemic, the workshops were held in a virtual room, beginning on March 10, 2021 and continued every Wednesday until the end of April, with the involvement of researchers and project staff, lasting one hour per session.

The themes that would be worked on were given at the start of the first session (connected to the call for proposals for the selection of fellows), tasks were distributed among the participants, and a discussion about the concept and practices of SAwD was started. The results of the activities performed and artifacts created during the week were presented at each session.

The goal of the workshops is to create an SE conceptual map, the Stakeholder Diagram (SD), the Instructional Project

TABLE I
ACTIVITY PLANNING

When	Activity	Who	Objective	Technique
1	Workshops	Researchers and project team	Previous study of the SAwD and selection of the model to create learning objects	Bibliographic research
2	Workshops	Researchers and project team	Create a SE conceptual map; create the Stakeholder Diagram (SD) and the Instructional Project (IP)	Document analysis and brainstorming
3	Design Workshop 1	Stakeholders	Update the SD, prepare the Assessment Framework (AF) and define requirements on the Semiotics Ladder (SL)	Document analysis and brainstorming
4	Design Workshop 2	Stakeholders	Analyze the 1st prototype and update the requirements of the SL	Document analysis and braindrawing
from 5 to 9	Prototyping	Project team	Update prototype to final version	Prototyping
10	Evaluation	Teacher and students	Use the game as a teaching tool and evaluate the result	MEEGA+ [29]

(IP), and a low fidelity prototype to be worked on throughout the design process. The SD is available in section IV-A, as well as the details of the other artifacts generated.

D. Design Workshop 1

The goal of this semio-participatory design workshop was to collaboratively analyze the IP and low fidelity game prototype from the perspective of the stakeholders defined in the SD, to identify problems, suggest ideas and solutions, and to contribute to the composition of the Semiotics Ladder (SL) requirements.

This workshop took place on May 11, 2021, remotely, and lasted 1 hour and 10 minutes. It included 11 people who represented the stakeholders listed in the SD, being two software engineering professors (who also represent the role of course coordinator and public manager), a games professor, the professor responsible for the extension project "The use of ludic as a teaching tool" from Federal Technological University of Paraná (UTFPR), a student of the Computer Engineering course, a Software Engineering student (who also represents the role of designer and developer), an Electrical Engineering student (who also represents the role of developer), two master's students from the UTFPR (one representing the industry and the other the graduates), a doctoral student from Federal University of Paraná (UFPR) and an architect; the psychologist did not participate. The workshop was chaired by the coordinating researcher of the project.

Participants were given instructions on how to create a username and password in order to access the OpenDesign platform and the project. Fig. 4 shows the project home screen on the platform, which displays the number of participants (including the system administrator and all workshop participants), the number of stakeholders defined in the SD, and the number of problems, ideas, and requirements generated during the workshop.

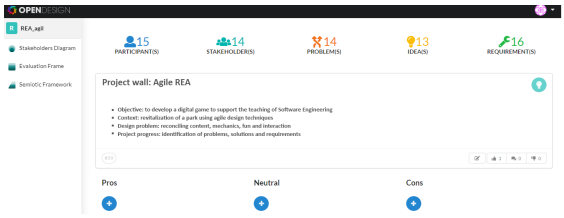

Fig. 4. The Project home screen on OpenDesign platform.

The brainstorming technique was applied in order to identify problems and solutions that made up the Assessment Framework (AF) and the SL, which can be seen in section IV-B.

E. Design Workshop 2

The goal of this semio-participatory design workshop was to assess game screen prototypes in order to suggest design and interaction improvements as well as uncover new requirements for the SL. This workshop took place on June 21, 2021, and lasted 1 hour and 20 minutes, with involvement from key stakeholders (teachers and students) as well as designers. A graduate student from the Computer Engineering course from UTFPR, students from the UFPR course linked to the PPGInf from UFPR, a former student from the Technology in Systems Analysis and Development course, and a professor from SE are among the guests.

The workshop began with an explanation of the braindrawing technique rules and aims, followed by the presentation of the game storyline and screen prototypes. Following the presentations, the participants were directed to the OpenDesign platform, where they were given instructions on how to use the Braindraw Online feature. Three sessions of braindrawing were performed.

1) First Braindrawing Session: In the first session of braindrawing, the instructions screen from the first phase of the game was analyzed, which allows the player to select personas. It enables the player to learn the characteristics of the users of the system to be developed, in this case, residents of the neighborhood who can help revitalize a park, as shown in Fig. 5.

Fig. 5. Instructions screen for the first part of the game "Personas selection".

The sketching time was 90 seconds with one round, meaning each participant's drawing was only given to the other participants once, and the consolidation time was 120 seconds. The drawings of all participants are available for joint analysis and final consolidation at the end of the session. Fig. 6 shows the drawings created during this session. The unisex name "Noah" will be omitted from this session proposals for adjustments and new criteria, and the player will be able to choose a nickname to feel more involved with the game. The end result of this round is available in section IV-C.

Fig. 6. Result of the first drawing session.

2) Second Braindrawing Session: In this session, the selection screen of user stories was examined, allowing the player to learn about the needs and expectations of the users, and, in the case of the game, to confirm what the residents would like to see implemented in the park revitalization. The player must be cautious with his or her decisions during this phase, as there will not be enough time to satisfy all of the demands. Fig. 7 shows the screen.

Fig. 7. Selection screen on "User Stories".

For this session, participants had 45 seconds for the drawing, with one round, and 60 seconds for consolidation, agreed upon by the participants who reported having time left over in the first session. At the end of the session, the drawings of all participants are made available for joint analysis and final consolidation. The drawings generated in this session can be seen in Fig. 8.

3) Third Braindrawing session: In this session we analyzed the screen that allows the definition of the complexity for the execution of user stories (story points). The definition of the complexity will influence the definition of the sprints backlog. This screen can be seen in Fig. 9. In this session we kept the time of 45 seconds for the design with one round and 60 seconds for the consolidation. The drawings generated in this session can be visualized in Fig. 10.

Fig. 8. Result of the second drawing session.

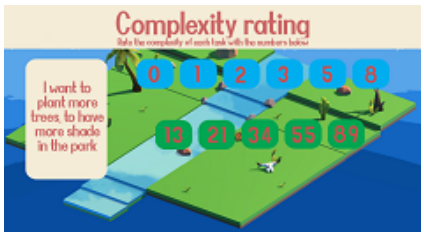

Fig. 9. Screen to define the complexity of the "User Stories".

F. Application and evaluation

The game was applied as a didactic instrument to support the teaching and learning of SE, in March 2022, in the subject Software Project Management, in three undergraduate courses (Computer Engineering, Software Engineering, and Systems Analysis and Development Technology) and in one graduate course (Master of Business Administration in Software Engineering), offered in UTFPR.

In this subject, concepts, techniques and tools for managing traditional and agile software projects are presented. The game was used after a theoretical exposition of agile practices for project management that involve game content: user stories, product backlog, story points and sprints. In two classes the students played in the classroom in the presence of the teacher and in two classes they played remotely.

Subsequently, the students answered a questionnaire with some profile information, such as course, period, age, knowledge and experiences with agile management and experience with games and educational games. In order to obtain information about their opinion regarding the appearance, usability, and learning of the game, they answered a questionnaire

Fig. 10. Result of the third drawing session.

proposed by [29]. A total of 73 students participated. The results are presented in section IV-D.

IV. Results and Discussion

This section presents the results and discussion of the workshops, the semio-participatory design workshops, and the evaluation of the game.

A. Workshop Outcomes

Three artifacts were created as a result of the workshops III-C: an SE conceptual map, an SD, and an Instructional Project IP. The conceptual map was created using the Pedagogical Project for the Software Engineering course from UTFPR, the campus Cornélio Procópio, and the teaching plans for the courses offered in the Academic System. The design of this map assisted in the definition of the game content, which might be tied to multiple subjects. One of the parameters that determine the IP is the content to be addressed in the game.

The IP is the basis for the elaboration of a learning object. It defines the theme of the project, the characteristics of the learners and instructors, the learning environment, the learning theory, the scope and granularity of the content, as well as the sequencing of the content, evaluation criteria, and the instructional content. In the game the techniques of agile software project management are addressed, but applied to the revitalization of a park, where the player will be the project manager and must know the "personas", the needs or expectations (user stories), prioritize (product backlog), estimate the effort needed to accomplish (story points), build the "sprints backlogs", and run the sprints. The game was named Park Man. The initial screen of the game can be seen in Fig. 11.

Fig. 11. Home screen to the game.

During one of the sessions the stakeholders in the project were identified. The stakeholders are people that may be directly or indirectly affected by the software to be developed or that may contribute in some way in its construction. The stakeholders identified were registered in the OpenDesign platform [7], which allows the collaborative development of the SD. We chose to define roles that represent stakeholders in each of the categories proposed by the SD and that, later on, will be nominated and invited to participate in the semio-participatory design workshops. The guests were given access to the OpenDesign platform [7] to create other SAwD artifacts. The SD can be seen in Fig.12.

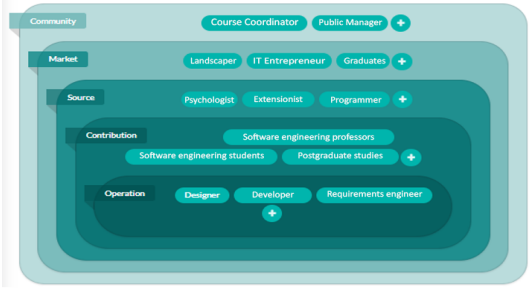

Fig. 12. Stakeholders Diagram.

B. Design Workshop 1 Outcomes

The execution of Design Workshop 1 (section III-D) resulted in the discussion of problems and proposed solutions allocated in the AF, as well as in requirements laid out in the SL.

Fig. 13 shows a summary of the contributions by stakeholder category. It can be observed that the largest number of contributions is concentrated in the category of stakeholders that represents the people responsible for the development of the system, with a total of 15 contributions, and next, the stakeholders that represent the customers or users of the system, that is, people who are directly impacted by the problem or proposed solution, with a total of 6 contributions. The total number of contributions from all categories was 28.

Fig. 13. Summary of contributions by stakeholder category.

In Fig. 14, a portion of the AF available in the OpenDesign platform is depicted in relation to the contributions of the stakeholders that make up the SD's "Contribution" category. Stakeholders report issues and provide solutions in this section. All participants, regardless of category, can provide likes or dislikes, as well as make comments on all reported problems and solutions, allowing for more effective participation from all parties concerned. The left-hand squares are for explaining problems, while the right-hand spaces are for giving ideas and solutions. The other participants interact by signaling pros, neutrals, and cons to that particular scenario by clicking on one of the squares, which opens a panel for discussing the problem or solution. 16 requirements were formed from the AF's challenges, thoughts, and answers, and they were placed in the FS steps: social world, pragmatic, semantic, empirical syntax, and physical world.

The requirements are registered in the FS on the OpenDesign platform in the same way that occurs in AF. The

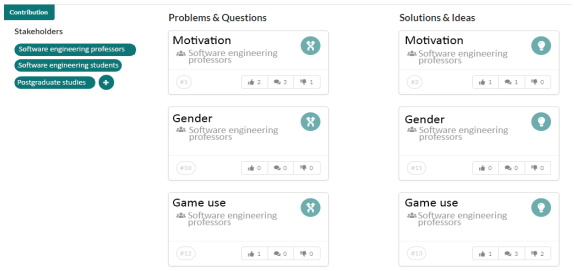

Fig. 14. Assessment Framework.

stakeholders enter the requirements in a collaborative manner and give their comments on whether they are pro, neutral, or pro that requirement. Fig. 15 is a representation of the FS generated during the session.

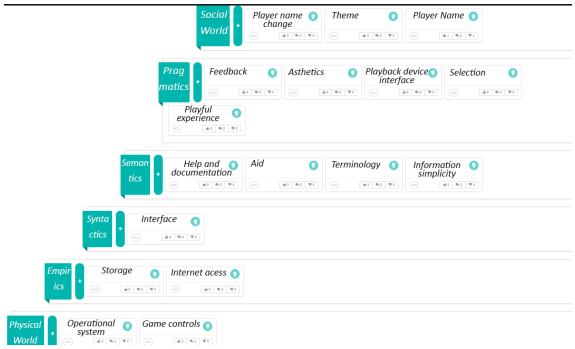

Fig. 15. Semiotics Ladder.

After this workshop it was possible to observe that only six participants effectively contributed to the process of identifying problems and proposing solutions, which suggests that involving stakeholders who have something to contribute, but are not directly or indirectly affected by the solution, is a challenge for future semio-participatory design workshops. The use of the OpenDesign platform requires previous training, according to the report of some participants who justified not launching data due to their low understanding of the functionalities. In this case, a solution could be to add some extra time in the workshop for this purpose.

The use of the brainstorming technique sparks discussions and generates notes, but some participants did not participate effectively, possibly due to shyness or another factor related to the interaction, so it is recommended that workshops associate or use another technique, such as brainwriting, for example.

C. Design Workshop 2 Outcomes

In this design workshop three braindrawing sessions were held, as reported in section III-E. The first braindrawing session resulted in the suggestion of six requirements and one layout change:

- insert an image instead of just plain text for instructions;
- create an interactive tutorial with the player interacting with the stakeholders with mini objectives;
- insert navigation arrows;
- provide a menu selection option;
- include “exit” button;
- increase the size of the personas selection button;
- offer other avatars for the choice of the game character.

The second braindrawing session resulted in two suggestions for requirements and one change in the layout of the user story selection screen:

- insert orientation arrows to change screens both forward and backward;
- allow the player to choose where to place the elements in the park along with the persona;
- place the selection option at the top of the user story to be selected instead of at the bottom.

At the end of the third braindrawing session, four requirements and one layout change were suggested:

- create a schedule that presents the user stories by group according to the classification received;
- use a monochromatic scale, from a lighter tone to a darker one as the complexity increases;
- use the color system similar to traffic lights, green for lower complexities, yellow for medium complexities, and red for higher complexities;
- include a help button;
- arrange the user stories side by side instead of as a list.

The notes for improvement of the prototypes represented in the drawings presented in section III-E were also discussed verbally during the session and via chat available on the OpenDesign platform. The final result after the three sessions of braindrawing was twelve suggestions for new requirements and three layout changes.

A participatory design workshop with the application of the braindrawing technique demonstrated the involvement of the participants, with the elaboration and sharing of drawings that suggested improvements in the screen prototypes analyzed, and according to the number of requirements and layout suggestions generated, the game design gained significant improvements.

Fig. 16 shows the image of the result of the park’s revitalization when all the expectations of the neighborhood residents (personas) are met. However, due to the time constraint given by the game, the player does not get the maximum score if he or she includes all the elements, as this means that he or she underestimated the effort required to execute the user stories.

Fig. 16. Revitalized park.

From the results of the Workshops and the Designs Workshops the prototype evolved to the final version, considering

some restrictions that emerged during the coding process, such as, for example, it was not possible to insert randomness elements. But the main thing was implemented, the suggestions of requirements and design changes were met. Requirements that were not met due to time constraints or the limit of knowledge of the technology used in the coding are registered for future updates of the game.

D. Evaluation results

After the students played Park Man, they answered the quiz proposed by [29], which contained 35 questions. Tab. II shows the questions and the total answers of the students to the most relevant questions for discussion, according to the Likert scale (Strongly agree (5), Agree (4), Neither agree nor disagree (3), Disagree (2), Strongly disagree (1)). An open question was included for criticisms and suggestions

TABLE II
EVALUATION QUESTIONNAIRE RESULT.

Item	Description	5	4	3	2	1
1	The game design is attractive (interface, graphics, board, cards).	26	29	12	4	2
2	Texts, colors and fonts match and are consistent.	34	29	7	2	1
3	Learning to play this game was easy for me.	26	22	18	6	1
4	The game rules are clear and understandable.	13	22	23	10	5
5	The fonts (size and style) used in the game are readable.	48	19	2	3	1
6	The game allows customizing the appearance (font and/or color) as per my need.	9	10	21	15	18
7	The game protects me from making mistakes.	5	12	19	17	20
8	The organization of the content helped me to be confident that I would learn from this game.	16	27	23	6	1
9	The game offers new challenges (new obstacles, situations or variations) at an appropriate pace.	9	20	21	10	13
10	I feel satisfied with the things I learned in the game.	13	20	24	11	5
11	I would recommend this game to my colleagues.	17	25	12	11	8
12	I was able to interact with other people during the game.	8	5	14	12	34
13	I had fun with the game.	15	23	18	12	5
14	Something happened during the game (game elements, competition) that made me smile.	15	15	22	9	12
15	Game content is relevant to my interests.	15	26	19	9	4
16	It's clear to me how game content is related to discipline.	40	23	6	4	0
17	The game is a suitable teaching method for this subject.	27	20	18	8	0
18	The game contributed to my learning in the discipline.	20	24	16	7	6
19	The game was efficient for my learning, compared to other activities in the discipline.	15	18	20	13	7

The answers suggest that the game design pleased the majority (74%), but it would be interesting to allow the player to configure font size or color. Ninety-one point six per cent found the game easy to use, but it is necessary to understand where others had difficulties. Regarding the clarity of the game rules, 21% did not understand the rules. Regarding the errors, it was evident that many players were in trouble, so new tests should be conducted for proper treatment of errors.

The considerations about fun and challenges were carefully considered in order to include other elements to address the issues. As for the relevance of the content, learning, and relationship with the discipline, the results were satisfactory, as can be seen in items 15 to 19 of Tab. II, but as the goal is to build a socially aware educational game that benefits the largest possible number of users, it will be necessary to seek improvements to meet the 28% who disagreed with the last two questions of the questionnaire.

In general, it was possible to conclude that the SAwD application worked well with satisfactory results obtained.

V. FINAL CONSIDERATIONS

The goal of developing an educational game to support the teaching of SE, using concepts, techniques, and tools pointed out by SAwD was achieved, even though it is possible to observe areas for improvement to make better use of what SAwD has to offer in the construction of any type of system.

It can be seen that involving several types of stakeholders brings important considerations, which in traditional development processes may go unnoticed. The identification and involvement of stakeholders of different categories collaborated greatly to improve the understanding of the problem, pointing to more humanized and interactive solutions, and this was evident in the fact that the game was effective in its main purpose, that is teaching, even though the researchers and the development team were incipient in the creation of educational games.

The choice of the techniques to be used in the workshops is of utmost importance, because based on them there may be more or less interaction of stakeholders, directly reflecting on the results. We suggest the inclusion of the brainwriting technique together with or instead of brainstorming.

A. Future Works

SAwD can be used to create other sorts of educational games in the future, such as board games, role-playing games, and escape rooms, because these games are easier to adopt since they do not require information technology expertise and take less time to create.

Projects to improve the game in order to boost the fun, the interaction between players, the insertion of randomization features, and the fixing of bugs are encouraged in the future, as they are intended to make the game even more engaging and addicting for the students.

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