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"The Mysterious Disappearance": assessment of a sustainability-themed virtual educational escape room in higher education

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Abstract

Purpose – In this study, we assessed the educational value and efficacy of a virtual educational escape room (VEER), called "The Mysterious Disappearance", for training pre-service teachers.

Design/methodology/approach – "The Mysterious Disappearance" was developed ad hoc and contains various activities and puzzles focussing on the Sustainable Development Goals (SDGs). The research will evaluate the design quality and satisfaction of 193 participants regarding the VEER, their perceptions of game-based learning (GBL) and analyse which soft skills are most used and which valence typology (positive/pleasant or negative/unpleasant emotions) has the greatest impact on players' experience. Descriptive, exploratory factor and inferential analyses are employed.

Findings – The study indicates that the VEER is rated very positively by pre-service teachers. Overall satisfaction levels are high, and the resource and methodology are perceived as favourable. The design quality of the resource is also well rated, with participants perceiving it as a challenging but engaging and well-balanced. Participation in the VEER shows several benefits, especially in cognitive and motivational areas. The participants demonstrated high levels of soft skills utilisation. The resource elicits predominantly positive and pleasurable emotions. Finally, there is a positive perception towards GBL among pre-service teachers, both as students and future teachers.

Originality/value – This study employs a multivariate analysis, using a questionnaire comprising three scales. This study's dual focus on participants' perceptions, as current Students and Future teachers, provides insights into their potential role as designers/implementers. Findings contribute to the ongoing development of academic hypotheses, particularly by highlighting the increased motivation linked to VEER use and its positive impact on learning. Designed with the SDG framework, the game enhances teachers' engagement with the 2030 Agenda, supporting their professional development and promotes values related to sustainability. The VEER was developed ad hoc by one of the authors, and the study has potential implications for numerous fields and areas of research.

Keywords Virtual educational escape room, Innovative and disruptive methodology, Pre-service teachers, Assessment, Soft skills, Environmental and sustainable education

Paper type Research paper

1. Introduction

The increasing prevalence of educational escape rooms (EERs) across various formal educational levels has reported numerous benefits, highlighting its cognitive and motivational impacts, along with the development of soft skills (López, 2024). Among the diverse purposes for which EERs are employed, a small yet growing corpus of resources aims to engage younger learners with complex issues, such as climate change and

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sustainability (González-Muñoz and Ouariachi, 2024; Ouariachi and Elving, 2020). Nevertheless, there is a paucity of research investigating these trends with pre-service teachers, with even fewer studies focusing on virtual EER (VEER). This population has the potential to design and replicate these innovative and disruptive methodologies in their future professional performance, influencing the learning processes of numerous future generations for decades (Yeflach, 2024). This fact is crucial, given that the younger population has demonstrated a considerable influence in climate activism and the pursuit of sustainability (Aczel and Makuch, 2023).

In this context, "*The Mysterious Disappearance*" VEER was developed ad hoc to work on the Sustainable Development Goals (SDGs) with students from the *Master in Secondary Education Teaching* at the University of Granada, pre-service teachers. The design of the resource has revolved around 3 main pedagogical objectives: (1) To present to pre-service teachers, in a practical way, a disruptive methodology that they can implement in their future teaching; (2) To promote the acquisition of knowledge and stimulate curiosity about sustainability and (3) To practice and develop soft skills, that are essential for the social and professional performance of future teachers.

The theoretical and pedagogical foundations of the VEER are those delineated in the literature review of the study, which underscores the SDG of the United Nations, and the implementation of the escapED framework by Clarke *et al.* (2017). The VEER was developed using *Genially*, incorporating the *S'CAPE* and *Sandbox-Educación* extensions. The original design (Figure 1) comprised over 100 screens. Each screen presents participants with different challenges (solving a puzzle, searching for clues, deciphering codes, among others), designed to enhance knowledge and motivate students towards learning about the SDG, with a particular focus on climate emergency (SDG 7, 12, 13, 14 and 15). Figure 2 presents visual depictions of the game environments. Figure 3 depicts players' inventory (tablet) and three puzzles examples.

The design also incorporates modern games based on television series, including "*The Squid Game*" and "*Wednesday*" (Figure 4).

Two pilot tests were carried out to assess VEER functionality, identify errors and analyse its difficulty level. First pilot involved students from the Master in *Compulsory Secondary Education Teaching* (target population). The duration was set to a maximum of 60 min. This test allowed for various design adjustments, including numerous bug fixes and reductions in difficulty and game length.

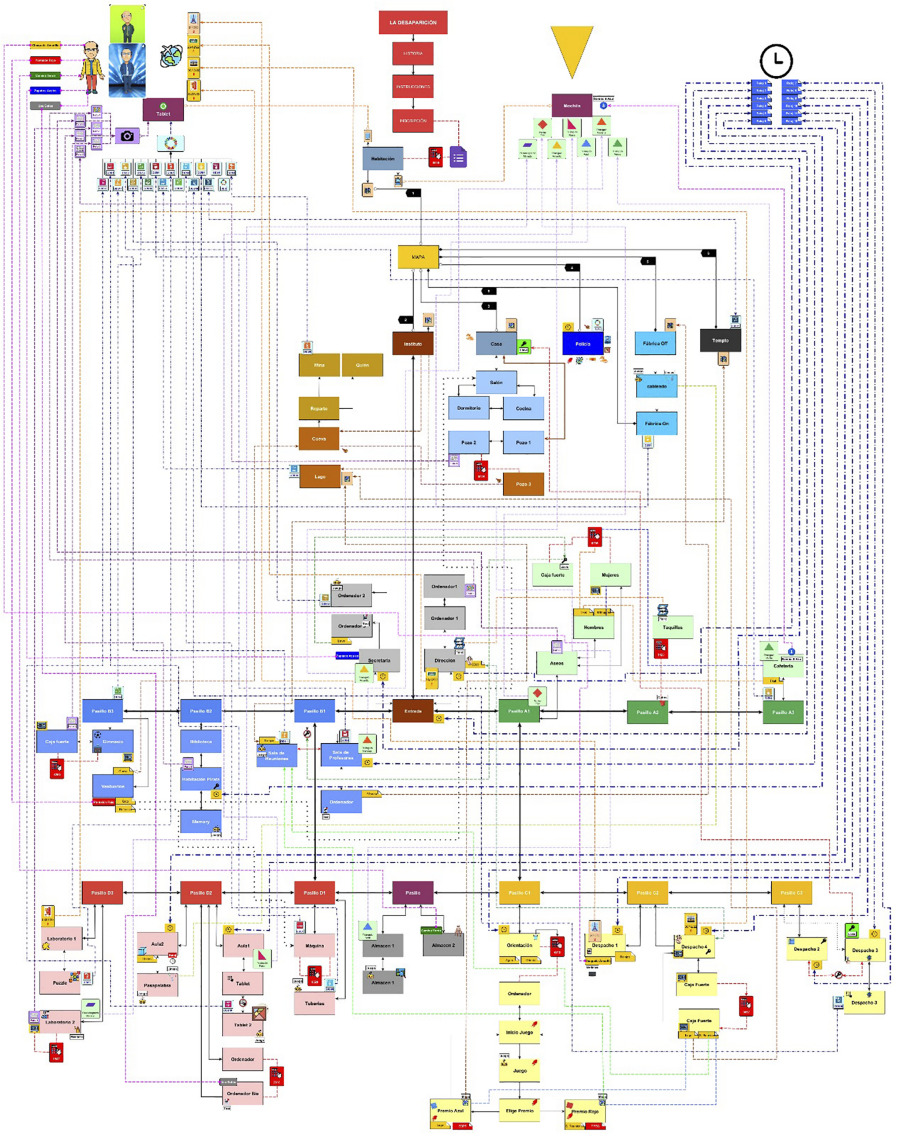
Second test involved 30 university professors. The feedback was positive, no bugs/errors were found and difficulty was considered appropriate for the target audience.

Through the design, implementation and subsequent study of the resource, the present research aims to evaluate the VEER design quality and satisfaction level among 193 participants; to ascertain pre-service teachers perceptions towards game-based learning (GBL); to analyse which soft skills are most utilised and which valence typology (positive/pleasant emotions or negative/unpleasant emotions) has the greatest impact on player' experience. The following research questions were developed to guide the study:

RQ1. What aspects of the VEER and GBL do pre-service teachers rate favourably or unfavourably after completing the playing session?

RQ2. Does the VEER session facilitate the development of soft skills in future teachers, and what is the predominant emotional valence associated with this process?

RQ3. What is the impact of demographic factors, such as age and gender, on the other variables included in this study?



Source(s): Authors' own creation/work

Figure 1.
Game logic design of the VEER

2. Literature review

2.1 Education in the context of climate emergency and the Agenda 2030

In a few years, the world will reach a significant milestone regarding global sustainability and climate change. The year 2030 will mark a key point in the fulfilment of numerous international agreements, with the 2030 Agenda for Sustainable Development being particularly relevant. In the same year as the Paris Agreement (an international treaty designed to maintain global warming below 1.5°C, compared to pre-industrial levels) was

Figure 2.
Maps, rooms and other relevant details

Source(s): Authors' own creation/work

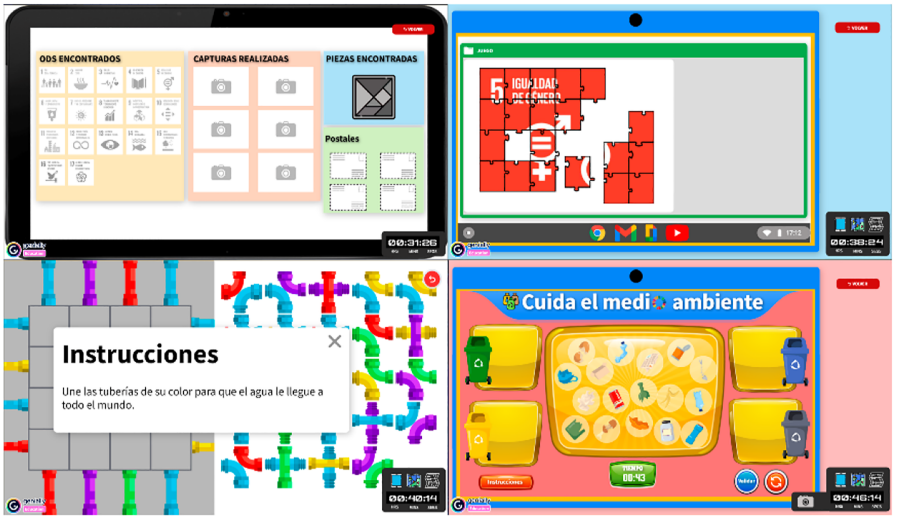


Figure 3.
Tablet interface and various puzzle examples

Source(s): Authors' own creation/work

signed, the United Nations member states collectively approved and committed to achieving 17 SDG. The 2030-Agenda seek to eradicate global poverty and improve the quality of life for all people, whilst simultaneously mitigating climate change and protecting the global environment (United Nations [UN], n.d.). Seven years on, in its most recent report, the United Nations Secretary General notes: "unless we act now, the 2030 Agenda could become an epitaph for a world that might have been" (UN, 2023, p. 2).

In this context of climate emergency and for sustainability, immediate and innovative actions are required in all spheres of human society. Of particular importance is the sphere of

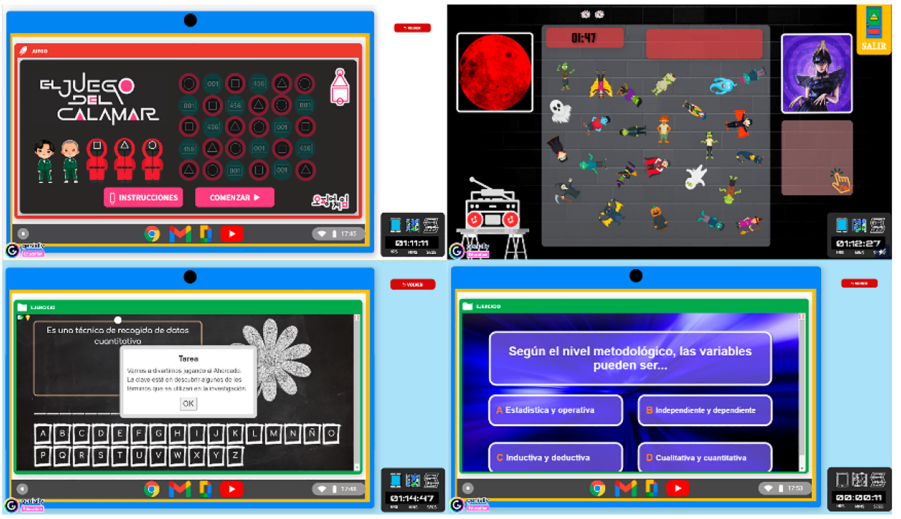


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Figure 4.
Series and games-related puzzles and activities

education, which plays a crucial and internationally recognised role in disseminating scientific knowledge, raising awareness, motivating, and promoting skills and habits linked to the conservation of the planet among current and future generations (IPCC, 2023; Thunberg, 2022). Nowadays, a considerable number of studies indicate that innovative and even disruptive methods are required for sustainability education (Lester *et al.*, 2023). Disruptive methodologies are innovative and unconventional pedagogical approaches that challenge traditional teaching-learning methods and aim to significantly reshape education by the following: (1) Incorporating more effective, motivating and adaptable ways of learning that align with the demands of the 21st century. (2) Promoting development of soft skills, understood as personal and interpersonal meta-abilities that enable individuals to develop effectively in the social and professional environment. (3) Reconfiguring and empowering the role of the student as an active agent in their learning process (Zeybek and Saygı, 2023).

2.2 Disruptive methodologies: GBL and EER

There are several methodologies that the academic literature recognises as disruptive. Among them is GBL, considered a leading trend in the field of education. GBL is defined as the application of games in the educational environment with a pedagogical intention (Dahalan *et al.*, 2024; Rivera *et al.*, 2022). This methodology facilitates meaningful learning among players through the creation of playful, motivating and challenging environments that encourage students' active participation (Dehghanzadeh *et al.*, 2023). The most prevalent resources employed in GBL are known as serious games. The design of these games is informed by an underlying educational intention (López, 2024).

EER are collaborative serious games that can be conducted in either a physical or online setting. In the latter case, they are commonly designated as VEER. In these educational games, teams of players must collectively explore different rooms, search for clues/objects needed to advance, solve puzzles and undertake tasks in order to reach a goal within a limited time frame. There are various frameworks that designers can draw upon when creating VEER. One of the most relevant is EscapED (Clarke *et al.*, 2017), which has become a pivotal approach in the context of higher education. It establishes a systematic pattern and a

coherent structure that designers can extrapolate and adapt to their specific context, needs, pedagogical objectives and student population.

The use of this resources in educational contexts has become increasingly popular in recent decades (López, 2024), and has been accompanied by a considerable body of research seeking to explore its pedagogical value, with a variety of approaches, including systematic literature reviews, non-interventional perceptual studies and interventional studies. A synthesis of the aforementioned reviews and research reveals the following benefits:

(1) Most participants perceive these experiences as highly engaging/interesting and is associated with emotional elicitation, particularly the so-called positive emotions (Yllana *et al.*, 2023). This finding is consistent across cohorts of varying ages and cultural backgrounds (Zainuddin *et al.*, 2023).

(2) Facilitates meaningful learning and improves players' cognitive processes, even when used with complex and systemic topics such as climate change, energy transition, or SDG (González-Muñoz and Ouariachi, 2024; López *et al.*, 2024).

(3) Enables the implementation and development of numerous soft skills (Veldkamp *et al.*, 2020), which are widely linked to the cross-cutting skills, highlighted in *The European Sustainability Competence Framework* (Joint Research Centre, 2022). Therefore, promoting skills required by future citizens in order to achieve fairer and sustainable societies.

(4) Its innovative and disruptive approach aligns with "SDG4.Quality education", integrating technology for experiential learning while potentially fostering emotional connections with eco-social issues, such as climate change, energy transition and others (González-Muñoz and Ouariachi, 2024).

2.3 VEER: an emerging tool in the training of pre-service teachers

The implementation of disruptive resources on formal education, specifically VEER, has been a topic of considerable interest and debate in recent decades (López, 2024). This indicates a necessity for a transformation in the educational paradigm and also reflects the urgent requirement to identify more effective educational responses for the promotion of sustainability and mitigation/adaptation to the climate crisis (IPCC, 2023; Lester *et al.*, 2023; Thunberg, 2022). In this context, it is crucial to examine not only the efficacy and advantages of such pedagogical approaches for students, but also for potential designers/implementers, namely pre-service teachers. Research studies conducted within this group has revealed an emerging line of work with significant potential.

The study by Calle *et al.* (2022) demonstrates that pre-service teachers in the field of secondary education positively value the application of VEER in their initial training. The study highlights not only the benefits that these teachers obtain from these resources as students, but also as future teachers, since they comment that working with these resources allows them to learn about innovative teaching methodologies. These findings also align with García *et al.* (2020), who posited that practical experience during teacher training process is a predictor of a greater predisposition towards its future implementation. The fact that utilisation of VEER with pre-service teachers does not only result in immediate benefits for this population, but may also have a multiplier effect is of particular relevance in the context of climate emergency and sustainability. As previously stated, in this context, the implementation of innovative and disruptive educational approaches is required in order to effectively impact the motivation and awareness of the population, while simultaneously fostering the development of soft skills, essential for their functioning within a society in which they have a recognised role and duty as agents of change (Aczel and Makuch, 2023).

3. Research methodology

The study comprised a sample of 193 students enrolled in the *Master* in *Secondary Education Teaching* at the University of Granada. Pre-service teacher trainees, whose objective is to become future secondary school teachers upon completion of the programme. The entire student population of the aforementioned Master participated in the study ($n = 201$).

In order to control for potential influence of age on other variables, participants were divided by generations. As a result, 8 *Generation X* participants (aged 55 to 58) were excluded, due to insufficient representation. The retention of this small group would have complicated generational comparisons, thereby weakening the analysis and limiting the generalisability of the results. Final sample consisted of *Generation Z* (58.5%), aged 21–26, and *Y* or "*millennials*" (41.5%), aged 27–42. In terms of gender, 45.6% of the participants identified as male, and 54.4% as female. Additionally, the sample was also controlled at educational level (all participants were enrolled in the same Master) and at professional interest (pre-service teachers).

In order to collect the data, the scales proposed by González (2019), Romero *et al.* (2019) and the SIAD Association (2018) were revised. The language was adapted to align with the target population, and additional ad hoc items were included to explore perceptions as future teachers, as well as a qualitative section. To ensure the validity and reliability of the instrument, we undertook the necessary steps to guarantee alignment with the original items. The final questionnaire comprises six sections (Figure 5), and the present study is primarily concerned within the first five.

The questionnaire was administered during the 2022/23 academic year. It was conducted in person, using the Google Forms platform, to reduce paper usage, and also maintain the anonymity and voluntary participation of respondents. Data were subjected to statistical analysis using the Statistical Package for the Social Sciences (SPSS) software. A series of validity and reliability analyses were conducted on the questionnaire, with an overall reliability of 0.89. Given the inclusion of additional items and the differing targeted population, exploratory factor analysis (EFA) were employed to identify the dimensions and underlying constructs of each section of the instrument. The preliminary steps for EFA are as follows: (1) Kaiser–Meyer–Olkin (KMO) test, which assess sample adequacy measuring correlations among variables (threshold >0.05), and (2) Bartlett's sphericity test, which evaluate discrepancies between the correlation and diagonal matrix (significance level $p < 0.05$). The criterion for factor retention was set at a variance of 1 or greater, enhancing the clarity and validity of the results.

Descriptive analyses were employed to explore the data, and inferential tests were conducted for each non-demographic section with the demographic variables. In order to avoid false positives (α-type error) and false negatives (β-type), non-parametric and parametric tests were performed (significance level $p < 0.05$).

The investigation has been performed in accordance with the principles stated in the Declaration of Helsinki, and subjects have provided appropriate informed consent. The research has a favourable report from the University of Granada Ethics Committee (n[a] 3252/CEIH/2023) and meets the required standards guarantees of confidentiality, anonymity and data protection.

4. Results

4.1 Pre-service teachers' assessment of the VEER experience

In order to ascertain the suitability of data exploration by dimensions, an EFA was conducted on the 18 items comprising the *VEER assessment* section. The KMO test yielded a score of 0.77, indicating good sampling adequacy, and Barlett's test returned values of $\chi^2 = 1599.33$, df = 153 and $p = 0.00$, further confirming the suitability of the data for EFA.

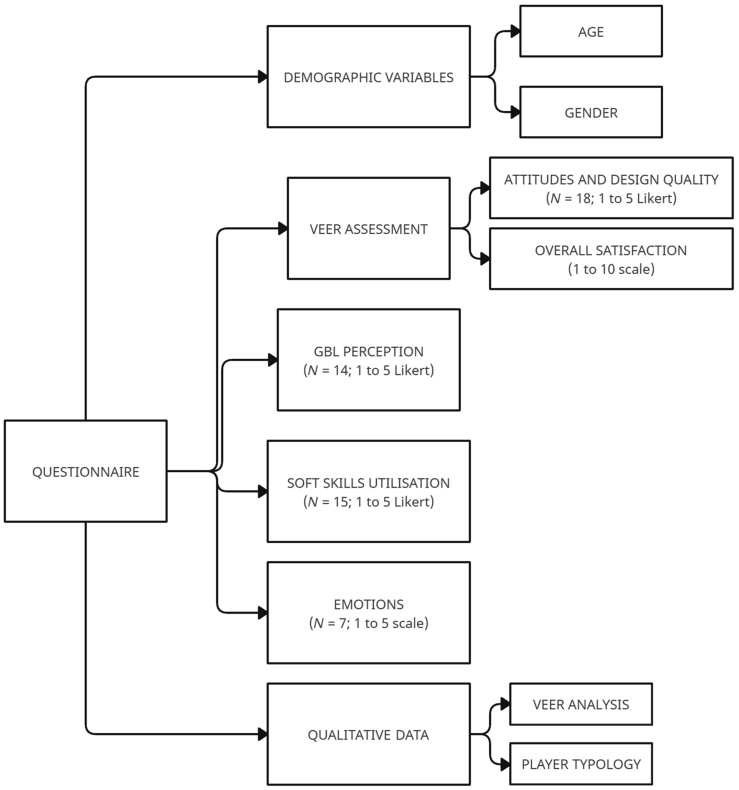


Figure 5.
Questionnaire sections

The analysis yielded 4 principal components that collectively explained 62.59% of the accumulated variance. An oblique rotation was employed, which enables correlation between factors/components. Table 1 presents the extracted components, the reliability analysis scores for each of them, as well as the item loadings.

In order to facilitate data interpretation, it was decided that the scores of the two negative components (VEER_NEG_ATT and VEER_BAD_DESIGN) should be inverted. This inversion was necessary to ensure that higher values in these components/items did not indicate a more unfavourable overall assessment of the VEER. Figure 6 presents mean and standard deviation (SD) scores for *VEER assessment* section.

Inferential group difference analysis was employed to examine the potential for statistically significant divergences related to gender and age. Two statistical tests were employed: the Mann–Whitney *U*-test, a non-parametric test, and the Student's *t*-test, a parametric test. Table 2 provides a summary of those components/items that reached statistically significant values in both tests performed, as well as the subdivision of the mean scores for each group.

Regarding students' *Overall satisfaction*, which is quantified on a scale of 1–10 points, the mean score for the general sample is 9.12 ± 1.16. A total of 47.7% of the students rated the experience as 10, while over 32% rated it as 9. Inferential group difference analyses were conducted to explore potential significant divergences in relation to gender and age. However, the statistical analyses yielded no significant results.

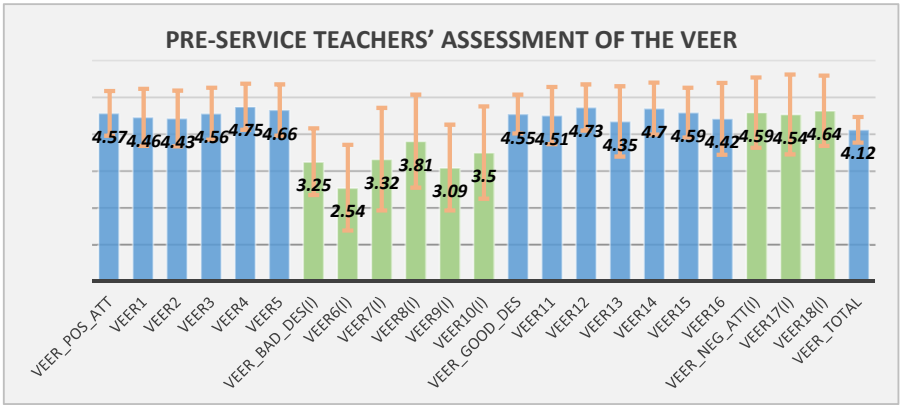
Items/Components	Components 1	2	3	4	Cronbach alpha
Positive attitude towards VEER (VEER_POS_ATT)					
VEER1-I would like to explore the subject further through the use of virtual escape rooms	0.85				0.90
VEER2-My motivation for pursuing this subject has increased after playing this escape room	0.85				
VEER3-I would like this methodology to be used in other subjects in the Master's programme	0.85				
VEER4-I prefer this methodology over the conventional approach	0.84				
VEER5-Participating in this escape room has increased my interest in the subject matter	0.83				
Bad desing: high difficulty and confusion(VEER_BAD_DES)					
VEER6-I consider that the level of difficulty I found when playing this escape room was high		0.84			0.80
VEER7-I believe that additional knowledge, beyond what was covered in class, is required to successfully complete this escape room		0.76			
VEER8-The puzzles/challenges related to the contents of the subject were difficult		0.70			
VEER9-In many occasions, I felt lost and I didn't know how to collaborate with the other students		0.53			
VEER10-The puzzles/challenges not related to the contents of the subject were difficult		0.51			
Good desing: teamwork and logistic(VEER_GOOD_DES)					
VEER11-All members of the group were involved and worked together			0.81		0.75
VEER12-The allotted time to complete the escape room was sufficient			0.66		
VEER13-The size of the groups has been appropriate			0.66		
VEER14-The method used to randomly form the groups was appropriate			0.62		
VEER15-The team was able to work together and communicate effectively with one another			0.62		
VEER16-The solutions to the puzzles/challenges were in alignment with the subject matter			51		
Negative attitudes towards VEER (VEER_NEG_ATT)					
VEER17-I would NOT recommend this type of activity in class				0.88	0.86
VEER18-I have NO intention of participating again in any similar activities				0.86	

Source(s): Authors' own creation/work

Table 1. Exploratory factor analysis of the VEER assessment section

4.2 Perceptions of pre-service teachers regarding the use of GBL in education

To assess the relevance of the dimensional exploration of the data, an EFA was conducted on the 14 items that constitute the *GBL perceptions* section. The KMO test achieved a good score (0.88), as did Bartlett's test ($\chi^2 = 1795.59$; df = 91; $p = 0.00$). The EFA (oblique rotation) yielded 3 principal components, collectively explaining 71.70% of the cumulative variance. Table 3 presents the extracted components, factor loadings and reliability scores for each component extracted. Figure 7 shows the mean scores and SD for each component and item.



Note(s): Bars representing inverted items are displayed in green
Source(s): Authors' own creation/work

Figure 6.
Mean score and standard deviation of the VEER assessment section

	Gender ($\bar{x}$ and p)			Age ($\bar{x}$ and p)		
	Male	Fem	$p(U/t)$	GenY	GenZ	p
VEER_POS_ATT	4.50	4.63	0.04/0.04	–	–	–
VEER_NEG_ATT(I)	4.44	4.72	0.04/0.04	–	–	–

Note(s): Only items with significant values in both inferential tests are included. U = Mann Whitney's U; t = Student's t-test
Source(s): Authors' own creation/work

Table 2.
Inferential test on VEER assessment with gender and age

Inferential group difference analyses were conducted. Table 4 presents those items that reached statistically significant values in both tests performed, as well as the subdivision of the mean scores for each group.

4.3 Assessment of the Soft skills utilisation during the VEER

An EFA was conducted on the 15 items that comprise the *Soft skills utilisation* section, given that the KMO measure reached a quasi-perfect score of 0.93, and the Barlett's test yielded a significant result ($\chi^2 = 1917.912$, df = 171, $p = 0.00$). An oblique rotation was employed, and 3 principal components were identified, explaining 63.90% of the total variance (Table 5). Figure 8 presents mean and SD for each component/item.

Inferential analyses were conducted, and Table 6 presents those items that reached statistically significant values in both tests, as well as the mean scores for each group, with the data subdivided by gender and age.

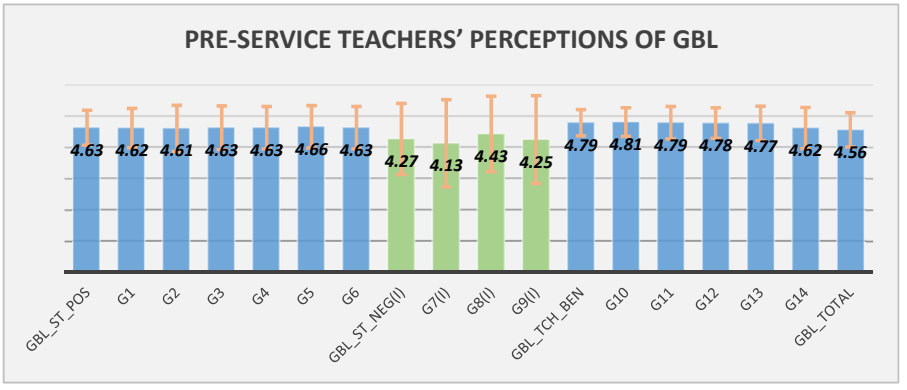
4.4 Emotions felt during the VEER experience

An EFA of the *Emotions* section was performed, given that the KMO measure (0.74) and the Barlett's test ($\chi^2 = 591.472$, df = 21, $p = 0.00$) achieved scores that are deemed adequate. An orthogonal rotation was employed, in accordance with the findings of the literature review, which indicate potential polarisation into two independent factors. In this case, the results align with the expectations, with two independent factors explaining 72.09% of the accumulated variance. First factor is associated with pleasant/positive emotions, while

Items/components	Components 1	2	3	Cronbach alpha
Positive perception of GBL as student (GBL_ST_POS)				
G1-I believe that incorporating games into theoretical lessons would enhance my learning outcomes	0.86			0.92
G2-I think that game-like classroom activities should be used more often	0.85			
G3-I believe that incorporating games into the classroom could enhance my enjoyment and engagement with the subject matter	0.83			
G4-I would like my teacher to use gamification strategies in the classroom	0.83			
G5-The use of game-based activities in the classroom should be combined with the incorporation of contemporary technological resources (e.g. mobile apps)	0.79			
G6-I believe that taking part in game-like activities can increase my motivation	0.77			
Negative perception of GBL as student (GBL_ST_NEG)				
G7-I do NOT believe that this kind of activity can serve as a learning tool to enhance the comprehension of theoretical ideas and their practical application in daily life		0.90		0.82
G8-I would NOT like to participate in a game-like activity during theory classes		0.89		
G9-Playful or game-like activities are NOT appropriate for this subject		0.78		
Perceived benefits of GBL in teaching (GBL_TCH_BEN)				
G10-Using games helps students to communicate better with their colleagues			0.93	0.86
G11-These kinds of activities are good for developing teamwork			0.87	
G12-Compared to a traditional classroom, I believe that game-based activities help students to be more active in class			0.62	
G13-I believe that implementing gamification strategies or using games in the classroom increases student motivation			0.57	
G14-The incorporation of game-like and/or gamified activities in the classroom enhance learning outcomes			0.50	

Source(s): Authors' own creation/work

Table 3.
Exploratory factor analysis of the GBL perception section



Note(s): Bars representing inverted items are displayed in green
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Figure 7.
Means score and standard deviation of the GBL perceptions section

	Gender ($\bar{x}$ and p)			Age ($\bar{x}$ and p)		
	Male	Fem	$p(U/t)$	GenY	GenZ	$p(U/t)$
G5	4.57	4.74	0.02/0.02	–	–	–
G6	4.51	4.72	0.02/0.03	–	–	–
GAM_ST_NEG(I)	4.02	4.49	0.00/0.00	–	–	–
G7(I)	3.88	4.35	0.00/0.01	–	–	–
G8(I)	4.11	4.70	0.00/0.00	–	–	–
G9(I)	4.07	4.41	0.01/0.02	–	–	–
GAM_TOTAL	4.45	4.70	0.00/0.00	–	–	–

Table 4.
Inferential test on GBL perception with gender and age

Note(s): Only items with significant values in both inferential tests are included. U = Mann Whitney's U; t = Student's t-test
Source(s): Authors' own creation/work

	Components			
Items/components	1	2	3	Cronbach alpha
Individual and self-management skills (SK_INDIV)				
C1-Self-motivation	0.85			0.87
C2-Inquiry	0.84			
C3-Time management	0.76			
C4-Self-confidence	0.72			
C5-Creativity	0.70			
C6-Analyse and synthesise	0.55			
C7-Adaptability	0.50			
Management skills(SK_MANAG)				
C8-Leadership		0.93		0.76
C9-Plannification		0.70		
C10-Initiative		0.66		
C11-Responsibility		0.55		
Collaboration and problem solving skills(SK_COLLAB)				
C12-Teamwork			0.95	0.80
C13-Problem solving			0.78	
C14-Critical thinking			0.52	
C15-Communication			0.51	

Table 5.
Exploratory factor analysis of the soft skill utilisation section

Source(s): Authors' own creation/work

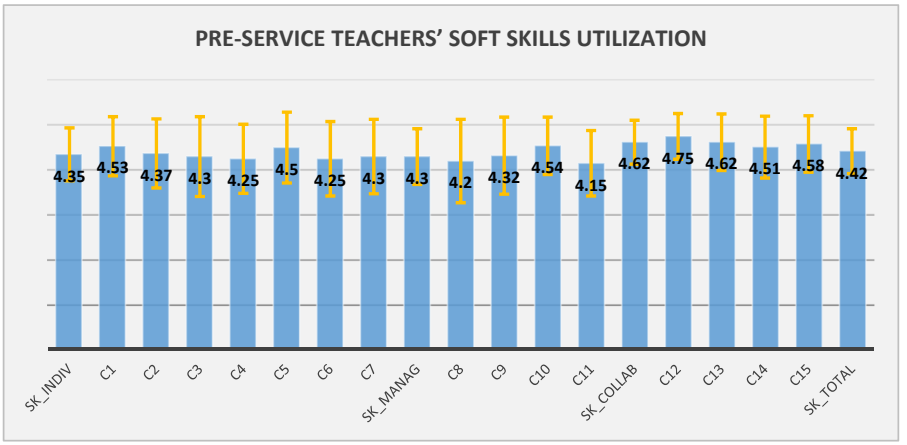
the second factor is associated with unpleasant/negative emotions (Table 7). Figure 9 presents mean and SD scores for each component/items.

Inferential analyses were conducted to explore significant divergences in relation to gender and age. However, it yielded no significant results for any of the variables.

5. Discussions

5.1 Pre-service teachers express a high level of satisfaction with the VEER, although there is scope for improvement

Results of the VEER evaluation demonstrate high satisfaction levels among pre-service teachers, with a mean rating of 9.6. These results are not significantly influenced by the demographic variables, such as gender or age. These general and favourable results align



Source(s): Authors' own creation/work

Figure 8. Means score and standard deviation of the soft skills utilisation section

	Gender ($\bar{x}$ and p)			Age ($\bar{x}$ and p)		
	Male	Fem	*p(U/t)*	GenY	GenZ	*p(U/t)*
SK_COLLAB	4.53	4.69	*	–	–	–
C15	4.48	4.67	*	–	–	–

Note(s): Only items with significant values in both inferential tests are included. U = Mann Whitney's U; t = Student's t-test
Source(s): Authors' own creation/work

Table 6. Inferential test on soft skills utilisation with gender and age

	Components		
Items	1	2	Cronbach alpha
Pleasant/positive emotions(EMO_POS)			
E1-Confidence	0.89		0.89
E2-Reliability	0.86		
E3-Satisfaction	0.84		
E4-Enthusiasm	0.83		
Unpleasant/negative emotions(EMO_NEG)			
E5-Anxiety		0.88	0.83
E6-Tension		0.83	
E7-Frustration		0.80	

Source(s): Authors' own creation/work

Table 7. Exploratory factor analysis of the emotions section

with the *VEER assessment* section's mean value (VEER_TOTAL). The EFA carried out on this section reveals 4 key dimensions. After reversing negative items and conducting a thematic analysis, two main categories emerge: *Attitudes* (VEER_POS_ATT and VEER_NEG_ATT) and *Design* (VEER_GOOD_DES and VEER_BAD_DES).

Items related to *Attitudes* exhibit favourable mean scores, exceeding 4.43 points. These items are linked to the desire to continue using VEER, increased motivation and interest in

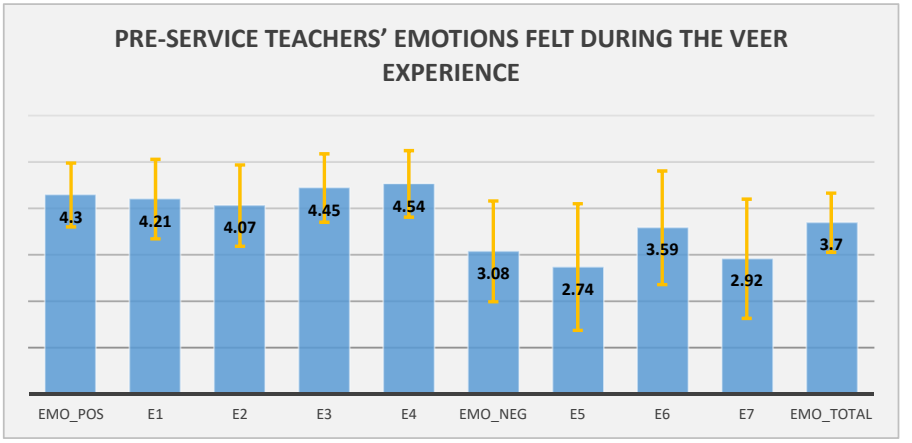


Figure 9.
Means score and standard deviation of the emotions section

Source(s): Authors' own creation/work

the subject, and a preference over traditional approaches. These findings align with those of Calle *et al.* (2022) and González-Muñoz and Ouariachi (2024), as well as systematic reviews by Hayden *et al.* (2020) and Zainuddin *et al.* (2023), which identified EER as highly motivating for students. Veldkamp *et al.* (2020) proposed that some researchers may have misinterpreted players' motivation towards these resources as an indication of increased motivation to learn about the subject. However, our study shows that pre-service teachers expressed high motivation towards the VEER while also acknowledging its role in fostering their motivation to learn.

Regarding *Design*, significant differences exist between the mean scores of its two dimensions (VEER_GOOD_DES and VEER_BAD_DES). VEER_GOOD_DES, reflecting positive design aspects, achieves high mean scores ranging from 4.35 to 4.73, covering items related to group size, teamwork ease, allotted time and puzzle relevance. Notably, the sufficiency of allotted time received the highest score in *Design* section. On the other hand, VEER_BAD_DES compiles the lowest scores once inverted, covering items related to difficulty and feelings of confusion while playing or collaborating. Veldkamp *et al.* (2020) highlighted that difficulty and time constraints are crucial for effective design, requiring careful balance to achieve desired pedagogical outcomes. Excessively challenging puzzles may hinder completion within the time limit, while overly simple ones can lead to disengagement. In this case, participants exhibit a neutral opinion regarding high puzzles/task' difficulty and also agree that playing time was sufficient. Both indicators suggest that VEER is perceived as a challenging yet well-timed experience.

The results for item VEER9 appear to be controversial when contrasted with the high scores of items related to teamwork on the positive design section; however, it is possible that this modest average score (3.09) may be consequence of *Genially* limitations, which hindered creating an unified gaming environment for players to see their teammates' locations and completed task/puzzles. This situation potentially posed challenges in terms of dividing tasks or understand how to assist one another and indicate areas for improvement in future iterations.

Inferential analyses indicate that gender does not significantly impact on *Design*, but does influence *Attitudes*. However, since no individual items show a notable gender difference, this influence appears to stem from a broad aggregated effect, making it less meaningful/

actionable for deeper exploration. Additionally, no significant differences were found between *Generation Y* and *Generation Z*, aligning with findings by Yawson and Yamoah (2020), which identified significant differences only between *Generation Z* and *Generation X* (1965–1979) concerning e-learning. As digital natives, both *Generation Z* and *Y* are familiar with virtual environments. Moreover, the COVID-19 pandemic has standardised virtual classes/resources, consequently, the absence of divergences in the assessment of learning through such environments is congruent (Veldkamp *et al.*, 2020).

5.2 Pre-service teachers express a positive perception of GBL, both as current students and future teachers

Pre-service teachers' responses indicate a highly favourable perception of GBL, with an average mean score of 4.56 out of 5. The EFA yielded three dimensions; however, after the inversion of the negative items and through thematic analysis, two main sets emerged: (1) perception as current *Students* (GBL_ST_POS and GBL_ST_NEG) and (2) perception as *Future teachers* (GBL_TCH_BEN).

As *Students*, they rated this methodology favourably, with positive-dimension scores ranging from 4.61 to 4.66, while inverted negative-dimension ranged from 4.13 to 4.43. Solís (2015) notes that negative items tend to yield lower scores despite inversion; however, consistent response trends strengthen the questionnaire's reliability, as occurs in current study. The *Students* cluster items focus on desire for GBL implementation, increased motivation and interest, and how it promotes learning connected to real-life situations.

Regarding their role as *Future teachers*, they exhibit a markedly positive perception of GBL, reaching the highest scores in the section. In this case, the items are grouped into three categories: (1) benefits for teamwork and communication, (2) increase in students' motivation and proactivity, and (3) potential to enhance learning outcomes. These findings align with previous researches and systematic reviews that highlight GBL as a well-received teaching methodology which fosters knowledge acquisition and facilitate meaningful learning, particularly when implemented games are designed with an educational/pedagogical approach (López, 2024).

Inferential analysis found no significant differences between *Generation Y* and *Z,* reflecting similar patterns observed in VEER, that are likely to be extrapolated to the broader context of GBL. Regarding gender, statistically significant differences were only observed in participants' perceptions as *Students*. The divergences were especially pronounced in GBL_ST_NEG dimension, with females consistently scoring higher. This raises important questions regarding the nature of these differences: (1) it indicates a more favourable perception of GBL among females, or (2) it reflects sociocultural gender role influences. It is crucial to explore underlying factors further, as the current analysis does not provide conclusive evidence. Results suggest that gender may influence their perceptions from a more personal perspective, but do not affect their perception as *Future teachers*, where from a pedagogical and professional standpoint, both genders exhibit similar trends.

5.3 The VEER requires a high level of soft skills utilisation to be completed, potentially facilitating their development in a practical and enjoyable manner

Results from *Soft skills utilisation* section indicate that pre-service teachers perceive a high application of these skills during the intervention, with an average score of 4.42 out of 5. EFA identified 3 dimensions: SK_INDIV (self-management), SK_MANAG (leadership/team management) and SK_COLLAB (collaboration/problem-solving), with scores ranging from 4.15 to 4.75. These findings align with previous studies, which posit that EER/VEER demands utilisation of numerous soft skills (González-Muñoz and Ouariachi, 2024). Notably, SK_COLLAB, which includes teamwork, problem-solving, critical thinking and

communication, scored highest in section. These results align with studies that have previously asserted that EER and VEER are particularly effective in promoting/developing these four soft skills (González-Muñoz and Ouariachi, 2024; Veldkamp *et al.*, 2020). These findings are especially relevant for teacher trainees, as they will be required in their future professional roles (Zeybek and Saygı, 2023).

Gender significant divergences appeared only in SK_COLLAB, where females achieved higher mean scores in Communication (C15). These findings are consistent with Qazi *et al.* (2022), who conducted a systematic literature review and meta-analysis of academic studies, identifying differences in the utilisation of communication skills based on gender, which indicated that females were favoured in this area. No significant differences based on age were found. The absence of significant discrepancies in soft skills utilisation, both in terms of age and gender (with the exception of C15), suggest VEER as an effective resource for developing soft skills among pre-service teachers, without introducing significant demographic biases.

5.4 Playing the VEER elicit predominantly positive emotions among pre-service teachers

Results of *Emotions* section reveal that VEER elicits a wide range of feelings with varying valence among players. EFA identified two dimensions aligning with the emotional valence typologies from the literature: (1) Positive/pleasant emotions, triggered by goal achievement or anticipation, encouraging repetition of actions/situations that cause them; (2) Negative/unpleasant emotions, arising from goal obstruction/interruption or perceived personal danger, often leading to behaviour changes in order to avoid or resolve the situation that causes them (Fernández, 2020).

Positive emotions scored the highest in this section, ranging from 4.07 to 4.54. This indicates that during the VEER, players experienced emotions associated with feelings of control ("E1-Confidence" and "E2-Reliability") and enjoyment ("E3-Satisfaction" and "E4-Enthusiasm"). These "pleasurable" results are further reinforced by the low scores in unpleasant emotions, such as "E5-Anxiety" and "E7-Frustration", which exhibited scores below 2.93. Literature suggest that higher intensity levels of these two negative emotions are typically associated with situations in which individuals perceive a lack of control over the situation, resulting in feelings of significant irritation or shock due to this perceived inability to act effectively against it (Fernández, 2020; González-Muñoz *et al.*, 2024). The only stronger unpleasant emotion is "E6-Tension", with an average of 3.59. Anxiety is a psychological state characterised by emotional distress, while Tension is a state of physiological and psychological preparedness for action, elicited by a concrete and present challenge. This Tension peak reflects a state of alertness among players, which can be attributed to the inherent time-limited nature of VEER (González-Muñoz and Ouariachi, 2024; Veldkamp *et al.*, 2020). Overall, the co-occurrence of high levels of pleasant emotions and low levels of unpleasant emotions suggest a satisfactory learning environment, which is consistent with Yllana *et al.* (2023) conclusions. No statistically significant differences were found based on age or gender.

6. Implications, limitations and further research

Findings may have implications in numerous areas and fields:

(1) VEER and GBL research: our study consolidates previously observed patterns and trends, extending them to higher education and pre-service teachers (a less explored population), while introducing novel insights that may open new discussions.

(2) Educational practitioners: findings reinforce this methodology as highly motivating for students that focus on the practical application of knowledge and development of soft skills. Consequently, the quality of teaching and learning processes is enhanced (in alignment with SDG 4).

(3) VEER designers: results offer a deeper understanding of pivotal elements required for optimal functioning and accomplishment of pedagogical objectives (e.g. balance between difficulty and playing time). Limitations related to virtual platforms lacking servers are also identified, potentially impacting gameplay experience.

(4) Educational policymakers and public policy: favourable results suggest that innovative/disruptive methods should be incorporated into higher education curricula. This may guide policymakers in shaping future educational frameworks that prioritise engagement and real-world applicability, advocating for educational reforms that aligns with efforts to address environmental challenges.

(5) Students' professional development: this methodology promotes utilisation/cultivation of numerous soft skills, increasingly demanded by employers.

(6) Pre-service teachers and future generations: the application of these methodologies with pre-service teachers has the potential to encourage them to consider replicating them with their future students. This could result in a multiplier effect, whereby a single pre-service player can influence numerous generations of students for decades to come.

(7) Environmental and sustainability education: the versatility and motivational effect of VEER fosters the exploration of complex and systemic topics such as sustainability and CC in an engaging yet profound manner. Furthermore, the development of cross-cutting skills (*The European sustainability competence framework*) encourages the acquisition of competences and values associated with a higher likelihood of achieving the SDGs and sustainability in society.

(8) Overall social impacts: study's results highlight the benefits of VEER utilisation, which may potentially shift societal attitudes towards innovative and disruptive learning methods in formal educational settings. While still preliminary, these findings suggest the possibility of developing a more informed, skilled and engaged citizenry, ultimately benefiting society by preparing individuals to navigate complex challenges and contribute to community well-being.

The implications and transfers identified must be considered within the context of the study to assess its replicability/applicability in other educational settings. Although the sample includes all Master's students in *Compulsory Secondary Education Teaching*, is still limited to this specific group and to Spain. Excluding eight participants due to under-representation and significant age divergence may limit the generalisability of the results. Methodology lacks a control group or pre-intervention measurement, limiting comparisons and to conduct more complex analyses. Questionnaire could be improved, as the Emotion section utilises a relatively simple scale that potentially omits key emotional aspects. There is a lack of control for variables such as previous teaching experience or socio-economic factors. Additionally, self-reported responses could introduce bias, as they may have felt compelled to rate the intervention processes positively. *Genially* and the resource exhibit some limitations that may have influenced the study's results. Lastly, the interconnection between theory and practice with respect to pre-service teachers and VEER is still constrained; however, this situation is typical of an emerging and evolving field of study.

As future lines of enquiry, we intend to refine the VEER employed in the study, incorporating player feedback, with the objective of confirm its benefits and effects in new

cohorts of pre-service teachers. Moreover, the methodology of the study itself will be enhanced with the incorporation of control groups and pre-post intervention measurements, thereby increasing its robustness and overall validity. Another line will be exploring to examine cognitive, motivational and emotional effects of these disruptive methodologies with other population groups, such as secondary school students. It would also be valuable to conduct comparative studies between the effects of designing VEER versus playing them, as well as comparing its impacts with other types of serious games, such as board-games or video-games. Finally, investigating the long-term impacts on students' professional development will contribute to the discourse on effective educational practices and justify the broader implementation of VEER and GBL in teacher training programmes.

7. Conclusions

This study examines the perceptions/assessments of an interventional process, utilising VEER and GBL, among pre-service teachers in the *Master* in *Compulsory Secondary Education Teaching*.

Regarding the VEER procedure, participants expressed unanimous and gender/age-neutral satisfaction levels, indicating high overall Satisfaction. These findings align with numerous prior studies that have identified VEER as a highly engaging resource (e.g. Hayden *et al.*, 2020; Zainuddin *et al.*, 2023). These positive results are further explored within the *Attitudes* and *Design* dimensions. Regarding *Attitudes*, participants demonstrated a clear preference for the use of VEER over more traditional methodologies, as well as a dual-factor motivational influence: (1) a motivation to use VEER and (2) an increased motivation to learn about the topic being worked on. This dual motivational benefit offers a novel perspective on current hypotheses in this area, such the one put forth by Veldkamp *et al.* (2020). *Design* section findings indicate that the VEER is perceived as a well-designed resource. Participants indicated that the puzzles/tasks were challenging, but not excessive, and perceived the allotted time to complete it adequately. These findings are in accordance with those of Veldkamp *et al.* (2020), who identified these factors as being instrumental in preventing frustration and enabling the achievement of pedagogical objectives. Some participants expressed confusion regarding effective collaborative strategies, which may be attributed to the limitations of the *Genially* platform, lacking capacity for simultaneous gameplay among players. Regarding potential age moderation, there is no significant evidence indicating that influences this section, which is consistent with systematic reviews that identify *Generations Y* and *Z* as digital natives (Höfrová *et al.*, 2024). Additionally, statistical differences related to gender are only observed in *Attitudes* and may be attributed to an aggregated effect, making it less meaningful or actionable for deeper exploration.

In relation to *GBL*, the study presents a new perspective, examining the pre-service teachers' perceptions from the dual role that is inherent to them: as *Students* and *Future teachers*. In both cases, participants showed a favourable perception regarding GBL implementation, motivation increases following its application, soft skills promotion and student proactivity. These findings are consistent with previous researches (González-Muñoz and Ouariachi, 2024; Ummihusna and Zairul, 2022). Gender differences were observed in self-perception as *Students*, but not from a pedagogical or professional perspective (*Future teachers*), where both groups exhibited comparable trends. Conversely, age exhibits a lack of significance, as observed in the VEER section.

Regarding *Soft skills utilisation*, pre-service teachers indicated that all skills explored were employed in the resolution of the VEER to a relatively high degree, with collaboration skills (teamwork, problem solving, critical thinking and communication), being the most prevalent.

The VEER's focus on sustainability also contributes indirectly to the development of transversal competences aligned with the *European Sustainability Competence Framework* (Joint Research Centre, 2022), which are required to address the contemporary challenges of the educational and socio-environmental spheres. These findings are consistent across all age and gender groups in this study.

Findings from the *Emotions section* indicate that VEER elicit predominantly positive emotions, indicating feelings of control, satisfaction and enjoyment among players. Negative emotions, such as Anxiety or Frustration were lower, suggesting minimal distress (Fernández, 2020; González-Muñoz *et al.*, 2024). Conversely, Tension was notably higher, reflecting a state of alertness, which can be attributed to the inherent time-limited nature of VEER (González-Muñoz and Ouariachi, 2024; Veldkamp *et al.*, 2020). Overall, the high positive and low negative emotion scores indicate a satisfactory and engaging learning environment, with consistent emotional responses across age and gender demographics.

References

Aczel, M. and Makuch, K.E. (2023), "Climate change, young people, and the IPCC: the role of citizen science", *Elementa Science of the Anthropocene*, Vol. 11 No. 1, pp. 1-13, doi: 10.1525/elementa.2022.00029.

Calle, M., López, E., Miguel, D. and Carril, M.T. (2022), "Escape rooms en la formación inicial del profesorado de Ciencias Sociales: valoración y potential educativo", *Educación XX1*, Vol. 25 No. 2, pp. 129-150, doi: 10.5944/educxx1.31440.

Clarke, S., Peel, D.L., Arnab, S., Morini, L., Keegan, H. and Wood, O. (2017), "escapED: a framework for creating educational escape rooms and Interactive Games for Higher/Further Education", *International Journal of Serious Games*, Vol. 4 No. 3, pp. 73-86, doi: 10.17083/ijsg.v4i3.180.

Dahalan, F., Alias, N. and Shaharom, M.S.N. (2024), "Gamification and game based learning for vocational education and training: a systematic literature review", *Education and Information Technologies*, Vol. 29 No. 2, pp. 1279-1317, doi: 10.1007/s10639-022-11548-w.

Dehghanzadeh, H., Farrokhnia, M., Dehghanzadeh, H., Taghipour, K. and Noroozi, O. (2023), "Using gamification to support learning in K-12 education: a systematic literature review", *British Journal of Educational Technology*, Vol. 55 No. 1, pp. 34-70, doi: 10.1111/bjet.13335.

Fernández, E.G. (2020), "Procesamiento emocional", in Fernández-Abascal, E.G., García-Rodríguez, B., Jiménez-Sánchez, M.P., Martín-Díaz, M.D. and Domínguez-Sánchez, F.J. (Eds), *Psicología de la emoción*, Editorial Universitaria Ramón Areces, Mardid, pp. 75-121.

García, P.A., Sánchez, M.D.M. and Solano, I.M. (2020), "Mejoras y necesidades de un escape room educativa en la formación inicial de docentes", *Espiral. Cuadernos del profesorado*, Vol. 13 No. 27, pp. 109-120, doi: 10.25115/ecp.v13i27.3024.

González, S. (2019), "La gamificación en el aula para la enseñanza-aprendizaje de la Física y la Química en la Educación Secundaria Obligatoria: una propuesta didáctica basada en el Escape Room", Unpublished manuscript, Bachelor's tesis, Universidad de Valladolid, available at: http://uvadoc.uva.es/handle/10324/38553

González-Muñoz, E. and Ouariachi, T. (2024), "Unlocking learning: the impact of an educational escape room on energy transition", *Electronic Journal of E-Learning*, Vol. 22 No. 4, pp. 57-74, doi: 10.34190/ejel.22.4.3186.

González-Muñoz, E., Meira-Cartea, P. and Gutiérrez-Pérez, J. (2024), "Looking for the emotional footprint of climate change in young people: connections with education, information sources and climate action", *Environmental Education Research*, pp. 1-25, doi: 10.1080/13504622.2024.2364799.

Hayden, L., Haara, F.O., Lysne, M.S., Jensen, P.R. and Jenssen, E.S. (2020), "A review on use of escape rooms in education – touching the void", *Education Inquiry*, Vol. 13 No. 2, pp. 168-184, doi: 10.1080/20004508.2020.1860284.

Höfrová, A., Balidemaj, V. and Small, M.A. (2024), "A systematic literature review of education for Generation Alpha", *Discover Education*, Vol. 3 (In this issue), doi: 10.1007/s44217-024-00218-3.

Joint Research Centre (2022), *The European Sustainability Competence Framework*, Publication Office of the European Union, Luxembourg.

Lester, D., Skulmoski, G.J., Fisher, D.P., Mehrotra, V., Lim, I., Lang, A. and Keogh, J.W. (2023), "Drivers and barriers to the utilisation of gamification and game-based learning in universities: a systematic review of educators' perspectives", *British Journal of Educational Technology*, Vol. 54 No. 6, pp. 1748-1770, doi: 10.1111/bjet.13311.

López, S. (2024), "Educational escape rooms are effective learning activities across educational levels and contexts: a meta-analysis", *IEEE Transactions on Learning Technologies*, Vol. 17, pp. 711-724, doi: 10.1109/TLT.2023.3328913.

López, E., Gamero, E. and López, I. (2024), "Diseño de un escape room basado en los ODS: experiencia de gamificación en el aula con alumnado del Máster de Profesorado de Enseñanza Secundaria", *UTE Teaching and Technology (Universitas Tarraconensis)*, Vol. 1, p. e3644, doi: 10.17345/ute.2024.3644.

Ouariachi, T. and Elving, W.J.L. (2020), "Escape rooms as tools for climate change education: an exploration of initiatives", *Environmental Education Research*, Vol. 26 No. 8, pp. 1193-1206, doi: 10.1080/13504622.2020.1753659.

Qazi, A., Hasan, N., Abayomi-Alli, O., Hardaker, G., Scherer, R., Sarker, Y., Kumar, S. and Zubairu, J. (2022), "Gender differences in information and communication technology use and skills: a systematic review and meta-analysis", *Education and Information Technologies*, Vol. 27 No. 3, pp. 4225-4258, doi: 10.1007/s10639-021-10775-x.

Rivera, I., López, A., Ruiz, D.P., Olvera, M.D. and Gutiérrez, J. (2022), *Handbook of Research on Using Disruptive Methodologies and Game-Based Learning to Foster Transversal Skills*, IGI Global, Pensilvania.

Romero, C., Buzón, O. and Olivets, A. (2019), "Gamificación y escape room eductivo: una experiencia para el aprendizaje del álgebra", in *Campus Virtual De Congresos De Formación Ib 2019: Congreso Iberoamericano La educación ante el nuevo entorno digital*, available at: http://formacionib.org/congreso-entorno-digital/0023.pdf

SIAD Association (2018), "Evaluación de una experiencia piloto. Real Games para la prevención de adicciones. Informe de evaluación de resiliencia", available at: http://www.asociacionsiad.com/3d-flip-book/informe-de-evaluacion-resiliencia-2018/ (accesed 20 June 2023).

Solís, M. (2015), "The dilemma of combining positive and negative items in scales", *Psicothema*, Vol. 27 No. 2, pp. 192-199, doi: 10.7334/psicothema2014.266.

The Intergovernmental Panel on Climate Change (2023), "Climate change 2023: synthesis report. Summary for policymakers", available at: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf (accessed 20 May 2024).

Thunberg, G. (2022), "Lo más eficaz para salir de este atolladero es educarnos", in Thunberg, G. (Ed.), El libro del clima, Editorial Lumen, Madrid, pp. 324-327.

Ummihusna, A. and Zairul, M. (2022), "Investigating immersive learning technology intervention in architecture education: a systematic literature review", *Journal of Applied Research in Higher Education*, Vol. 14 No. 1, pp. 264-281, doi: 10.1108/JARHE-08-2020-0279.

United Nations (2023), "The sustainable development goals report. Special edition", available at: https://unstats.un.org/sdgs/report/2023/The-Sustainable-Development-Goals-Report-2023.pdf (accessed 20 May 2024).

United Nations (n.d.), "Sustainable development goals", available at: https://www.un.org/sustainabledevelopment/ (accessed 20 May 2024).

Veldkamp, A., van de Grint, L., Knippels, M.C. and van Joolingen, W.R. (2020), "Escape education: a systematic review on escape rooms in education", *Educationl Reseach Review*, Vol. 31, 100364, doi: 10.1016/j.edurev.2020.100364.

Yawson, D.E. and Yamoah, F.A. (2020), "Understanding satisfaction essentials of E-learning in higher education: a multi-generational cohort perspective", *Hellyon*, Vol. 6 No. 11, e05519, doi: 10.1016/j.heliyon.2020.e05519.

Yeflach, V. (2024), "Perceptions of pre-service teachers while developing a virtual educational escape room (VEER) using online collaborative learning", *International Journal of Educational Research*, Vol. 125, 102348, doi: 10.1016/j.ijer.2024.102348.

Yllana, F., González-Gómez, D. and Su Jeoing, J. (2023), "La enseñanza de contenidos científicos mediante una metodología basada en escape room", *Enseñanza de las Ciencias*, Vol. 41 No. 3, pp. 69-88, doi: 10.5565/rev/ensciencias.5873.

Zainuddin, Z., Rasyidin, R., Zanzibar, Z., Aruni, F. and Nurmasyahyati, N. (2023), "Andragogical principles in a gamification concept: how does it work for adult learners in an online class?", *Journal of Applied Research in Higher Education*, Vol. 15 No. 5, pp. 1632-1648, doi: 10.1108/JARHE-04-2022-0127.

Zeybek, N. and Saygı, E. (2023), "Gamification in education: why, where, when, and how? A systematic review", *Games and Culture*, Vol. 19 No. 2, pp. 237-264, doi: 10.1177/15554120231158625.

Further reading

López, S., Saqr, M., Gordillo, A. and Barra, E. (2023), "A learning analytics perspective on educational escape rooms", *Interactive Learning Environments*, Vol. 31 No. 10, pp. 6509-6525, doi: 10.1080/10494820.2022.2041045.

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