

Article

Serious Games and Soft Skills in Higher Education: A Case Study of the Design of *Compete!*[†]

Nadia McGowan¹ , Aída López-Serrano^{2,*} and Daniel Burgos² 

¹ Centro de Investigación, Transferencia e Innovación (CITEI), Universidad Internacional de La Rioja (UNIR), 28224 Madrid, Spain

² Research Institute for Innovation & Technology in Education (UNIR iTED), Universidad Internacional de La Rioja (UNIR), 28224 Madrid, Spain

* Correspondence: aida.lopez@unir.net

† This paper is an extended version of our paper published in López-Serrano, A.; McGowan, N.; Burgos, D. New digital tools to teach soft skills and sustainability for the labor market: gamification as a tool for competency acquisition in realistic contexts. In Learning Technologies and Systems for Education, Eds. González-González, C.S.; Fernández-Manjón, B.; Li, F.; García Peñalvo, F.J.; Sciarrone, F.; Spaniol, M.; García-Holgado, A.; Area Moreira, M.; Hemmje, M.; Hao, T; Springer Nature: Cham, Switzerland, 2023.

Abstract: This article describes the serious game *Compete!*, developed within the European Erasmus+ framework, that aims to teach soft skills to higher education students in order to increase their employability. Despite the increasing relevance of soft skills for successful entry into the labour market, these are often overlooked in higher education. A participatory learning methodology based on a gamification tool has been used for this purpose. The game presents a series of scenarios describing social sustainability problems that require the application of soft skills identified as key competencies in a field study across different European countries. These competencies are creative problem-solving, effective communication, stress management, and teamwork. On completion of each game scenario and the game itself, students receive an evaluation of both their soft skills and the strategic and operational decisions they have made. In the evaluation of these decisions, both the economic and sustainability aspects of the decision are assessed. The teacher can then address the competencies and sustainability issues using the different game scenarios, thus creating higher motivation and deeper understanding amongst the students. This hybrid learning methodology incorporates digital tools for the cross-curricular teaching and learning of sustainability and soft skills. In conclusion, this article describes a possible method of incorporating soft skills in higher education; this complements students' technical knowledge while helping to achieve Sustainable Development Goals.

Keywords: serious games; soft skills; game design; *Compete!*; gamification; Erasmus+; higher education



Citation: McGowan, N.; López-Serrano, A.; Burgos, D. Serious Games and Soft Skills in Higher Education: A Case Study of the Design of *Compete!*. *Electronics* **2023**, *12*, 1432. <https://doi.org/10.3390/electronics12061432>

Academic Editors: Filippo Sciarrone, Marco Temperini, Marc Spaniol, Luigi Laura and Frederick W. B. Li

Received: 31 January 2023

Revised: 28 February 2023

Accepted: 16 March 2023

Published: 17 March 2023



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1. Introduction

The modern labour market demands greater skills from its workers. These transcend academic and technical knowledge and have begun to incorporate soft skills [1]. These have progressively become a marker for increased employability [2–4].

Among these soft skills are problem-solving, stress management, effective communication, and teamwork. These are essential for students to find good jobs and continue updating their skills. In addition, it must be considered that technological change creates opportunities and increases productivity in a global market. The current labour market is significantly competitive and many jobs require not only hard or technical skills, but also effectiveness and efficiency while interacting with other individuals. Competency in these roles is achieved using soft skills [5]. The introduction of these skills in higher education has proven to be challenging [6].

Approaches to improving students' soft skills include the provision of learning technologies and gamification through serious games as a learning technique that can help them succeed in a job market immersed in the global economy [7]. This has been demonstrated by previous work focused on the development of pilot courses in order to enhance students' intrinsic motivation for online learning during the COVID-19 pandemic [8]. In relation to the application of gamification for the acquisition of soft skills when trying to join the labour market, research focusing on gamified training demonstrated the improvement of individual soft skills, in particular a significant positive effect on creativity-oriented leadership [9].

The cultural landscape in the digital ecosystem has grown to encompass not only the fine arts and literature, but also new creative forms such as comics, podcasts, gifs, and videogames. While some of these forms have been considered of little artistic or intellectual relevance, they have gained their own space as digitally native generations have grown and embraced them. Videogames have been seen as a minor form of entertainment. However, they have also been used as research, propaganda, or educational tools.

Gamification and serious games have gained traction due to the increased availability and usage of digital devices and a development in the skills required to use them, which both teachers and students have acquired. While gamification and serious games have been embraced for primary education students as a motivational tool, the most exciting opportunities around educational games are related to using their intrinsic features as a vehicle in order to teach skills that are not easy to acquire in traditional teaching models in higher education contexts.

Compete! is a serious game aimed at raising awareness among higher education students of the importance of soft skill competencies and their impact in professional and personal settings, focusing on the former. While there are many studies on serious games, their relationship to soft skill acquisition is a relatively new area of research.

Compete! was developed within the European Erasmus+ framework as a participatory learning methodology based on gamification. The videogame is a tool to help students critically apply soft skills and discuss their impact in classroom settings. The game design emphasized giving the students feedback on their decisions throughout the narrative it presents in order to integrate assessment in the game design [10]. This feedback helps improve students' understanding of the impact of their decisions and how these reflect the acquisition of soft skills. The goal is to help final-year university students improve their skills towards their incorporation into the workplace. No special requirements are required for students to participate.

In this study, we present an analysis of current research on serious games applied to soft skills, as a context within which *Compete!* was developed. After this research context, the specific design of the *Compete!* proposal is presented, including the design of this serious game, the soft skills included in it, its storyline, structure, and competency measurement. This single player 2D game (Figure 1) can be played online through any internet browser. It can be accessed and played through the *Compete!* Project's website.

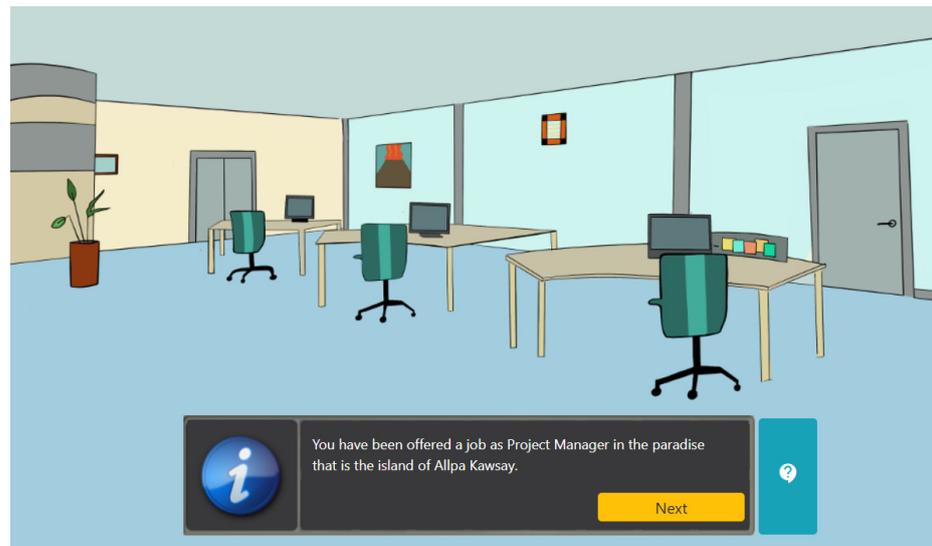


Figure 1. *Compete!* interface.

2. Methodology

The first section of the study aims to assess the research context within which *Compete!* was developed by analysing research performed regarding serious games and soft skills. A bibliometric approach was selected in order to conduct this contextualization. Bibliometric analyses are used to evaluate the impact of specific research topics and the influence of authors, journals, or institutions in that field [11,12].

The sample data were obtained from the Core Collection of Web of Science (WoS). This database was selected due to its high-quality, specifically in the coverage of journals related to STEAM in education [13]. However, studies show that both WoS and Scopus offer similar results when queried and that both are robust tools for bibliometric analysis [14].

The search was performed within ‘Topic’, which includes abstract, titles, author keywords, and Keywords Plus. Keywords Plus is an algorithm created by Clarivate in order to incorporate ‘words or phrases that frequently appear in the titles of the article’s references and not necessarily in the article’s title or as Author Keywords’ into searches [15]. The terms included in the search were ‘Serious Games’ and ‘Soft Skills’.

The search of ‘Serious Games’ yielded 10,934 results; these were reduced to 63 when adding ‘Soft Skills’ as a criterion. Document type was further refined to only include articles. This was conducted to guarantee meticulous peer-review of the materials included in the dataset [16]. As a result, the final dataset was comprised of 23 articles. Articles published each year, the journals where they were published, subject categories within WoS, and topics of interest were examined. As the focus was on what topics are being studied, citation analysis has not been included.

The second section of this study describes the design of the *Compete!* project. There are many frameworks available for serious game design [17] and the main challenge is to balance learning and making the game attractive [18]. In this case, the methodology followed resembles the one proposed by Barbosa, Pereira, Dias, and Silva [19], based on tasks and mini-games or puzzles. The design differentiates educational content (the soft skill selection), how the storyline is structured, the game structure, and learning assessment methods.

3. Results

3.1. Bibliometric Analysis

Publications that study serious games and their relationship to soft skills can be found starting in the year 1993 but they are few in number. Only 23 documents were found, 15 of which (65.22%) were published between 2019 and 2022 (Figure 2).

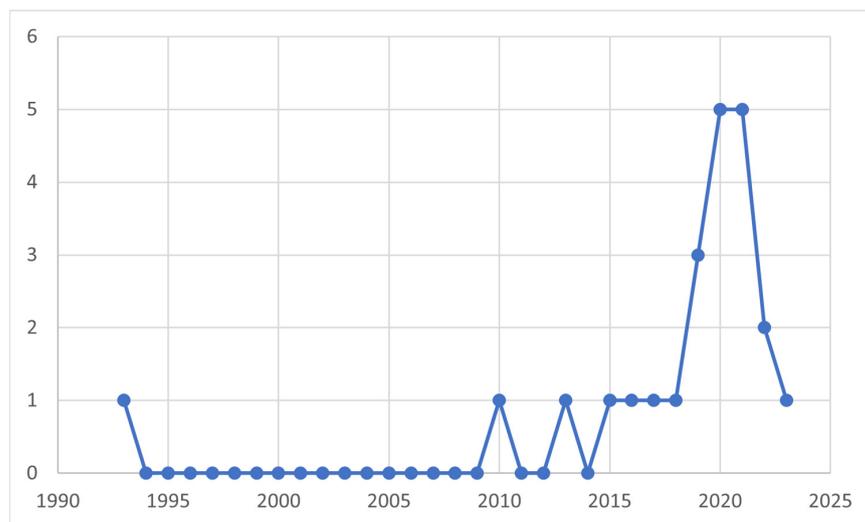


Figure 2. Articles per year.

A total of 19 journals have been identified as sources for these articles. Only three have published more than a single paper on the topic. These are *International Journal of Serious Games* (3 articles), *Entertainment Computing* (2), and *Simulation & Gaming*.

Top institutions publishing in this area include the University of Indianapolis (3 articles), University of Porto (3 articles), Corvinus University of Budapest (2 articles), North Dakota State University (2 articles), and the University of Naples Federico II (2 articles). Each of these articles was published from 2018 onwards.

Of the 65 authors identified, most published a single paper on the topic, and only three (Almeida, Buzady, and Eikel) publish two. The articles have an average of 2.96 authors per article; only three are single-author publications.

Subject categories (based on WoS classification) show that most publications are within the education and educational research domains (eight occurrences). Other areas of interest include Computer Science Interdisciplinary Applications (three occurrences) and Psychology—Social (three occurrences). The full list can be found in Table 1.

Table 1. Occurrences of Web of Science categories.

WoS Categories	Occurrences
Education and Educational Research	8
Computer Science—Interdisciplinary Applications	3
Psychology—Social	3
Computer Science—Cybernetics	2
Computer Science—Information Systems	2
Computer Science—Software Engineering	2
Education—Scientific Disciplines	2
Social Sciences—Interdisciplinary	2
Telecommunications	2
Engineering—Chemical	1
Engineering—Electrical and Electronic	1
Engineering—Manufacturing	1
Environmental Sciences	1
Environmental Studies	1
Ergonomics	1
Green and Sustainable Science and Technology	1
Hospitality—Leisure Sport & Tourism	1
International Relations	1
Management	1
Medicine—General and Internal	1
Nursing	1
Orthopaedics	1
Psychology—Applied	1

A search was performed on the bigrams (Table 2) present in the abstracts of the articles within the database. Once ‘soft skills’ is eliminated as a result (38 instances), the remaining bigrams are an indication of the areas of interest of these articles.

Table 2. Occurrences of bigrams in article abstracts.

Abstract Bigrams	Occurrences
Educational escape	7
Board games	5
Lab session	5
Modern board	5
Simulation game	5
Crisis management	4
Professional practice	4
Project management	4
Skill development	4
Business simulation	3

The topics analysed presented the following descriptive results according to the frequency and thematic content that exists in the articles found within WoS.

First, it should be noted that gamification is widely used for learning competences in different areas of higher and professional education. Universities and businesses are developing ad hoc gamifications to teach technical and soft skills to their students and professionals, with the aim of improving methodology and learning outcomes in a flexible way. Thus, the articles analysed show the application of gamification tools in the business, education, security, defence, technology, and commerce sectors.

The tools developed through gamification are primarily escape rooms and simulation games. Educational escape rooms are interactive experiences in situ used for the teaching of competences that are contextualized in the field of higher education, in different areas of knowledge, through gamification. This tool, aimed at both students and teachers, has been developed for the learning of soft skills that are necessary to address very specific topics in the field of health, specifically aimed at nursing students, to address issues such as cardiovascular disease [20]. Similarly, in chemical engineering [21], the application of gamification for technical and soft skills learning offers positive results. Students achieve effective and practical learning in a short period of time. These results are confirmed by the outcome evaluation of programs such as escapED [22], where teachers highlighted the advantages of educational escape room models designed for digital and technological platforms. Taking these educational models as a starting point, the development of interactive experiences in situ continues to be improved and iterated upon.

Simulation games are tools that provide the opportunity to manage scenarios with which to rehearse situations that can be encountered in real life, allowing participants to actively interact with a project. They represent a way of stimulating learning processes through practical training; this has become known as experiential learning, or ‘learning by doing’. Simulation techniques are used in a wide variety of fields, such as automotive companies, where training procedures are provided and the behaviour of workers, with different profiles and under various controllable circumstances, is experimented with in order to investigate the mechanisms that affect the acquisition of knowledge in the environment.

Some gamification tools are based on previous methodologies developed in physical spaces, such as board games [23]. Board games offer a reference methodology for the development of competences, which are being taken as a reference for the design of serious games. In this sense, the application of the board game methodology allows for practical learning; this is why it is applied to the technical and soft skills training of professionals in different fields where it is necessary to make decisions in a short period of time. This is especially true in the case of IT security, where it is necessary to respond to emergencies in

cases of cyber threats. It is concluded that modern board games are a training tool based on exercises that facilitate training and rapid and effective response.

Along the same line of practical learning, virtual spaces have been developed through online lab sessions. These are virtual spaces in which technology is used with the aim of providing a high level of interaction between the students, the teacher, and the pedagogical resources. These spaces allow students to carry out all kinds of practices in a simplified way, interacting differently depending on their needs. Virtual spaces have been applied in higher education institutions, providing students with a flexible space with enormous possibilities. Thanks to this freedom, students are more likely to pay more attention to learning and achieve better results. This is because the way students acquire knowledge is flexible, responding to diverse sources of information and combining theory and practice. When virtual spaces are integrated into learning, learners are motivated to use their ingenuity and inventiveness in order to reach solutions to the various challenges. A practical example is their implementation in the C² business simulation game [24].

This analysis has shown that gamification is an effective tool for learning and developing soft skills. These skills are necessary for coping with real professional life, where effective project management and crisis management are necessary. Gamification offers the flexible, dynamic, economical, and open learning of competences. Table 3 shows the type of gamification in relation to the sectors in which it has been applied for the acquisition of technical competences.

Table 3. Gamification and sectors of application.

Gamification Type	Educational Escape Room	Board Games	Lab Session	Virtual Simulation
Education	1			
Company			1	1
Health	3			1
Crisis management			1	
Automotive				1
Peacekeeping				1
Engineering	1		1	1
Military				1
Modern board		1		
Total	5	1	3	6

3.2. Design of the Game *Compete!*

Educational games must strike a balance between education and entertainment [25]. While ‘edutainment’ generally holds negative connotations [26], games must provide a certain sense of fun to the player. In order to achieve skill acquisition while providing a fun environment, we first developed a study of which soft skills were to be included in the game. After selection, a storyline was designed to maximize their impact. Finally, assessment methods were developed for the game based on soft skill competency acquisition measurements.

3.2.1. Competence Framework

The soft skill framework design for *Compete!* [27] was based on the four categories outlined by the eLene4work taxonomy [28]: social, personal, methodological, and digital skills. These categories were presented to 500 enterprises and 350 recently graduated higher education students to identify which skills were deemed the most relevant in the labour

market [29] and to Sustainable Development Goals (SDGs). Each soft skill competency was divided into three basic behaviours [30]. The skills selected were as follows:

- **Creative problem-solving:** the ability to come up with unusual or clever ways to solve a problem. This competency helps solve novel, ill-defined problems in complex, real-world settings. This skill is related to SDG 9 (Industry, Innovation, and Infrastructure), as it specifically calls for increased investment in research and development, where creative problem-solving can be an important driver for innovation. The basic behaviours of this competency are problem definition, creative alternatives, and decision and action plan.
- **Effective communication:** the ability to convey a message to a person or group in an effective and efficient manner. This competency is the process of exchanging ideas, thoughts, knowledge, and information in such a manner that the purpose and content of the message is fully shared and understood by the receiver. This soft skill is related to several SDGs, including SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 4 (Quality Education). This skill can help deliver educational campaigns, facilitate discussion in poverty reduction, and promote those solutions proposed to improve these SDGs. The basic behaviours of this competency are logic, empathy, and trust.
- **Stress management:** the ability to deal with stress-inducing situations and the subjective experience of stress, using rational arguments and tools to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems. This competency is related to the capacity to set priorities and the effective use of time and resources. Stress management can be related to the achievement of SDGs related to health, well-being, and sustainable development, including SDG 3 (Good Health and Well-being), SDG 8 (Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), and SDG 16 (Peace, Justice and Strong Institutions). The basic behaviours of this competency are resourcefulness, prioritisation, and timeline management.
- **Teamwork:** the ability to work together in a group with other people, using cooperation for mutual benefit and collaboration as a deeper communal effort toward a shared goal. Teamwork involves the capacity to count on other people's ideas and capabilities and to coordinate different actions in order to achieve the team output. This soft skill is essential to many SDGs, but SDG 17 (Partnership for the Goals) specifically highlights the importance of collaboration to achieve other SDGs. The basic behaviours of this competency are common goals, team spirit, and team organization.

3.2.2. The Game's Story Structure

The storyline designed for *Compete!* gamifies the approach to soft skill competency acquisition. The story revolves around sustainability and the choices given to the players have both a social and economic impact. The narrative is divided into two introductory tasks and ten challenges. The initial challenges help introduce the player to the game. Each challenge is a unique scenario where a social or environmental problem is presented.

The player takes the role of a new Project Manager on the Island of Allpa Kawsay, inspired by Ecuadorian territories. This position requires advising the local government and helping them develop the local economy sustainably while keeping the residents happy.

The initial introductory tasks present the setting, the office from where the player will work, and the gameplay.

The challenges are as follows:

1. **The international investor:** the player is offered the chance to build a hotel on a beach that is part of a natural reserve.
2. **Better fish to fry:** fish reserves are depleted in local waters.
3. **High voltage:** the island has a power shortage. An adequate energy source must be chosen.

4. Deep waters: island water supplies have been polluted by the local mining industry.
5. Rubbish: the island’s only landfill is full, and the lack of proper on-site waste management is contributing to rising pollution levels.
6. Naturally, a disaster: rising pollution triggers a volcanic eruption that, in turn, causes a tsunami. The player must act and help solve the crisis.
7. Poachers: an international mafia wants the locals to smuggle a rare bird for them.
8. Sea Level Rising: water levels are at an all-time high. Something must be done before the island drowns.
9. Deforestation: forests are being consumed by farms and timber production.
10. Slave trade: the lack of local opportunities and the many crises put the inhabitants at risk of falling into human trafficking and modern slavery abroad.

3.2.3. Game Structure

The game’s introduction is comprised of two introductory tasks that help the player become familiar with the storyline and the gameplay. Afterwards, the player is presented with the core of the game, which is the ten challenge scenes. Each challenge follows an identical structure (Figure 3). The structure is as follows:

1. The challenge storyline is presented.
2. The player is given a task. They must pick between two possible choices to complete it. Each choice helps measure specific soft skill competencies.
3. Counsellors give their opinion of the best course of action.
4. The player decides which counsellor gives them the best option. This choice will be assessed based on its sustainability and social impact.

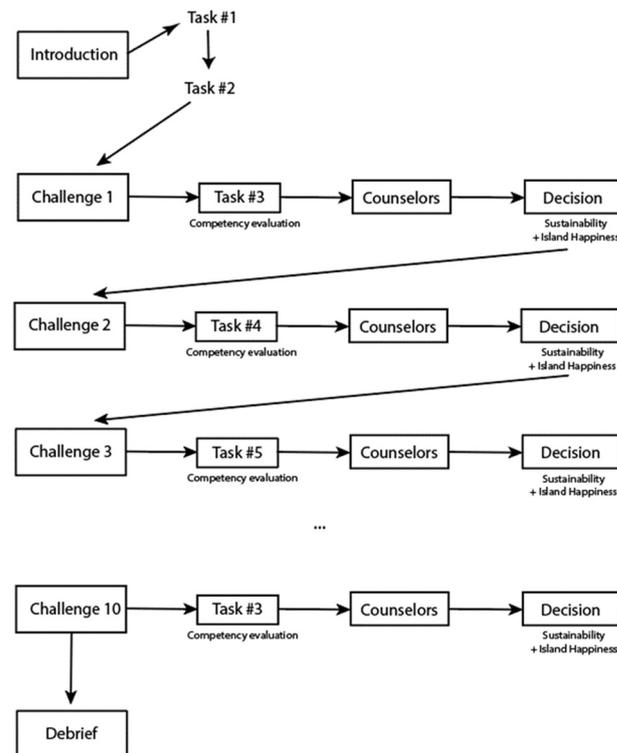


Figure 3. Game structure.

3.2.4. Measuring Soft Skills

Soft skill competencies are measured independently from the social and economic impacts of the decisions the player makes.

Soft skill competencies are measured in three dimensions. Each of these dimensions is measured using a binomial right or wrong (a or b) decision. Social and economic impacts

are measured through sustainability and island happiness. Sustainability refers to the economic impact of the decisions made by the player. Island happiness is the social impact of their decisions. Both are linked by the answer given to the competency measurement task. The correct answer will give the player access to the best option in the decision section. If the incorrect answer is chosen, the option that would have awarded the player the maximum number of points will not be available. That counsellor will explain why they cannot offer advice. Giving competencies a real-life impact reflects how people who have developed their soft skills have better opportunities to achieve results when they are involved in a project.

Each competency is measured a total of three times on a 4-star scale. On each occasion, a different aspect is emphasized. Each competency has two elements worth one star and one core element worth two stars. Stars are awarded based on choosing the correct path when faced with a task during a challenge. This results in a maximum of four stars per competency. Their distribution can be found in Table 4.

Table 4. Competency point distribution per challenge.

Challenge	Creative Problem-Solving	Effective Communication	Stress Management	Teambuilding
Puzzle 1			1 star	
Puzzle 2	2 stars			
Challenge 1		1 star		
Challenge 2				1 star
Challenge 3	1 star			
Challenge 4		2 stars		
Challenge 5	1 star			
Challenge 6			2 stars	
Challenge 7				1 star
Challenge 8				1 star
Challenge 9			1 star	
Challenge 10		1 star		
Total	4 stars	4 stars	4 stars	4 stars

Soft skill competency scores are shown in a style like the one presented in Figure 4.



Figure 4. Scoring system for soft skills competences.

Economic and social impact are measured from 0 to 15 points. In each challenge, the player must listen to their counsellors and decide whose advice they will follow. These choices impact the amount of sustainability and island happiness points. As there are five counsellors, there are five possible choices (Table 5), which distribute points in the following manner:

1. 0 Sustainability, 0 Island happiness (0 S + 0 Ih): the choice neither develops a sustainable economy nor increases island happiness.
2. 1 Sustainability, 0 Island happiness (1 S + 0 Ih): the choice is good for a sustainable economy but has no positive social impact.
3. 0 Sustainability, 1 Island happiness (0 S + 1 Ih): the choice does not improve the local economy in a sustainable way but does have a positive local impact.

4. 1 Sustainability, 1 Island happiness (1 S + 1 Ih): the choice is both sustainable and will be socially positive.
5. 1.5 Sustainability, 1.5 Island happiness (1.5 S + 1.5 Ih): the choice is sustainable, socially positive, and has the extra advantage of being a creative and well-thought-out option.

Table 5. Distribution of points and counsellors for each challenge.

Challenge	0 S + 0 Ih	1 S + 0 Ih	0 S + 1 Ih	1 S + 1 Ih	1.5 S + 1.5 Ih
Challenge 1	Noelia	Francesca	Martin	Yarik	Greta
Challenge 2	Greta	Francesca	Martin	Yarik	Noelia
Challenge 3	Noelia	Greta	Yarik	Martin	Francesca
Challenge 4	Francesca	Greta	Martin	Yarik	Noelia
Challenge 5	Martin	Noelia	Greta	Francesca	Yarik
Challenge 6	Greta	Noelia	Francesca	Yarik	Martin
Challenge 7	Martin	Yarik	Greta	Noelia	Francesca
Challenge 8	Yarik	Martin	Francesca	Noelia	Greta
Challenge 9	Noelia	Yarik	Greta	Francesca	Martin
Challenge 10	Greta	Francesca	Martin	Noelia	Yarik

Counsellors have each distinct personalities that affect how they react to the situations the player encounters. This creates a logic behind their suggestions, although their personal views are never made explicit.

- Martin: the idealist.
- Greta: the realist.
- Francesca: money-centered.
- Noelia: tourism specialist.
- Yarik: local activist.

3.3. Competence Assessment through Gamification

Each scene provides feedback to players regarding their choices (Figure 5). These are divided into two sections. The first shares the results related to the social and economic impacts, measured based on sustainability and island happiness of the chosen course of action. The second is related to the soft skill competency associated with the challenge. In this case, the feedback suggests other possible courses of action or reinforces why the choice was adequate. In all cases, players are encouraged to discuss the topic with their peers.

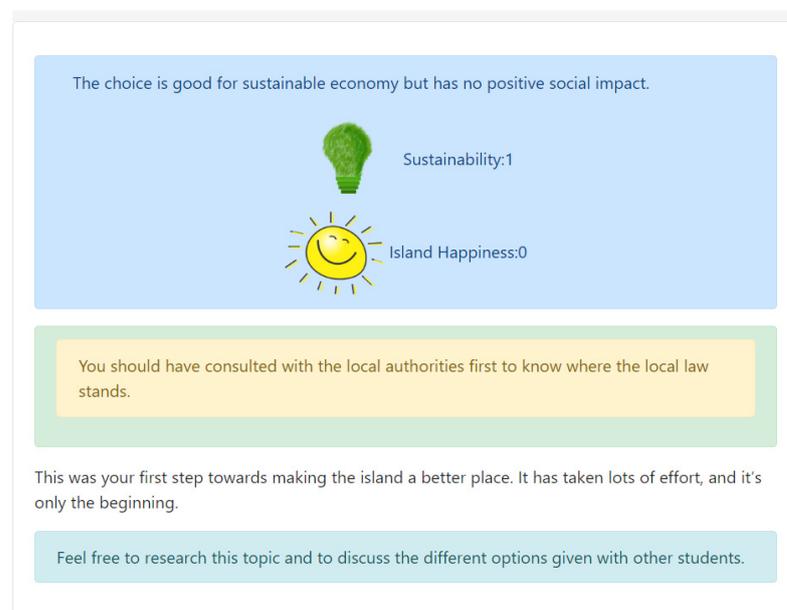


Figure 5. End of Challenge 1 scores.

After completing the tenth scenario, players access the Final Report section, where their total scores are shared and explained. This is the accumulation of the partial scores from each scene. The aim of the design is to highlight the importance of the soft skill competencies and their critical behaviours in order to motivate the player to further develop these skills (Figure 6).

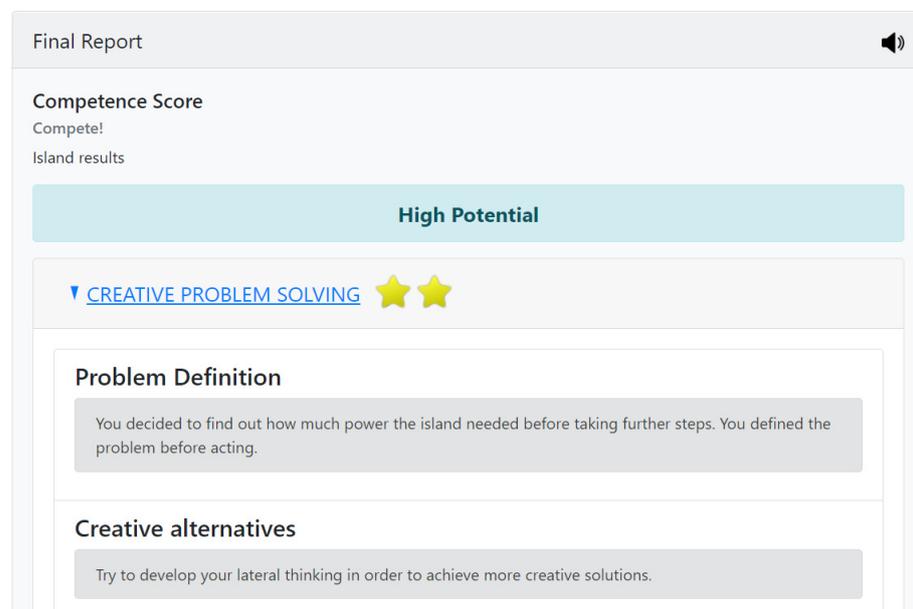


Figure 6. Final report example.

External factors are measured independently during the game, from 0 to 15 points each. At the end of the game, the scores are summed up and results are given according to the following categories:

- Four stars (25–30 points): Expert
- Three stars (19–24 points): Professional
- Two stars (13–18 points): High potential
- One star (7–12 points): Beginner
- No stars (0–6 points): Newbie

Each soft skill competency is also awarded stars based on the results obtained in the assessment of each related behaviour. The explanations related to each behaviour highlight the choices the players have made and how they could have behaved differently in order to increase their competency in that soft skill area. The result is an overview of all the choices taken that can help players reflect on their overall behaviour.

4. Discussion and Conclusions

There has been an increase in research papers regarding soft skills in serious games during the last few years (2019–2022); most of these relate to virtual simulations and educational escape rooms. Within this context, the *Compete!* videogame was designed to help higher education students acquire soft skills to help them join the labour market successfully. The use of gamification in education can help students not only learn the key concepts that define soft skills, but also practice the application of the acquired knowledge in real-world simulated situations [24].

The design of *Compete!* aims to improve individual soft skills, including communication skills, creative intelligence, and collaboration skills. Serious games such as *Compete!* are visually attractive and dynamic; they help to develop these soft skills needed in working life through knowledge acquired by taking right or wrong decisions. In this sense, *Compete!*

can provide an active learning space in which students can try out various strategies that can be applied in professional life settings. In addition, they receive direct feedback.

Therefore, *Compete!* can be an effective and targeted training for the integration of young people into the labour market. *Compete!* can be used in classroom settings as part of active teaching-learning in cross-curricular environments. The game design fosters active dialogue that can be used to increase student engagement. This is achieved through a series of scenes that introduce current topics of interest and which can create controversy regarding what would be an adequate solution for them. *Compete!* aims to increase higher-education-student employability while also raising awareness regarding the sustainability issues embedded in the storyline. Given the fact that choices made by players have economic and social impact, higher awareness of these issues is also an expected result. Therefore, the game design and methodology promote the Sustainable Development Goals proposed by the United Nations.

However, there are some risks involved in the use of serious games for effective soft skill learning. Serious game can oversimplify complex concepts and situations; this can be misleading and fail to capture the nuance of real-life situations. The skills may also be hard to translate to real-world situations if the students focus on game mechanics and not core content. Lack of engagement is also a potential risk if participants are not invested in the game. Finally, there is also the risk of the design not being sufficiently inclusive and unbiased. Careful design is required to minimize this risk.

Given that this is a pilot project, the study presents some limitations, such as not being able to include all sub-competencies. In addition, time limitations in game extension may mean a lack of reinforcement of the learning of each competency. Future versions should address this difficulty.

The application of this serious game will provide the first results about the level of acquisition of each soft competence achieved by the students. Depending on this, its application is also planned to adjust and improve the gamification methodology, if necessary. In addition, it is planned to extend the methodology used for the acquisition of other competencies specific to each knowledge discipline. Similar serious games may also be designed for other academic levels, such as master's degrees and vocational training.

Author Contributions: Conceptualization, D.B. and A.L.-S.; methodology, N.M.; software, D.B.; investigation, N.M. and A.L.-S.; data curation, N.M.; writing—original draft preparation, A.L.-S.; writing—review and editing, N.M.; project administration, D.B.; funding acquisition, D.B. All authors have read and agreed to the published version of the manuscript.

Funding: This work has been partially co-funded by the European Union, through the Erasmus+ Programme (GA 2019-1-IT02-KA203-062350).

Data Availability Statement: The bibliographic analysis database is publicly available at <https://doi.org/10.5281/zenodo.7544882> (accessed on 17 January 2023).

Conflicts of Interest: The authors declare no conflict of interest.

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