Employing Social Interactions of Multiplayer Role-Playing Games in a Serious Game
The Case of maSters of AIR (SAIR)

Varvara Garneli(✉) and Konstantinos Chorianopoulos

Ionian University, Corfu, Greece
vgarneli@ionio.gr

Abstract. Collaborative games prompt players to work together, communicating, coordinating, and assisting each other; such features make them suitable for learning purposes. Although several suggestions have been made to design serious collaborative games, the RPGs' social interactions have not yet been explored in the context of science learning. This study evaluated a multiplayer game that integrates chemistry content in the gameplay mechanics of adventure games and RPGs. Twelve game testers participated in the evaluation process, constructing five groups: two groups of three persons and three groups of two. The players downloaded and installed the game on their computers, and then they played it. The results from the qualitative data confirmed that the clearly defined rules system facilitated teamwork through constant coordination and communication, making playing a pleasant experience. In addition, each player progressed his/her character through individual activities, promoting active collaboration in the missions' accomplishment. Thus, the social character of RPGs has the potential to support the design of collaborative learning settings.

Keywords: Collaborative games · Role-Playing games · Science education

1 Introduction

A collaborative learning setting promotes several interactions among the participants. Parameters, such as group size, group structure, role-based scenarios, rule systems, interactions' monitoring, and regulation, might increase the probability of triggering learning mechanisms [1]. On the other hand, collaborative games encourage players' interactions, focusing on teamwork, coordination, and assisting each other; such features make them suitable for teaching, training, and assessing. A collaborative game design should split the work among players, develop heterogeneous resources, assign distinct tasks and abilities, and encourage communication and teamwork [2]. In this direction, the potential of employing Role Playing Games (RPGs) features to promote interactions among players in an educational setting needs further exploration and evaluation.

RPGs are a popular game genre that has its roots in the 1970s. Multiplayer RPGs include various features that facilitate group work [3]. The Multiplayer Serious Game Methodology (MSGM) provides guidelines to integrate the educational content in the

F. de Rosa et al. (Eds.): GALA 2021, LNCS 13134, pp. 220–229, 2021.
https://doi.org/10.1007/978-3-030-92182-8_21

gameplay mechanics of adventure games and RPGs, blending the entertaining character of video games with collaborative learning techniques [4]. MaSters of AIR (SAIR) [5] is a multiplayer chemistry game designed according to MSGM guidelines. SAIR aims to motivate and enhance science learning to 14 years old students. The integrated educational content regards oxygen, an essential component of the atmospheric air. Therefore, SAIR encourages players to perform several game activities that promote group work. Additionally, personal growth and character progression are achieved through individual activities as the work is split to all members to acquire skills and resources. Finally, those unique players' achievements facilitate collaboration, as they relate with the missions' completion. Although MSGM guidelines emphasize the multiplayer character of the game in various ways, there is no evaluation of players who used the game.

This study aims to evaluate the multiplayer component of SAIR, a game that integrates chemistry content in the gameplay mechanics of RPGs. The experimental procedure included participants who read the online instructions [6], downloaded and installed the game to play it in groups of two or three persons. Participants worked from a distance, using their equipment. Players had to keep notes on the process, describing them, underlying difficulties, and suggesting improvements. Moreover, there were two synchronous sessions and constant asynchronous communication with the researchers to ask questions and solve technical problems. In addition, that gave additional data to the researchers to evaluate the process of downloading, installing, and connecting to the game. The significance of this assessment is great as the teachers' acceptance to implement a serious game in a typical learning setting is influenced by several factors, such as the need for technical and organizational support, training on using them, previous gaming experience, and more [7]. Therefore, this study:

[1]: evaluated the interactions among players while using the game
[2]: recorded potential difficulties that players might encounter
[3]: provided future improvements to the game design

2 Related Work

Designing digital games that can engage people in collaborative activities is a challenging process. Zagal [8] suggests the use of different roles and abilities that need coordination and decision-making. Another suggestion regards the use of quite tricky problems that need players to collaborate. Therefore, players must work together to share knowledge and resources and identify the best strategy to apply. Wendel [9] designed the "Escape of the Wilson Island," to underline the features of collaborative multiplayer games. The game employs requirements of the traditional single-player games, such as fun, narration, challenges of multiplayer games design, such as concurrent gaming, interaction, and finally, the serious game design, such as the inclusion of learning content. Nevertheless, extraordinary coordination is needed to solve the collaborative tasks.

From a different perspective, employing RPGs features could also support collaborative interactions among players. The "pen and paper" RPGs go back to the 1970s; players sit around a table, interacting with the game world through their characters. Another player undertakes the role of the game master, who is responsible for the game

world beyond the players' characters. Playing the game involves verbal description by the players or by the game master. Written materials determine the rules, aims, and character descriptions. Finally, a character sheet describes the character in quantitative terms, allowing the character's progression. Pen and paper RPGs are social affairs; players often get together to spend time in role-playing activities with their friends and maximize their character's effectiveness in a structural context [3, 10]. Dillembourg's instructions [1] for designing adequate collaborative learning settings suggest using role-based scenarios and a clearly defined rule system.

On the other hand, digital RPGs have similarities and differences with pen and paper RPGs. Digital RPGs also provide players a virtual world to move and explore through their characters, in a freeway. Players still interact with the game world through interactions that include battles, dialogues, and object interactions. There is even the concept of the game master, one or more characters who control the game rules but in a quantitative way. A clearly defined rule system manages players' actions [3], facilitating collaboration [1].

3 Methodology

3.1 Research Design

The "maSters of AIR" (SAIR) is a chemistry game for three players. The multiplayer component was designed using the MSGM guidelines. The SAIR supports three different types of activities: individual, cooperative, and collaborative activities. Therefore, each player, through his Playable Character (PC), is assigned several individual activities. Responsible for those assignments are the Non-Playable Characters (NPCs) which guide players throughout the game. In addition, the individual activities reward PCs with skills stored in their inventories, increasing their growth with different skills (see Fig. 1).

(a) (b) (c)

Fig. 1. Individual activities: players progress their characters, acquiring one skill each. (a) Harold acquired the copper oxidation skill. (b) Therese is assigned to balance the sulfur oxidation to acquire the sulfur oxidation skill. (c) Marsha is assigned to balance the iron oxidation

Those skills have a significant meaning as they empower collaboration in the game; the NPCs assign missions that require each character to use his/her individual skills to complete the assigned missions (see Fig. 2).

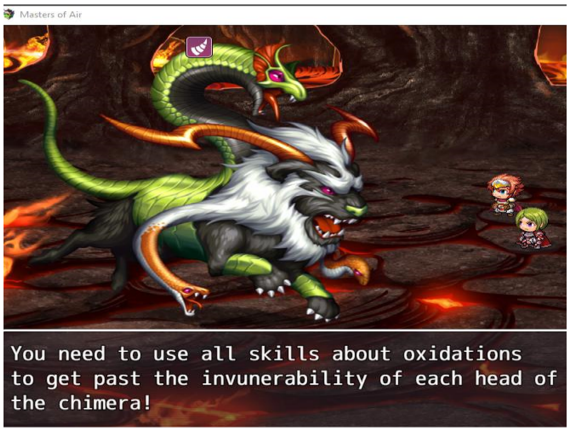

Fig. 2. Battles force players to collaborate, using their acquired skills to eliminate their enemy.

Additionally, some activities promote group work differently. In this viewpoint, PCs are on the same map, attending the same events. However, these cooperative activities have a free character meaning that one PC can perform the assigned tasks or watch the others complete them [4, 5] (Fig. 3).

(a) (b)

Fig. 3. Cooperative activities promote teamwork through coordination and communication. (a) Players observe the experiment. (b) Players walk in the forest to observe and learn content.

This study explored the interactions among players while they were performing the various game activities. Moreover, we assessed the process of downloading, installing, and connecting to the game. The evaluation was conducted in May 2021 in Greece. The research followed all necessary procedures to be in alignment with institutional rules and ethics.

3.2 Participants

We assessed the multiplayer component of SAIR with twelve master's degrees in "Digital Applications and Innovations" students (six females and six males). Their average age was 35.8 years old (SD = 8.03). Students optionally participated in the study. They constructed five groups: two groups of three persons and three groups of two.

3.3 The Chemistry Game

SAIR is a multiplayer educational game that integrates chemistry content in the gameplay mechanics of adventure and Role-Playing Games, according to the MSGM methodology guidelines. The integrated curriculum follows the policies of the introductory chemistry book [11]. In addition, the game connects the content with real-world applications, supporting meaningful collaborative learning. The integrated chemistry content regards the chapter on oxygen, including the oxygen properties, the oxides, and the combustions, as described in the introductory chemistry book [11]. The game can be used by students who are 14 years old or by people who would like to learn chemistry in an alternative way.

The game was developed with RPG MAKER MV, a role-playing game development engine published by Degica and developed by Kadokawa Games [12]. Instructions for installing and using the game are available online. Additionally, the game's code is available on the internet for further improvements, modifications, and content updating [6].

3.4 Procedure

We organized the game's evaluation in the following steps. First, we informed the participants about the content and the aim of the study. Then, we asked them to read the online instructions and download and install the game on their computer. Participants worked remotely due to the Covid-19 pandemic. Therefore, they followed the instructions to create a virtual network for two or three persons. We additionally suggested the use of online collaborative tools to communicate. Then, participants connected to those virtual networks to play the game. They kept notes of the process as well as the various problems they encountered. They could also use asynchronous communication tools or/and two synchronous sessions with the researchers to solve technical issues and ask questions.

3.5 Measures and Data Analysis

We based the evaluation process on the data from the participants' notes and their questions during the process. The researchers used these data to assess the game's installation and use, emphasizing the multiplayer component. Our first step was to remove all the personal information before digitizing them. Then, we performed an inductive content analysis to identify properties, attributes, and embedded patterns. Finally, we highlighted interesting phrases and discussed our data to develop the study's coding schema. In particular, this study explored three coding categories, social experience, technical issues, game use. Although the inductive analysis could give more coding categories, we did not use them as the age of participants was not appropriate to assess the educational perspective.

3.6 Results

The inductive content analysis of the qualitative data revealed some interesting coding patterns regarding the multiplayer component and its implementation in the SAIR's gameplay mechanics (see Table 1).

Table 1. Inductive content analysis

Coding categories	Description	Examples
Social experience	The way the game forces players to collaborate and cooperate	"All players must collaborate to complete an assigned mission" "The game did not provide an in-game communication tool, and therefore we needed to use other communication channels" "The game did not permit a single player to use it; one or two more players needed to join him/her"
Technical issues	Issues that occur due to the multiplayer component	"I could not join the game at a later time." We did know how to advance to the following map"
Game use	Game content, such as stats, names, and supplementary information that guides players	"I could not understand some game statistics, such as HP "I would like an introduction to my character and his/her role in the game." "I did not know the steps to leave the game without affecting the other players"

Participants underlined the need to connect two or three players in a virtual network to play the game (20%), while they also noticed the need for collaboration/coordination (56%) and communication (16%).

Although the participants' notes did not clearly describe the multiplayer game component, the various technical issues concerned connectivity. Furthermore, the coordination issue due to the multiplayer component appeared in 60% of the cases. For example, the "waiting players" warning message, meaning that one or more group members have not finished assigned tasks, so the others should wait for them (48%). In addition, 16% of them underlined the need for in-game communication. Finally, 56% mentioned technical problems to join the virtual network. Therefore, participants asked for better guidance in using the game, especially in the beginning (36%). Moreover, this guidance also concerned specific features, such as the battle feature (36%) or the characters and their statistics (20%).

4 Discussion

This study evaluated SAIR, a chemistry game for two or three players who want to practice introductory chemistry content. The evaluation process provided valuable insights into the potential of multiplayer digital games and RPGs elements in the context of science education.

4.1 Social Experience

Most participants clearly described SAIR as a digital chemistry game that "forces" two or three players to collaborate. They noticed from the beginning that "the game does not allow one player to start playing unless one or two more players join the game world. "On the other hand, some observations reflect the game's individual, cooperative, and collaborative activities that enrich the gameplay. For example, one participant realized that the game's instructions were not always the same as those of her peers". Individual cognition does not stop in peer interaction. Additional to the cognitive mechanisms that occur in collaborative settings, there are still individual activities, such as reading, building, predicting, and more, which trigger some learning mechanisms, such as induction, deduction, compilation, and more [1]. Individual activities are additionally crucial for the gameplay as they facilitate characters' evolution and collaboration. In particular, individual activities reward players with skills (character progression) to use them coordinately in the battle's challenge. Character progression and the battle challenge are basic RPGs features that can support collaboration [10]. Following the MSGM guidelines, collaborative activities facilitate group work, promoting players to assist each other [2]. Therefore, players "enjoyed working together as active members of the group." They were very excited, suggesting "the enrichment of the game with more activities that promote active participation."

The players relied on "constant communication and coordination" to advance the game plot and avoid unexpected game stops. "It was common sense that "one player's actions depended on the steps of the others". The game demanded coordination to complete the assigned missions, which included the battle challenges. They could not progress to the next level or eliminate an enemy unless they coordinated their effort. As a result, they all needed communication tools, suggesting in-game communication features to improve the gameplay. Meanwhile, all groups used familiar synchronous communication tools to play the game. Coordination and communication processes are essential in collaborative gameplays [8].

4.2 Technical Issues

The cooperative character of some activities prompted players to act as a group. In this case, all of them should participate in activities, such as taking instructions and observing experiments, meaning that they could not advance the game plot without their peers. The message "waiting players" appeared to point out this need. However, 48% of the players thought that the game unexpectable stopped, and they did not realize that some peers needed more time to complete an action (see Fig. 4). It seems that the game design needs to employ alternatives to improve this issue.

Fig. 4. Warning message

Players mentioned that "in case of not coordinated actions, they should start all over again," as the need for coordination influences the game track advancement. Players who use the SAIR must transfer all together to the following map [5]. Adventure games allow a serial game plot, according to the content of a book [2]. In this direction, the MSGM suggests the integration of the science's book educational content in the gameplay mechanics [4]. Therefore, the game design wants all players to move to the following map together. However, it seems that the "group traveling" needs a more careful design.

Another technical issue concerned the game battle, a collaborative activity that also requires coordination and communication to successfully eliminate an enemy. Such problems made the gameplay difficult for those who had no game experience. On the other hand, the groups that involved one player with such knowledge successfully managed to deal with such problems. Thus, previous gaming experience seems to be important in implementing a multiplayer game [7]. A way to deal with such issues is to structure heterogeneous groups that involve experienced and inexperienced players [1].

Some other technical issues concerned the failure of participants to reconnect to the virtual network or join it later. However, the game does not permit changes to the group's structure due to its collaborative learning character. Such issues need the host to save the game and restart the session with all participants.

4.3 Game Use

Most of the aforementioned technical issues made players ask for more instructions, especially regarding the battle's use, the characters' statistics and skills, and the gameplay. Players suggested some manageable levels, aiming to teach players the gameplay, the battle's process, and show to save their work for future use. Gee [14] argues that games include excellent methods to teach all players, even the inexperienced ones, how to play the game.

The last players' suggestion does not concern the multiplayer component. Instead, players underlined the luck of providing players with more information about their virtual character and its role in the game. They needed to feel more "connected to their character and even have the option to choose it". The players of digital RPGs move in the game world through their character, gaining new skills and abilities to overcome obstacles and

fulfill their quests. Therefore, the game could employ a more prosperous storytelling element to connect players with their character and facilitate their progression [10].

4.4 Limitations and Future Work

The study presented in this paper has some limitations too. Although the evaluation process gave us evidence of the RPGs multiplayer component and its implementation in a serious game with science content, the game targets 14 years old students who learn introductory chemistry concepts. Therefore, we did not evaluate the influence of the multiplayer component on the learning experience and learning performance. Moreover, we assessed the game only remotely due to the Covid-19 restrictions. Nevertheless, we had the chance to have an overall picture of downloading, installing, and playing the game by groups of two or three persons.

Future work will improve SAIR, empowering the storytelling element to connect players with their characters and roles. Furthermore, manageable levels will be added to introduce players with the gameplay. Finally, the game needs an evaluation that involves 14 years old students and their teachers with the use of quantitative and qualitative methods, such as voice-chat or text-chat discussions analysis.

5 Conclusions

This study evaluated the multiplayer component of SAIR, which is a digital game for up to three persons. The game relies on complex gameplay that includes different types of activities which promote individual effort, character progression, coordination, and collaboration between players. Significantly, the collaborative activities need the active participation of all players. As a result, players enjoy working together in such pleasant environments, influenced by the RPGs elements.

References

1. Dillenbourg, P.: What do you mean by collaborative learning? In: Dillenbourg, P. (ed.) Collaborative-learning: Cognitive and Computational Approaches, pp. 1–19. Elsevier, Oxford (1999)
2. Wendel, V., Konert, J.: Multiplayer Serious Games. In: Dörner, R., Göbel, S., Effelsberg, W., Wiemeyer, J. (eds.) Serious Games, pp. 211–241. Springer, Cham (2016). https://doi.org/10.1007/978-3-319-40612-1_8
3. Hitchens, M., Drachen, A.: The many faces of role-playing games. Int. J. Role-playing **1**(1), 3–21 (2009)
4. Garneli, V., Patiniotis, K., Chorianopoulos, K.: Designing multiplayer serious games with science content. Multimodal Technol. Interaction **5**(3), 8 (2021). https://doi.org/10.3390/mti5030008
5. Garneli, V., Patiniotis, K., Chorianopoulos, K.: Game mechanics of a character progression multiplayer role-playing game with science content. In: Marfisi-Schottman, I., Bellotti, F., Hamon, L., Klemke, R. (eds.) GALA 2020. LNCS, vol. 12517, pp. 415–420. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-63464-3_40

6. SAIR: A Multiplayer Chemistry Game. https://www.notion.so/SAIR-A-Chemistry-Multiplayer-Game-bf4a108cc89440349e20658e54a0e6b9. Accessed 17 July 2021
7. Sánchez-Mena, A., Martí-Parreño, J.: Teachers acceptance of educational video games: a comprehensive literature review. J. e-Learning Knowl. Soc. **13**(2) (2017)
8. Zagal, J.P., Rick, J., Hsi, I.: Collaborative games: lessons learned from board games. Simul. Gaming **37**(1), 24–40 (2006)
9. Wendel, V., Gutjahr, M., Göbel, S., Steinmetz, R.: Designing collaborative multiplayer serious games. Educ. Inf. Technol. **18**(2), 287–308 (2013)
10. Costikyan, G.: Where stories end and games begin. Game Dev. **7**(9), 44–53 (2000)
11. Gymnasiou, C.B.: http://ebooks.edu.gr/ebooks/v/html/8547/2206/Chimeia_B-Gymnasiou_html-empl/. Accessed 17 July 2021
12. RPG MAKER MV. https://www.rpgmakerweb.com/products/rpg-maker-mv. Accessed 17 July 2021
13. Hsieh, H.F., Shannon, S.E.: Three approaches to qualitative content analysis. Qual. Health Res. **15**(9), 1277–1288 (2005)
14. Gee, J.P.: What Video Games have to teach us about Learning and Literacy, 1st edn. Palgrave Macmillan, New York (2003)