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Delving into the impact of location-based games on high school students: Foro Italico vs. The Siege

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Abstract: This study presents the research results of the implementation of two location-based educational games in the field of history and cultural heritage, created on Taleblazer to be played by high-school students on smartphones. The games were designed to take place in the city of Rhodes island and were titled: "The Siege of Rhodes by Muhammad the Conqueror (1480 p.C.)", briefly hereafter, The Siege and "Let's Discover the Secrets of Foro Italico", briefly hereafter, Foro. By applying to each of them a different design strategy (gamification versus narrative-driven plot), the prime aim was to understand which features were preferred by different age groups, but also which other, external parameters influenced the reception of the games.

The overarching pedagogical basis under which this research was placed brought together a series of theoretical approaches that cross-fertilised each other: The game-based learning, Cognitive

Theory of Multimedia Learning, Situated learning in combination with approaches that highlight the importance of augmented reality and location–based (digital) games to improve the learning outcome.

The research sample was 58 students, aged 12-18, who participated in both games, and the methodological tool was a questionnaire, distributed to the participants after the completion of both games. The processing and analysis of the data was done in the program SPSS.

The games were created in the context of previous research, with the aim of verifying or differentiating from already recorded results. This research largely confirmed previous research results but also enriched the existing conclusions with new ones, regarding the importance of the age group and previous experience of the participants, as most of the experiments so far did not provide sufficient statistics of quantitative data. Although the learning performance was not we verified, the additional findings could prove useful in the future for a more tailored design of similar educational games, in order to optimise the learning process, taking into account factors that influence game reception. However, the need for a larger sample size and for further investigation of how games function as learning resources is undeniable.

Keywords: Augmented reality, city of Rhodes, cultural heritage, gamification, history, location-based games, simulation, storytelling, Taleblazer.

Introduction

Research Problem

Digital environments are the affinity space of the new generation (Gee, 2017). The ubiquity of technology and the amount of student interaction with it affect how students process information and acquire knowledge. Different experiences lead to different thought structures. With the continuous development of digital spaces and tools, new educational and participatory methods and practices have been developed, among which digital games seem to be at the forefront (Koutroumanos & Nikolopoulou, 2010).

Digital natives (Prensky, 2001) also known as i-gen (Twenge et al., 2019) or gamers generation (Beck & Wade, 2005) "do not respond to traditional teaching methods" (Katz, 2000), since the Monopoly of the school in controlling and disseminating knowledge is over. Necessary digital literacy skills and knowledge are primarily social in nature and include the ability to take advantage – among others- of distributed knowledge and collective intelligence, problem-solving, social interaction, negotiating identity, communication through multimedia tools (Gee, 2003; Jenkins, 2006).

Multimedia changes the studentship role by offering them the freedom of individual pace in processing information as well as active and responsible participation in the learning process while maintaining his commitment and attention at high levels. Among all media activities, gaming and indeed mobile gaming is the most popular and widespread among the youth. 79% of under-22s play mobile games, which are primarily aimed at a younger population. Smartphones are their gateway to gaming, so the popularity of mobile gaming among Generation Z is greater than expected. Jesse Schell (2010) summed it up as the trend towards a 'Gamepocalypse' “where every second of your life you are actually playing a game in some way”.

On one hand, the popularity of games among young people and on the other hand, the high level of percentage of daily engagement with them has stimulated the educational community's research

interest in their use to achieve learning goals. The observed gap between the daily habits of young people especially in their relationship with mobile technologies, and the conventional, educational practices, triggered even more and accelerated educational research with the aim of optimally utilising technologies and especially games for the achievement of learning objectives.

Due to the universal use of mobile smart devices, there has been exponential growth in the number of mobile applications developed for educational purposes, which mainly adopt a gamification approach (Kumar, 2023), to boost motivation and enhance learning performance (Zainuddin et al., 2020). A step further, game-based learning refers to the innovative learning approach that involves games or other kinds of software applications with educational value (Tang & Hanneghan, 2011). The goal of game-based learning is to bridge the gap between the everyday culture in and out of school of the new generation. By making learning more compelling and engaging, students are motivated to participate and adopt a positive attitude towards knowledge and educational processes.

Thus, the concept of the game-based learning approach and the cognitive theory of multimedia learning are considered in collaboration, as multimedia learning environments often include game-based learning to enhance student motivation. The principle known as the "multimedia principle" states that we learn more deeply from a combination of media than from words alone (Mayer, 2005) and in this context, the application of games is proposed as an alternative solution to reduce the cognitive load that is usually traced to conventional educational practices.

Location-based games (LBGs) are placed at the intersection of the above three theories, which are additionally supported by the theory of situated learning. Situated Learning (SL) argues that meaningful learning only takes place if it is embedded in the social and physical context within which it will be used. According to this approach, students engaged in activities that focus on real problems are asked to use their critical thinking and kinesthetic abilities to construct new knowledge through either analog or digital resources (Wen & Looi, 2019). LBGs are a subcategory of pervasive games (Magerkurth et al., 2005) in which the game evolves and progresses through a player's location and movement. The action takes place in the real world, enhanced by the use of augmented reality technology. Recent literature shows that students can benefit from location-based mechanics in a wide range of learning experiences in various cognitive domains (Quintero et al., 2019). However, there are still many unexplored aspects concerning various factors, which this research aspires to investigate. In this direction, the findings of the present study aim to contribute to the adaptation of educational technology to specific users, in order to improve educational outcomes. Even more, through location-based games, learning can become more tangible, exploratory and relevant to the needs of the new generation.

Research Focus

Location-based augmented reality games (LBGs) offer users new possibilities to discover and interact with the outdoors, the use of GPS, connectivity and mapping technologies, opening up a wide range of research (Cashman & Phelps, 2009; Saker & Evans, 2016). They usually work on mobile devices (smartphones or tablets) and guide users to specific locations. Augmented reality (AR) is used to provide that extra layer with 3D objects, avatars and animations for player interaction. When someone reaches these sites, digital content is activated. Students are asked to complete challenges or assignments, answer quizzes, or interact with virtual objects that enrich their learning experience. Other terms used in research to describe certain types of LBGs include AR games and mixed reality games (Viinikkala et al., 2016). AR and mixed reality games are often spatial awareness games. Regardless of the term used, however, we are witness of a growing market for such location-based

games (LBGs) and gamified location experiences that appeal to an ever-increasing number of players. Geocaching, PokémonGo and Ingress are some representative examples. They create a fusion between physical and digital spaces and support the development of new forms of interactions and experiences in the city space that enhance the sense of place value and place identity.

The basic idea with these games is that players combine knowledge and movement in the real world, especially in places rich in cultural content, such as historic city centers or archaeological sites. Since 2000, many articles have mentioned LBGs as a new trend and recently this seems to be gaining ground. In the following decades, more and more location-based and mobile AR applications were developed (Ribeiro et al., 2021). Their field covers a wide spectrum, from environmental education (Schneider & Schaal, 2018), geography, IT (Lovászová & Palmárová, 2013), science, astronomy (Cecotti, 2022), business (Puja & Parsons, 2011), urban sustainability (Mangnus et al., 2022) history, physical exercise, tourism and various learning activities for the elderly or disabled (Marco et al., 2008).

There are several authoring tools for location-based games, like Taleblazer, ARIS and Unity with Mapbox (Metikaridis & Xinogalos, 2021), among which we selected Talebalzer, as the most appropriate for our purpose.

TaleBlazer is the only the platform that fully supports an all-visual programming language and allows anyone with no programming background creating a game by following the site's very well-edited and built-in step-by-step guide. It has a simulation feature so that a creator can remotely test the functionality of a game before publishing it. What's more, it supports various media formats (text, images, audio) to enhance the gaming experience, is free, and has a friendly, easy-to-navigate user interface. Its main drawback is that it does not support a multiplayer game and does not provide an online discussion space (Batsaras & Xinogalos, 2023).

The field of utilising location-based games to approach history and cultural heritage is on an upward trajectory. Many studies from the last decade demonstrate the growing interest of the scientific community in the specific field. Some outstanding examples of location-based educational games are the following:

- “The Heraklion Fortification Gates” offers students the opportunity to learn about the history of the Venetians gates of the city of Heraklion, in Crete (Vassilakis et al. 2018).
- “Doltso: A Traditional District of Kastoria in the Passage of Time” is designed by the Center for Education for the Environment and Sustainability of Kastoria. Its aim is to get students to know the Byzantine and post-Byzantine churches, the imposing mansions, and the historical buildings of the homonymous preserved district (Kleftodimos et al., 2023a).
- “Once Upon a Time in Dispilio” and “Crime in the Lake Settlement” take place in the same northwestern region of Greece, in the prehistoric remains of the mentioned sites and are created by the same institution (Kleftodimos et al., 2023b).
- The "Oracle of Delphi" (Ekonomou & Vosinakis, S., 2018) presents students with the great monuments of the most important Greek archaeological site of Delphi and their historical uses.

- "Viking Ghost Hunt" takes place in important historical locations in Dublin, Ireland. It engages the player in local Viking history (from the years 800–1169) through a ghost-hunting game in a multi-modal experience (Paterson et al., 2013).
- "O'Munaciedd' is part of the 'Matera Città Narrata' project. It presents the historical, artistic and natural heritage of the Basilicata region in southern Italy (La Guardia et al., 2012).
- "Explore!" is a treasure hunt designed for the archaeological site of Egnazia, Italy (Costabile et al., 2008), intended for middle school students. Its aim is to help students acquire historical knowledge and concepts while a loose narrative gives it coherence and engages participants in playful activities.
- "Frequency 1550" (Raessens, 2007; Huizenga, 2009) is a highly acclaimed educational game about medieval Amsterdam, designed to be played in the historic centre of the city.
- "The Voices of Oakland" (Dow et al., 2005) introduces visitors to the history and architecture of Oakland Cemetery, Atlanta's oldest cemetery.

The above list is not exhaustive or inclusive. Only a few of these games were contented, but significant examples taking place in sites of historical interest and used them as a guide for our own experiment.

Research Aim and Research Questions

For the formulation of the research questions, individual research articles on the use of location-based games for educational purposes were taken into account, as well as research review articles covering long periods of time, from 2010 onwards (Ribeiro et al., 2021; Laato et al., 2019). Individual studies usually check the degree of the positive reception of the game by the participants, the success criteria of the games (competition, collaboration, use of augmented reality, etc.), the emotions elicited by participation (pride, enthusiasm, boredom, indifference), and the game-learning relationship. In the reviews of a large volume of individual research, an attempt is made to answer, through grouping and comparison, more general issues, such as the cognitive subjects-fields of the games, the strategies that are integrated to facilitate learning or to attract students, and stimulate participation, the learning outcomes, the challenges-difficulties of developing similar games and the future prospects of this type of applications. Although the relevant research is rapidly developing, the existing literature falls short in providing answers to the questions we intend to investigate, as the results delivered so far measure percentages of the total participants, without correlation with other variables.

Many of our research questions are placed in the context of the previous research, the results of which they attempt to verify or refute, as follows:

- Are students excited by participating in spatially sensitive augmented reality games? Do they prefer competitiveness? Do they enjoy collaboration? Do they think such games have educational value? Do they gain new knowledge? Do they have previous experience with similar games? Do they find navigating digital maps easy? Do they single out any feature of the games as their advantage?

In addition, it was sought to cross and correlate the above data with other nominal variables, such as age group, gender, previous experience, and preferred game.

To sum it up, taking as a null hypothesis the absence of a relationship between the following variables, it was investigate whether this was true. If the null hypothesis is not verified, then it will mean that there is a relationship between the crossing variables in the following questions.

- Is the age group a factor influencing the game reception (enthusiasm, desire for future participation, knowledge acquisition, collaboration, competitiveness, ease of navigation)?
- Is the age group a factor that affects the preference for the type of game and its corresponding game mechanics?
- Equally, is the gender, a factor influencing game reception (enthusiasm, desire for future participation, knowledge acquisition, collaboration, competitiveness, ease of navigation)?
- Is the gender a factor that affects the preference for the type of game and its corresponding game mechanics?
- Even more, is previous experience, a factor influencing the game reception (enthusiasm, desire for future participation, knowledge acquisition, collaboration, competitiveness, ease of navigation)?
- Is the previous experience a factor that affects the preference for the type of game and its corresponding game mechanics?

Research Methodology

General Background

In most of the applied examples referred to above, the way to collect data was to fill in a questionnaire, the conclusions of which are presented descriptively. As there were no studies in the relevant literature that highlighted the complex relationships of data and how they interact, the contribution of the present research was a better and in-depth understanding of how various factors interact and influence the reception of the games as well as the learning process embedded in games.

Sample

The research sample was 58 students from high schools at the city of Rhodes, aged 12-18, who participated in both games and the methodological tool that was a questionnaire, distributed to the participants after the completion of the games. The selection was deliberately random so that there would be no differentiation in terms of achievement or other socio-cultural characteristics. The research took place in two phases, in June 2023 in the city of Rhodes in Greece, at the historical center, and at the medieval city accordingly. In the table 1 below the distribution of the participants in age groups and gender is demonstrated.

Table 1

Cross-tabulation of Age Group and Gender

Age group * Gender Cross-tabulation		Gender		
		boy	girl	total
Age group	12-15	16	19	35
	16-18	8	15	23
total		24	34	58

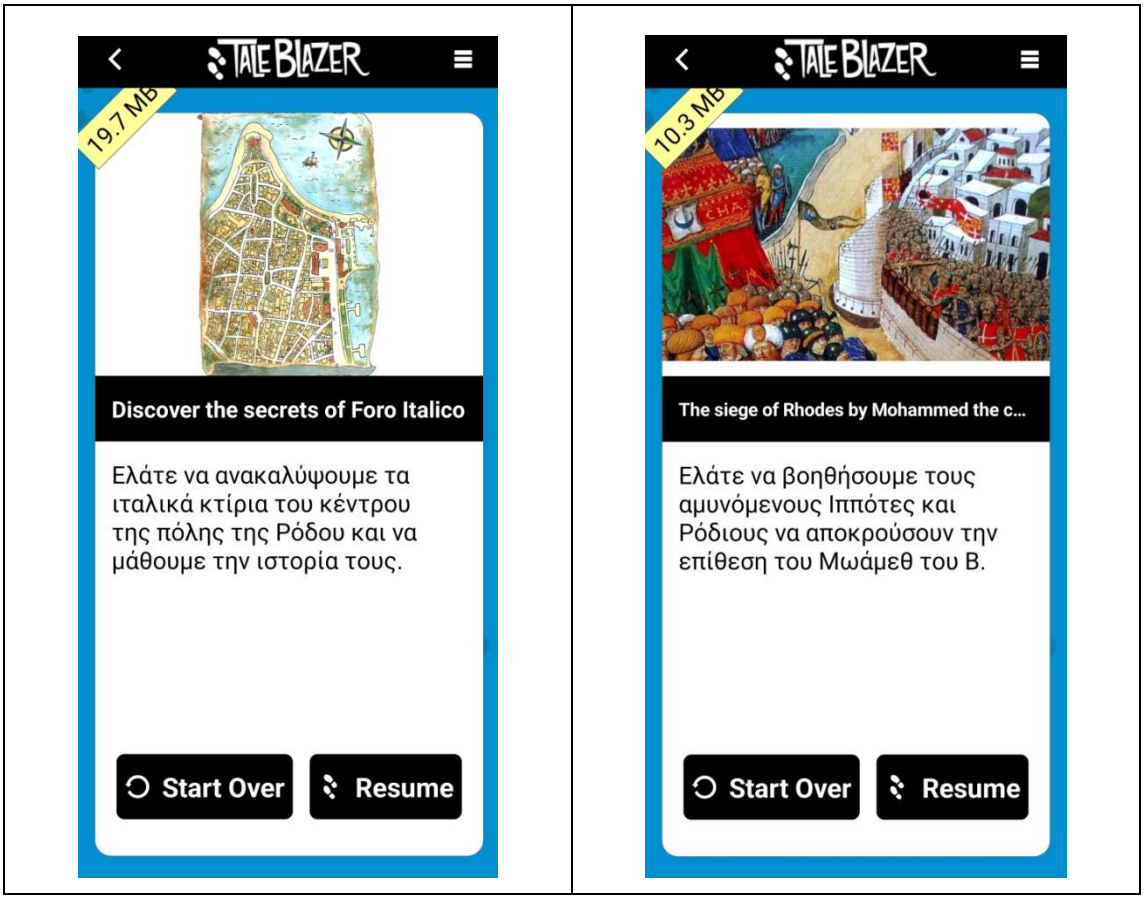
Instrument and Procedures

For the needs of the research, two games were created in Taleblazer with an emphasis on the different mechanics' patterns. Specifically, in Foro, quizzes, score points, and feedback were chosen as dominant mechanisms, while in The Siege, a narrative-driven plot based on real historical events, mission assignment, resource gathering, and, feedback were the prominent elements of the game.

In Foro (figure 1), 15 prominent buildings from the period of Italian occupation in Rhodes have been selected, which were located in today's Mandraki, formerly called foro italico, i.e. the administrative center of the period of Italian occupation. These buildings were also the stations of the tour, in a sequenced course where each agent gained visibility upon completion of the previous phase. For each building, comprehensive information was given about its use and history, and immediately after that, a multiple choice question was activated, from the correct answer of which the players collected points. If they collected 120 points or more at the end they got an honorary diploma of the worthy researcher. Otherwise, they just accepted a comforting handshake. The players might stop whenever they wish and participate in the competition among the teams with the number of points they have gathered so far.

Figure 1 and Figure 2

Home screen of Foro Italico and The Siege on Taleblazer



Source: author own development.

In the Siege (figure 2) players were challenged to confront the besiegers and prevent the occupation of the island by following a series of missions historically accurate of the events of the 1480 siege. To successfully complete the missions they must move speeding to various parts of the

Medieval city of Rhodes and the surrounding area to carry messages, aid in defense, manufacture ammunition, and more. In between they were called upon to collect their individual armory so that they could be knighted at the end of the game by the Grand Magister in recognition of their contribution to the salvation of the city. If a team withdrew and did not reach the final test, they did not receive any compensation or award. The game was essentially a siege simulation, based on real facts based on historical sources, with quests, though no puzzle solving and scoring.

After the completion of the two games, participants were asked to answer a questionnaire, as follows:

- Age group (12-15/ 16-18)
- Gender (male/female)
- Previous experience: Do you have previous experience in location-based games? (yes/no)
- Ease of navigation: Did you find the navigation easy? (5 scale Likert)
- Enthusiasm: did you feel enthusiasm during the game? (5 scale Likert)
- Acquisition of knowledge: Did you acquire new knowledge? (5 scale Likert)
- Choice: Which game did you like most? (Foro/The Siege)
- Game mechanics: Which game element do you think was more exciting? (Storytelling/ scoring)
- Educational value: To your opinion does the game have educational value?
- Desire for future participation: Would you like to participate in a similar game in the future?
- Location-based mechanics as a preference criterion: Do you think that the "location-based augmented reality" technology of the games was their most exquisite feature? (5 scale Likert)
- Competitiveness: Did the games promote competitiveness? (5 scale Likert)
- Which game was more competitive? (Foro/ The Siege)
- Compatibility with other cognitive fields: To your opinion are such (location-based) games compatible with other cognitive fields? (Yes/no)
- Immersion: In which game did you feel more immersed? (Foro/The Siege)
- Collaboration: Did the games promote collaboration? (5 scale Likert)
- Which game was more collaborative? (Foro/ The Siege)

The answers were transcoded to numbers, imported to SPSS (Statistical Package for the Social Sciences), and analysed.

The questionnaire generally followed the steps of previous similar studies, was pilot tested and validated to effectively measure the constructs. Some questions regarding the factors were aimed to investigate were aided. The sample was representative of the student population of the city of Rhodes, although not demographically in terms of the wider population of the island.

Data Analysis

The study addressed a relevant and practical topic in the field of educational technology and the research utilised quantitative data analysis, which allowed for statistical comparisons and provided objective insights into the relationships between variables. The Statistical Package for the Social Sciences that served the study was considered the most reliable analytical tool for similar studies.

Research Results

In the beginning, to get a general idea of the games' reception, the mean values of the participants' responses -on the graded Likert scale from 1(minimum) to 5 (maximum) were counted,

(Table 2). Storytelling, scoring, location-based mechanics, enthusiasm, and desire for future participation garnered the highest mean values among the other features.

Table 2

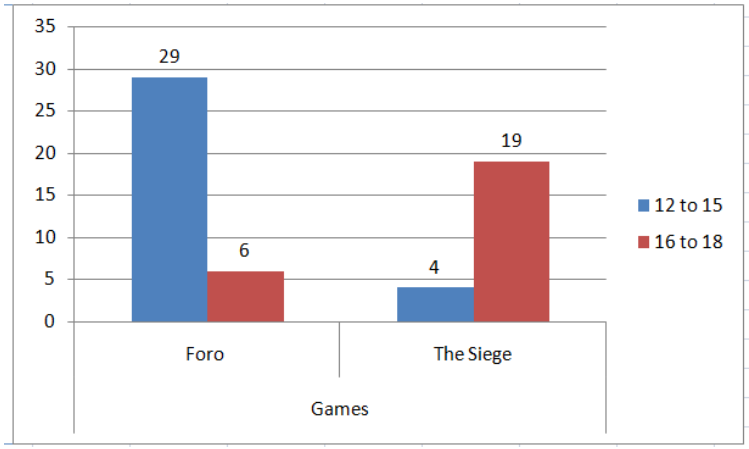
Mean Values of Measurable Variables

Ease of navigation	Competitiveness	Collaboration	Enthusiasm	Acquisition of knowledge	Storytelling	Score	Desire for future participation	Location-based mechanics as a preference criterion
3,53	3,71	3,02	4,17	3,21	4,59	4,53	4,40	4,19

Crossing the age groups (chi square) with their game preferences it became apparent that the 12-15 group showed a clear preference for Foro, while the 16-18 group for the Siege (figure 3).

Figure 3

Age Groups' Preferences



Source: author own development.

Furthermore, a non-parametric Mann-Whitney test was applied with age group as a grouping variable and a statistically significant difference was observed in a number of variables in favor of the 16-18 age group versus the 12-15 group, as follows: ease of navigation, excitement, knowledge acquisition (p=0, 0). The storytelling outperforms as an advantage in the same age group (p=0.19), as do spatial sensitivity (location-based mechanics) (p=0.33), competitiveness (p=0.03) and immersion (p=0.016). The desire for future participation, the development of collaboration and having a score as an advantage did not have statistically significant differences. In Table 3 the mean ranks of the variables of both age groups were described.

Table 3

Mean Ranks with "Age Group" as Grouping Variable

Variables	Age group	Mean ranks
ease of navigation	12-15	20,93
	16-18	42,54
enthusiasm	12-15	23,34
	16-18	38,87
acquisition of knowledge	12-15	23,03
	16-18	39,35
storytelling as advantage	12-15	26,07
	16-18	34,72
score as advantage	12-15	29,44
	16-18	29,59
desire for future participation	12-15	30,24
	16-18	28,37
location-based mechanics as a preference criterion	12-15	25,99
	16-18	34,85
competitiveness	12-15	24,33
	16-18	37,37
immersion	12-15	25,41
	16-18	35,72
collaboration	12-15	29,47
	16-18	29,54

The previous experience in similar games produced statistically significant differences in the condition of experiencing immersion (p=0.032), competitiveness (p=0.046) and knowledge acquisition (p=0.02), meaning the group with previous experience positively responded to all the above conditions. Table 4 presents the mean scores of the aforementioned statistically significant differences, with "previous experience" as the grouping variable.

Table 4

Mean Ranks with "Previous Experience" as Grouping Variable

Variables	Previous experience	Mean ranks
score as advantage	yes	28,21
	no	30,13
immersion	yes	35,92
	no	26,37
competitiveness	yes	35,61
	no	26,53
location-based mechanics as a preference criterion	yes	33,03
	no	27,78
desire for future participation	yes	26,53
	no	30,95
storytelling as advantage	yes	33,92
	no	27,35
acquisition of knowledge	yes	38,68
	no	25,03
enthusiasm	yes	34,87
	no	26,88
ease of navigation	yes	34,71
	no	26,96

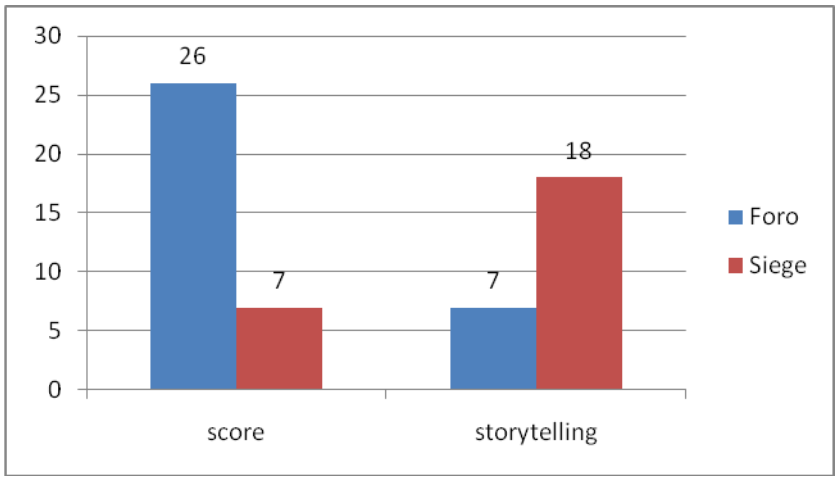
Gender as a grouping variable did not produce any statistically significant differences.

Applying the non-parametric test Mann Whitney once again, with grouping variable the preferred game, a statistically significant difference was observed in terms of the degree of immersion in favor of the Siege (p= 0.018) and in terms of competitiveness in the group that chose the Siege as their preferred game (p=0.016).

By cross-tabulating (chi-square test) the variables choice –preferred game- and preferred game feature, we came to the conclusion that those who expressed a preference for Foro, chose scoring as the most important feature of the games, while those who expressed a preference for the Siege indicated the narrative dimension of the game as the most important feature. In Figure 4 one notices that Siege is chosen for the narrative and Foro for the score.

Figure 4

Game Preference Cross-Tabulated with Game Mechanics



Source: author own development.

By applying the chi-square test again, crossing the opinion of the respondents on the educational value of the games with their opinion on the appropriateness of the application to be extended to other cognitive fields, a statistically significant relationship was identified (p=0.019), meaning there was a coherence in the answers of those responding positively and vice versa.

Extending the given research scope on probable additional relations, the Pearson correlation test to several variables was additionally applied.

So, a statistically significant correlation was found between the presence of storytelling and the experience of immersion (p=0.023) and between immersion with enthusiasm (p=0.02), knowledge acquisition (p=0.02), and competitiveness (p=0.00). More correlations were detected between enthusiasm and competitiveness (0.002), desire for future participation (p=0.001), and location-based mechanics (p=0.00). The desire for future participation was also statistically significantly related to location-based mechanics (p=0.00). The knowledge acquisition was positively related to immersion (p=0.002), enthusiasm (p=0.003) competition (p=0.001), and location-based mechanics (p=0.00).

Applying linear regression to check the predictive dynamics of the variables, it was found that enthusiasm was a predictor of the desire to participate in a similar activity (R=0.416) (p=0.001), as well as location-based mechanics (R=0.451) (p=0.000), on a moderate prediction grade.

To sum it up, having analysed the data with the grouping variables that were chosen as the axes of our research questions it was concluded that:

- The age group 16-18 had greater ease of navigation, showed more enthusiasm and stated that they acquired new knowledge. In addition, the 16-18 age group showed a clearly greater preference for The Siege and its narrative-driven structure, location-based

mechanics as a feature of the game, and competitiveness. They also reported experiencing greater immersion in the story than the 12-15 group. On the other hand, the 12-15 age group preferred Foro and the quiz-score structure. Regarding enthusiasm and desire for future participation, both age groups yielded the same statistical results.

- The gender as a grouping variable did not produce any statistically significant differences.
- Previous experience in similar games produced statistically significant differences in the condition of experiencing immersion, competitiveness, and knowledge acquisition, in other words the group with previous experience responded positively to all the above conditions.

Statistically significant correlations between the narrative-driven structure of The Siege and experiencing immersion, and between immersion with enthusiasm, with knowledge acquisition, and with competitiveness were also detected. Enthusiasm was also correlated with the desire for future participation and location-based mechanics. The knowledge acquisition was positively related to immersion, enthusiasm, competitiveness and location-based mechanics.

Finally, it can be concluded that enthusiasm and location-based mechanics were predictors of the desire for future participation in a similar activity.

Discussion

The given research questions have been answered satisfyingly. The main purpose of the research was to inspire educators and set an example for further similar educational applications, which could be more tailored and appropriately designed for the target age audience. Taleblazer was chosen mainly for a number of advantages compared to similar tools mentioned elsewhere (Kleftodimos et al., 2023a). Prior to the creation of the games, the relevant literature on spatially sensitive educational games for history and cultural heritage was studied in order to exploit specific design features that could enrich, and enhance a location-based augmented reality experience. So, we tried to make the game simple, balance fun with learning, enforce active discovery, motivate with challenges and rewards, including competitive mechanisms, offer clues and hints, make the best out of multiple modalities, and provide chunks of information for better assimilation (DaCosta & Kinsell, 2023). The aim was not to measure physical activity, social interaction, or cartographic education (Laato et al., 2019) other than ease of navigation as an indicator of cartographic management experience.

After implementing the games, the findings were compared with those of the relevant literature on LGBs – mentioned earlier – and realised that they were quite consistent with previous studies, especially in the reported positive impact (increase in interest, active engagement, motivation for participation, physical activity, and learning outcomes).

Since the evaluation process in most studies is mainly treated as a feedback tool for future improvement of LBGs (Ribeiro et al., 2021) and there is a lack of multivariate research studies that investigate and quantify the impact of the described applications in relation to several variables, it was decided to test how reported outcomes relate to factors such as gender, age, and previous experience.

Thus, we contributed to the evolving field of research with the following conclusions:

The age group is associated with a specific type of game that includes specific features and game mechanics (younger students show preference for quizzes-score-feedback, and older ones for a

narrative-driven plot) while gender does not seem to influence the specific choice. Previous experience in similar games also enhances the enjoyment of the game (immersion, competitiveness).

Limitations of the Study

Undoubtedly, a larger sample of students is needed for the results to be generalisable and more reliable. Also, there are still many features of games that could serve as criteria for student preferences or could facilitate learning. A drawback of the research is that it relies solely on quantitative data, which may not capture the nuances and deeper insights that qualitative data could provide.

While the study focused on age group as a factor, it did not delve deeply into other demographic variables, such as socioeconomic status or cultural background, which could also influence the game reception and learning outcomes.

This research focused on measuring variables embedded in these educational games, but did not delve into how they function as learning resources. It should have been followed by a knowledge test to verify whether the knowledge embedded in the games was actually mastered or remained on the surface. Undoubtedly, even the first contact with the cognitive content is a vestibule for the critical intake of knowledge later, but this is not a guarantee. Thus, this research provided a more detailed description of the impact of many factors, but much remains to be explored.

Besides, considering the average value of knowledge acquisition (3.21) which was relatively low compared to the rest of the statistical data, it was realised that the way of integration and transmission of knowledge should be further explored so that it can be assimilated seamlessly to justify the existence of similar Games .

Conclusions and Implications

The conclusions that were reached in relation to the age group and previous experience are important for the further design of similar games, suitably adapted.

The age group seems to be a criterion for the type of game mechanics to be chosen so that its reception is more positive and the learning goals more achievable.

Prior experience emerged as a factor affecting students' performance in spatially sensitive games and their reception. It is therefore essential that participants practice and navigate the digital maps before each application to ensure equal participation and the ability to enjoy the game to the same degree.

Suggestions for Future Research

Future research could focus on games that incorporate different design or mechanical elements and test what kind of response these elements elicit in students. There are many unexplored aspects in the field, which is still uncharted and promising.

For example, cognitive challenges that require problem solving could be used instead of prompts to move to a specific place, which can increase the degree of difficulty and the need for players to develop cooperation. This could prove to be a determining factor in the game's reception and player preference.

Also, in a different authoring tool (e.g. ARIS) (Batsaras & Xinogalos, 2023) or in the future version of Taleblazer that will allow monitoring the progress of the game participants, it would be

interesting to measure the degree of emotional involvement of the players, thanks to visibility of ongoing scores. Further, the relationship of their degree of involvement with the learning outcome could be explored.

In addition, other socio-cultural or economic parameters of the participants' profiles could be selected as independent control variables that may influence how players respond to the game.

Certainly, investigating the appeal of an educational game with mixed features (score and narrative) compared to the games under discussion, in which these features are found individually, would shed more light on how they affect different age groups.

Even more, future research could improve the targeting of learning outcomes and their integration into game design, taking into account the current findings about the preferred model of game mechanics in relation to age groups.

Finally, the designers of such authoring tools, by providing access to statistical data on game performance and player behavior, will allow game creators to tailor them taking robust evidence into account and also create educational content and difficulty levels accordingly.

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