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Systematic Review on Gamification and Cultural Heritage Dissemination[1]

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Abstract

In the current modern world, gamification and its innovative methods become one of the primary tools for advanced communication and socialization with users in a variety of sectors - finance, marketing, business training and entertainment (Kapoor et al., 2018). Studying the skills of the game link shows that thr game plays a powerful and productive role in improving the key skills and competencies required for success in education, real life, and professional realization (Pellegrino & Hilton, 2012). Comprising the historical-cultural heritage in the field of gaming cultural heritage training might be one of the most promising learning approaches for visitors of all ages. Gaming methods applied to cultural heritage studies include an opportunity to develop digital learning scenarios and paths based on vital historical themes and provide visitors with the possibility for cultural heritage learning. This article presents the results of a methodical review, aimed to understand how the gamification environment has been used, for the past five years, for promoting cultural heritage sites, activities and enhancing knowledge. A total of 72 studies have been published between 2015 to 2020, and 45 were selected for a systematic review. Results indicated that the final studies selected are mainly using novel gamification approaches for the promotion of cultural heritage.

Keywords: *Gamification, Cultural heritage,* Digital Learning Scenarios, Internet of Things

1. Introduction

Gamification is the process of introducing game strategies and components into some scenarios and situations that are not a game (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015). Gamification can be considered a tool to engage people in tasks (Nicholson, 2015), promote relationships (Caporarello, Magni, & Pennarola, 2017), or improve motivation (Sailer, Hense, Mayr, & Mandl, 2017). Khaled, Deterding, Dixon and Nack (2011, p. 9) suggested a definition of gamification as "the use of game design elements in a non-game context." Due to gamification elements, the gamification can be useful for teaching and learning activities because it can promote student engagement. The difficulties

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educationalists face related to student interest and engagement in their classroom are not new. In the past, educationalists have attempted to use a variety of inventions, including the use of motivational tactics. However, the impact of intervention only lasted for a short period. Due to its playful and natural characteristics, gamification can be a great solution to help solve student engagement and participation in learning activities (Kim, Song, Lockee, & Burton, 2018).

Gamification in education and learning is a set of processes and activities to solve the problems related to education and learning by using novel game mechanics (Kim et al., 2018). Games for learning and educational purposes such as serious games (SG) are now becoming more prevalent (Lamb, Annetta, Firestone, & Etopio, 2018). The primary function of a Serious Game is its aim of helping the player to achieve a learning target via an enjoyable experience (Anastasiadis, Lampropoulos, & Siakas, 2018).

Currently, researchers have witnessed the beginning of serious games, with the use of games to support cultural heritage promotion, such as historical knowledge learning and teaching, or promoting museums tourism (Applications, 2020). The majority of architectural and cultural heritage awareness games either offer an immersive, realistic reconstruction of reallocation to appreciate and learn the artistic, architectural, or values of cultural heritage sites or provides an engaging method to persuade users into the real experience (Mortara & Catalano, 2018).

Museums, as well as highly cultural heritage attractions, are multi-functional services whose mandates commonly comprise a variety of objectives (Wu & Wall, 2017) and commonly considered as being informal education and training sites and have been broadly recognized for their ability to promote the development of interest, motivation, enthusiasm, general openness, alertness and eagerness to learn and cultural awareness (Elwick, 2013).

As part of the procedure of protecting museums and cultural heritage sites are commonly understood to be essential of presenting, preserving and protecting heritage (Özer Sarı & Nazlı, 2018). In recent years, cultural heritage sites, especially museums, have been promoted as leisure-based education facilities. People around the world are utilizing their leisure time to visit museum collections and getting significant experience by enjoying museums and cultural heritage sites (Kurin, 2004).

Recent times have seen the massive development of digital sensors. These sensors can measure the environment, brain activities, people's behaviour, physical movements, biometric changes, their interaction with others, under different conditions. On the other hand, connecting embedded devices with sensors connected with software and middleware that conforms to current web standards is the key idea for the web of things and Internet of Things (IoT) (Ray, 2018).

The IoT phenomena were introduced a few years ago. The IoT uses various smart sensors that help to enhance the operational capability of IoT applications due to its potential characteristics and advancements in wireless technology, in recent time. It is getting more and more attention among technology producers, especially in gamification. The IoT offers the possibility of enabling

significant objects into visual ones, think and execute different tasks by having a conversation with each other, sharing, and storing data. The IoT converts these objects from conventional to smart by manipulating its underlying technologies such as ubiquitous and cogent computing embedded devices communication technologies, protocols, sensors networks, and applications.

When IoT was introduced, radiofrequency (RFID) appeared to be necessary for it. There are various technologies similar to RFID, such as Near Field Communication (NFC), vehicular to vehicular and machine to machine, which can be used to apply the innovative idea of IoT (Bertino, 2017). The adoption of smart technology makes it possible for the user to spend an easier and comfortable life. In recent times, smart technologies lead manifest effects on users' domestic spheres, like smart homes, assisted living, smart cities, smart cars, and smart museums.

The Internet of Things has observed advancements in services and manufacturing industry like more production, reliable and higher quality. Due to its reliability and quality, Cisco estimated that, by 2020, IoT-based systems would consist of 50 billion of digital devices which are connected to internet technology. For depth understanding on IoT, Cisco offers an IoT application which enhances productivity, produces new business models and makes new revenue systems (Miraz, Ali, Excell, & Picking 2015).

In recent times, smart sensors usage in cultural heritage sites has increased, like Augmented Reality (AR) which has an extensive characteristic to promote cultural heritage sites and can assist visitors at cultural heritage sites (Bearman & Geber, 2008; Notice, This, & Programme, 2020). Due to the characteristics of new technologies, it is a possible acoustical tool can mixed with AR tools to enhance visualization, especially in archaeology and cultural heritage sites (Bruno et al., 2017).

Gamification environments are enhanced by IoT sensors as well. The ability of games to engage and inspire (Xi & Hamari, 2020) and the characteristics of gamification can change the perception and views which, on the other hand, develop a positive approach to games (Shi, Renwick, Turner, & Kirsh, 2019). The usage of serious games is increasing in a non-entertainment context, such as training, and is transforming everyday lives. Therefore, social games and serious games communities are changing the way social interaction occurs, leading to more outstanding skills for social learning, leading to novel approaches for cultural heritage exploration and more important, bringing more fun into everyday life (Checa & Bustillo, 2020).

This paper reviews in recent times the role of gamification environments for the promotion of cultural heritage sites and activities. In this way, it seems essential to understand how the gamification environment can be developed, how it promotes cultural heritage sites and activities in a way that the visitors can gain knowledge and entrainment. Therefore, an extensive systematic review has been conducted, from 2015 to 2020, to understand the gamification environment which could promote cultural heritage sites and effectively convey knowledge of cultural heritage sites to visitors.

2. Background

The growth of games in non-leisure contexts is transforming daily lives and most importantly introducing more fun in everyday life (Arnab & Clarke, 2017). It is the power of games to motivate, engage and immerse (Alsawaier, 2017). The necessity to enhance pleasure and contest in daily activities has seen gamification classified as the use of game mechanics in a non-game context, being employed as a strategy to not only take part but also sustain participation. The illustration of gamification or how games are pervading human life is the example of education in serious games and virtual environments that are specifically developed for cultural heritage and educational purposes disclose the potential of these technologies to motivate and engage outside leisure activities (Mortara et al., 2019).

Hamari (2014) reviewed existing proposals that have impacted training and teaching. These approaches were based roughly on kinds of players, and they showed that personalization is vital to motivation. At the state of the art of serious game advancement, the author concludes that it is identical to the state of the art in entertainment game advancement. Both categories of games share the same structure, i.e. technology base, or as Zyda (2005) observes, applying games and simulation technology to non-leisure domains outcomes in serious games.

Over the past few years, there has been a massive development in entertainment technology, i.e. today's games are exponentially more sophisticated, smart and responsive than those of just a few years ago (Boomsma & Hafner, 2018). Which, in turn, intake the lead to remarkably high customers’ expectations. Modern real-time computer graphics can accomplish near virtual games, and photorealism, worlds are generally populated with the massive amount of high-value content producing a richer experience. The project "The main project: Discovering the territory of Old Peucetia" (Cesaria & Ferdinando, 2019) describes the usage of a tangible consumer interface game and how he/she understands cultural heritage, particularly considering the castle Caracciolo in Sammichle di Bari in Apulia, Italy. The main objective of this project is to promote the local heritage of old Pecucetia in Apulia among primary school students. This project provides a network of activities and educational workshops which have been arranged in the historical buildings of towns of old Pecucetia in order to allow students of primary school to learn the history and the environment of the area by gamification methods. Offered workshops rely on interactive tools and multimedia installations, that were designed, developed, and installed. Via events and simulation, familiar visitors and students of the exhibitions can engage themselves in ancient times and uncover the history of their area. The project "Cultural Heritage Design Element Labeling System With Gamification", conducted by Lee, Yi, & Kim (2020), developed an image labelling system with a graphical model-based labelling approach and introduced gamification. The robust labelling approach with gamification increased beginners' engagement and decreases the workload of expert and beginners' labellers; however, it reduces data agreement among beginners and experts.

Another study that offers the possibility to explore the cultural heritage sites under the water through AR gamification method is "A hybrid augmented reality guide for underwater cultural

heritage sites", conducted by Čejka, Zsíros, & Liarokapis (2020). This study offers a very innovative Augmented Reality model for the underwaters divers to introduce ancient, abandoned building at underwater archaeological locations. The study offers a prototype that runs on smart devices (smartphones) which are sealed in a waterproof casing and uses a hybrid method to pinpoint the location of divers — the prototype of this study experiment is based at In Baiae, Italy. A total of ten professional divers took part in this study, and their gamification experience level showed in the result that underwater AR substantially improves the user's experience and their entertainment level.

3. Methodology

3.1. Research question

The presented systematic review seeks an answer to the following question:

How does gamification contribute to the dissemination of cultural heritage?

3.2. Objectives

The primary goals to conduct this systematic review were to evaluate the evidence on the dynamics of the gamification approach in the promotion of cultural heritage sites, and to present a narrative synthesis on learning about cultural heritage sites through very novel approaches such as gamification, through Augmented Reality, Virtual Reality (VR) and Internet of Things applications. This research approach is essential as the prevalence of ancient knowledge and activities among the tourists is evident.

The goals of this systematic review are to assess the extensive quality of stated studies, to identify patterns over consecutive days, to compare gamification outcomes between tourists with different technological approaches; moreover, to examine rates of entertainment and explore the implication of gamification on application to cultural practice and to inform the investigation.

3.3. Research Procedure

For the systematic review, this research was carried out using the Scopus database, using one main query with two main keywords. First, "Gamification" and the second one is "Cultural Heritage (CH)". The reason behind the use of one query with two keywords was to focus only on gamification and cultural heritage studies and avoid the dispersion of results and consequently avoid the loss of focus from the main topic. Therefore, the decision was to use fewer keywords and queries.

3.4. Inclusion and Exclusion method.

The selected studies for systematic review cumulatively met the following inclusion procedures:

a) Studies have been published between 2015 to 2020.
b) Address gamification from the perspective of cultural dissemination.
c) Sufficiently described the design and usage of gamification application for promotion of cultural heritage.
d) Offers an innovative methodological gamification approach.
e) Selected studies present sufficient knowledge and highlight the importance of gamification applications in a cultural heritage context.
f) Selected studies present sufficient knowledge and highlight the importance of gamification applications in a cultural heritage context.

4. Results

There were 72 studies located in references, including 4 duplicates. In the first step, 68 studies were reviewed. However, 48 out of these 68 studies were examined, starting with an appraisal of their titles and abstracts. 36 out of 48 studies were accepted; these studies met the inclusion criteria. The remaining 12 out of 48 studies were excluded as they did not meet the defined inclusion method. The full text screened of 20 out of 68 studies, an additional eight studies were excluded, as when examined in greater depth, as these studies did not meet the inclusion criteria. In the end, 45 out of 68 studies fulfilled the inclusion criteria.

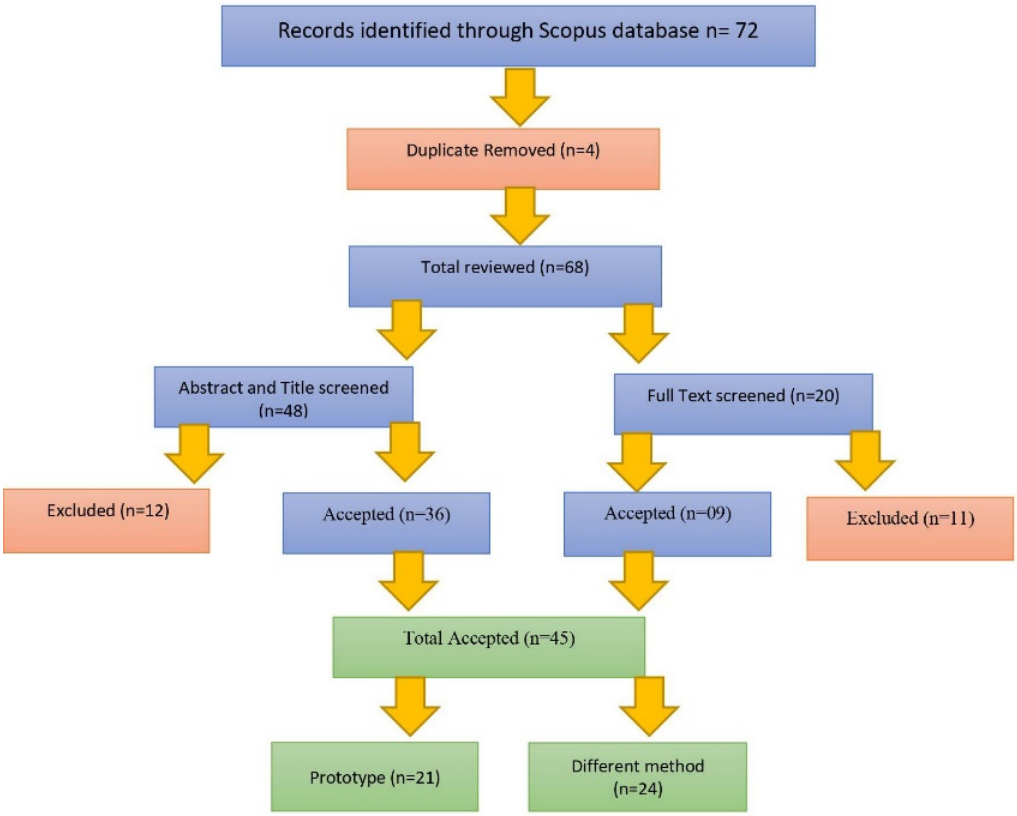

Fig. 1. Graphical representation of results

4.1. Quality appraisal

All studies titles, references and abstract were examined. However, 20 full texts of articles were analyzed and read, and 11 articles did not meet the inclusion criteria of the study, which lead to the exclusion of the systematic review. Then an assessment of quality was done. Higgins and Altman (2017) recommended against rating using statistically scales, so emphases were placed on an assessment of bias and in the assessment of the risk of bias from trial attrition, selection and selective conclusion reporting.

4.2. Data extraction

An electronic data form has been developed, updated by strobe checklist for descriptive cohort articles. Data was extracted for the research setting, research publishing date, design of the presented study, objective of the study, novel approaches used for presented studies and outcomes. The information abstracted was checked against the full-text articles independently.

Dates of publication and data collection.

The included studies were conducted, data collected and published between 2015 to 2020.

Fig.2. Percentage of publication in different years

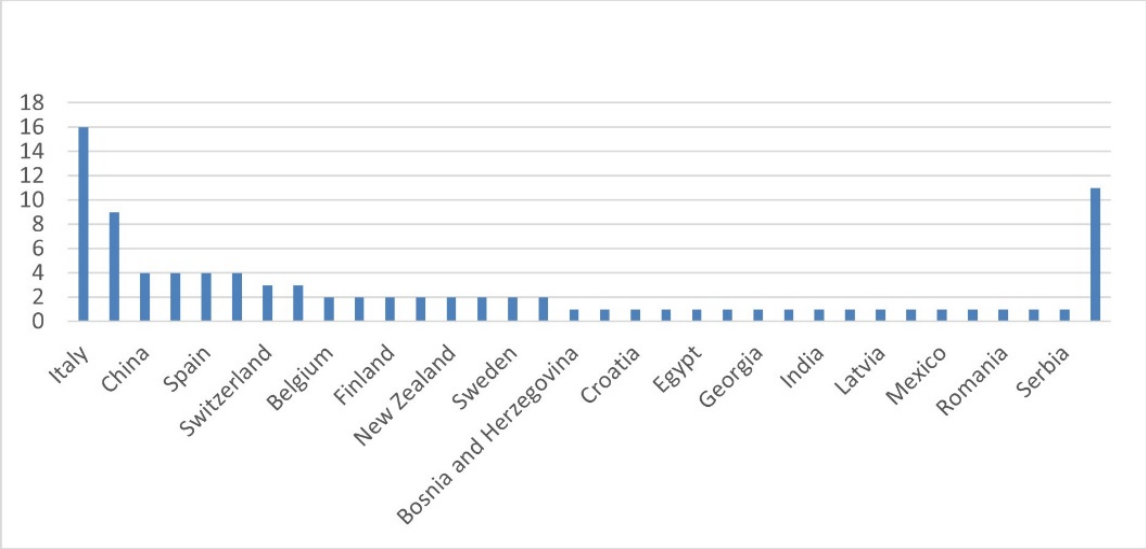

Fig. 3. The histogram represents the numbers of publications and list of countries where these publications are published

4.3. Reviews Studies` designs and methods

All 45 studies selected are based on a gamification approach for cultural heritage promotion. Twenty-one studies are based on the development of prototype applications and system, 24 studies remaining which are based on literature review, survey, or chapters. Most of the selected studies use AR and VR approaches to provide the gamification environment for culture heritage

exploration and to learn about cultural heritage. The following table describes the studies that develop a prototype application for gamification and cultural heritage context.

Table 1. Reviews of studies and prototype methods

Sr#	Authors and Year published	Title and Goals	Results
01	(Fakhour, Azough, & Kaghat, 2020)	**Title:** A Cultural Scavenger Hunt Serious Game Based on Audio Augmented Reality. **Goals**: The objective was to develop an interactive and immersive tour to guide tourist through different attraction places. Therefore, this study presents scavenger hunts platforms which are augmented audio reality and gamification concepts.	The results of the study highlight that the uses of audio augmented reality and severe gamification techniques help and persuade visitors to explore cultural heritage sites.
02	(Vera & Sánchez, 2016)	**Title:** A model for in-situ augmented reality content creation based on storytelling and gamification **Goals:** This study uses the AR content creation methodology. It offers a model in which storytelling features augment the content in Points of Interest. These main study goals are to empower users to become producers to develop and create digital content in different circumstances.	The results of this study highlight that the Model of this study encourages users to visualize and create content through their mobile devices. Moreover, the tourist can learn more and more about their surroundings and the location.
03	(Grammatikopoulou et al., 2019)	**Title:** An adaptive framework for the creation of exergames for intangible cultural heritage (ICH) education. **Goals:** The primary goals of this study are to develop and design an innovative framework for body motion customizable games. This framework will be able to move users' data and offers the game for training and learning.	The results of this study indicated that game-like application could be effective for learning and training, as positive feedback was obtained.
04	(Lu, Yuan, Lin, & Yuan, 2020)	**Title:** TouristGo: a location-based mobile game to improve the tourist experience by visiting path optimization. **Goals:** This study proposes a model for mobile games called TouristGo that offers the tourist a least crowded path, and it is also able to collect activity data of tourist.	The results indicated that tourists used a path where fewer people are, and they save time by using Tourist Go.
05	(Kotsopoulos et al., 2019)	**Title:** An authoring platform for developing smart apps which elevate cultural heritage experiences. **Goals:** The main aim of this study is to design and evaluate the implementation and analysis of 3DGuides authoring systems that develop smart apps which offer gamification experience, cultural heritage knowledge and mobile services.	The result of this study indicated that proper mechanics in gamification in promoting cultural heritage enhance the user cultural experience and their knowledge.
06	(Bozzelli et al., 2019)	**Title**: An integrated VR/AR framework for a user-centric interactive experience of cultural heritage: The ArkaeVision project **Goals:** This study offers a model of a prototype. This prototype offers a communicative approach that is very promising for cultural education and engagement. Moreover, users will have opportunities to engage themselves and explore historical sites through virtual technology.	The results of this study showed that virtual scenarios, characters, and prototype features helped users to feel immersed in the location.
07	(Olivieri, Schegg, &	**Title:** Cityzen: A social platform for	This study results showed that the platform uses

	Sokhn, 2016)	cultural heritage focused on tourism. **Goals:** This study offers a platform, which provides a semantic web-oriented data prototype that performs as a central storehouse and which can be used by tourists for precision and effectively planning their tours. This Model deals with cases of inaccurate and imperfect information by using the social web as the possibility of actively engaging tourists in the data organization while they explore the information provided.	social media to improve data management by allowing users to rectify and complete existing information and sharing their knowledge about new information. These characteristics indicated that the usage of the social media platform enhances the knowledge of tourists.
08	(Basaraba, 2018)	**Title:** Co-constructing Cultural Heritage through a Web-Based Interactive Digital Narrative **Goals:** This study investigates in what manner digital media can be utilized not only to attract and teach but also to promote the co-construction of cultural heritage narratives. The main question this study address is how a transdisciplinary approach can expand IDN theory (Interactive digital narrative theory) into creation and evaluation frameworks for multimodal, participatory narratives in the non-fiction genre.	The results show that the co-construction of cultural heritage heritages approach helps to promote the cultural activities and build a mechanism to promote cultural activities while the tourist visits the historical places.
09	(J. Lee et al., 2020)	**Title:** Cultural Heritage Design Element Labeling System with Gamification. **Goals;** The study presented offers an image labelling platform with a graphical Icons-based labelling approach with gamification features. The robust labelling approach with gamification rose beginners' motivation and engagement. It reduced the workload of the specialist and beginner's labeller. However, there is a reduced data agreement between expert and beginners, so the study considers opportunities for gamification with the specialized cultural heritage domain.	The results of this study indicate that increased motivation encourages the labeller to understand a lower feeling of workload. However, both motivations affected workload. However, the perceived choice does not co-relate to other factors.
10	(Tan & Lim, 2017)	**Title:** Digital heritage gamification: An augmented-virtual walkthrough to learn and explore tangible cultural heritage. **Goals:** The primary objectives of this study are to develop an innovative digital game for a virtual walkthrough application and entice visitors to explore and learn about historical places by using advanced graphics from Augmented Reality.	The researcher results show that this study is speculated to be pervasive to improve the cultural heritage knowledge for learners.
11	(López-Martínez, Carrera, & Iglesias, 2020)	**Title:** Empowering museum experiences applying gamification techniques based on linked data and smart objects. **Goals;** This study offers a gamified intelligent objects platform which needs significantly less maintenance, which automatically creates tasks by exploiting semantic web technologies. This platform was implemented in a real-life scenario.	The outcomes of this study persuade users to use this platform. Consequently, it can be generalized and adapted to other kinds of museums or cultural heritage institutions.
12	(Cesaria, Ferdinando, 2019)	**Title:** Gamification in Cultural Heritage: A Tangible User Interface Game for Learning About Local Heritage Ferdinando. **Goals:** The primary goal of this study is to explore and offer novel tools to develop the interest of students in cultural heritage and enhance their	The outcomes show the prototype increased students' motivation and engagement with the use of the game during the cultural heritage—education workshop.

		understanding and knowledge.	
13	(Prandi et al., 2019)	**Title:** Gamifying cultural experiences across the urban environment. **Goals:** The primary aims of this study are to design and develop a prototype that provides support in computing customizing urban paths across cultural heritage places and in sharing multimedia resources about Points of Interest, by using gamification components with the means of connecting tourists. A mobile application prototype has been implemented demonstrating the viability of the proposed methodology and using crowdsource activities as a source of information for cultural places and works of art.	The preliminary design of the prototype indicated that it integrates numerous and different data sources, mainly based on open data provided by official entities. Additionally, it combines gamification strategies and crowdsourcing to engage and involve users in being part of the community and enhancing the global dataset.
14	(López-gonzalez, 2016)	**Title:** Gaming as a Gateway Ensuring Quality Control for Crowdsourced Data. **Goals:** This primary study goal was to develop a crowdsourcing hybrid mobile application which can be used to collect information within a cultural heritage area. This application was able to investigate the usage of gamification in crowdsourcing settings, to develop the task and performance, incentivize people to participate and control the quality of their work.	The final prototype outcomes indicated the crowdsourcing approach had reported an increase in engagement.
15	(Ioannides et al., 2016)	**Title:** Imaging Novecento. A Mobile App for Automatic Recognition of Artworks and Transfer of Artistic Styles. **Goals:** The study offers a prototype mobile application that can be used inside the museum for exploring historical sites through a gamification approach with recreational and learning purposes.	The final application can enhance the interaction between users and a cultural heritage site through a gamification approach. The users reported their experience stating that the app reduces the cognitive effort of users versus the complexity and numerous artworks present in the museums.
16	(Huang, Chiao, & Huang, 2018)	**Title:** Innovative research on the development of game-based tourism information services using component-based software engineering. **Goals:** This project aims to develop a vivid story scene tour for online cultural exploration which enhances the interactive digital guide.	The final application highlights a game-based digital guide, which enhances the learning ability among the users and moves over a measure of the effect of entertainment.
17	(Claudio, Luca, & Luce, 2017)	**Title:** Interaction design for cultural heritage. A robotic cultural game for visiting the museum's inaccessible areas. **Goals:** The articles define the design of robotics conceived in codesign with museum stakeholders. In this study, researchers deployed telepresence robots in the museum's spaces. After evaluation of robot interaction, the researchers deployed more interacting activities for tourist experience enhancement. The study is based on the robot ability to be driven by tourists and the capacity of the robot to being used as a platform for digital storytelling.	The results of the study indicated to settle issues related to the minimal engagement by the younger users as to the museum, and a right project solution could be the inclusion of the user in the design process.
18	(Quattrini, Pierdicca, Lucidi, Di Stefano, & Malinverni, 2019)	**Title:** The European research night: new ways of communicating science with ICT and video mapping. **Goals:** This article defines the methodology that makes use of dramatic photo survey as a precise source for video projection mapping to understand and promote the cultural activities.	The results showed that through the proposed video mapping approach, it is easy to collect a considerable amount of data, and the channel of communication can spread digital cultural heritage.

19	(Papathanasiou-Zuhrt, Weiss-Ibanez, & Di Russo, 2017)	**Title:** The gamification of heritage in the UNESCO enlisted medieval town of Rhodes. **Goals:** This study offers design and delivers a model of heritage game that enhances the user experience while visiting historical places.	The final prototype design offers participatory cultural heritage services to the users for matching the cultural heritage expert knowledge with the cultural services for consumers.
20	(Moreno Sánchez & Navarro Newball, 2015)	**Titile:** La ciudad escondida. Toledo, laboratorio de comunicación transmedia. **Goals:** This study offers a model that can analyse the different types of immaterial and hidden lost heritage of their transmedia possibilities.	The authors conclude that the hidden and immaterial heritage is more important than the material one since it is this one that gives meaning to the social imaginaries and society. The proposed model – combining analogy and digital transmedia – allows complete communication, reaching all publics, allowing their participation.
21	(Cirulis, Paolis, & Tutberidze, 2015)	**Title:** Virtualization of Digitalized Cultural Heritage and Use Case Scenario Modeling for Sustainability Promotion of National Identity. **Goals:** The goal of this study is to develop a standard design for technologies and the consumption of virtual and Augmented Reality to achieve suggestion for the sustainability of the national identity of countries via the prism of cultural heritage. Thus, offering an organized and global technology solution that is not aimed towards individual museums and separate objects of cultural heritage but focuses on the overall region in the specialization of ancient sites.	The final application has two-dimensional information such as text and picture description, that helps to enhance the engagement with cultural heritage places. Moreover, it enhances the motivation to complete the tasks within heritage spaces.

4.4. Gamification via VR and AR methods

Mixed reality, including Virtual and Augmented Reality (VR & AR), is a creative model that invokes interactive 3D digital narratives that promote a new pattern of intangible knowledge communication as well as intangible cultural heritage (Ioannides, Magnenat-thalmann, & Papagiannakis, 2017). Currently, technological improvements are transforming the ways that users experience the virtual and physical environments. Specifically, VR plays a vital role in various industries (Berg, Vance, & Vance, 2017). For instance, education (Merchant, Goetz, Cifuentes, Keeney-kennicutt, & Davis, 2014), tourism (Griffin, Hwan, Lee, & Guttentag, 2017), health services (Freeman et al., 2020), research activities (Bigné, Llinares, & Torrecilla, 2016) and entertainment activities (Lin, Lin, & Wu, 2017).

Due to excessive usage of AR and VR in various areas, the demands of Augmented Reality and Virtual Reality increased the last five years. Therefore, the results of the systematic review show that 21 out of 45 studies are based on Virtual and Augmented Reality. These numbers indicated how vital VR and AR technology is for cultural heritage dissemination. The usage of AR and VR in these 21 studies is not only for entertainment but also for serious gamification. These 21 studies, through AR and VR, used gamification, a term for serious learning, and training activities. Some examples of studies that use VR and AR in gamification contexts are as follows: (Anastasovitis, Ververidis, Nikolopoulos, & Kompatsiaris, 2018; Applications, 2020; Bazzurri & Picardello, 2018; Bozzelli et al., 2019; Bugeja & Grech, 2020; Bujari, Ciman, Gaggi, & Palazzi, 2017; Cesaria, Ferdinando, 2019; Claudio et al., 2017; Huang et al., 2018; Kotsopoulos et al., 2019; Liritzis,

Ioannis, Al-Otaibi, F.M, Volonakis, P, Drivaliari, 2015; Nofal et al., 2020; Petrucco & Agostini, 2016; Study & Castle, 2016; Tan & Lim, 2017; Tsai & Chiang, 2019; Vera & Sánchez, 2016).

4.5. Gamification with various technological methods

In the present technological era, researchers are promoting cultural heritage via VR and AR gamification. However, many researchers are using different techniques and approaches to develop a gamification environment for cultural heritage dissemination. Therefore, the authors reviewed 24 studies out of 45 that used 24 approaches to develop a gamification platform or to understand the gamification application for cultural heritage enhancement. The following 24 studies use different approaches and methods to create a gamification environment for cultural heritage promotion.

Table 2 List of reviewed studies that used different approaches for Gamification

Sr#	Authors	Title	Methods or tools	Sectors
01	(Markovic & Sofronijevic, 2015)	Building a Gamified System for Capturing MOOC Related Data-Smart City Learning Community as its Most Precious Source of Intangible Cultural Heritage.	MOOC (Massive Open Online Courses).	**Cultural Heritage**
02	(Smaniotto et al., 2019)	CyberParks – The Interface Between People, Places and Technology.	This study uses the theoretical cyber parks approach.	
03	(Jia, Tan, Xiong, Li, & Hai, 2019)	Designing Edutainment Games for Intangible Cultural Heritage: the BNREG Project.	Edutainment games method	
04	(Vayanou & Loumos, 2019)	Designing Performative, Gamified Cultural Experiences for Groups.	Storytelling game	
05	(Kumar, 2016)	Introducing New Age To ICH: Revering Matters Of Significance.	This study uses a questionnaire method to know the perception of people about gamification terms.	
06	(Corallo et al., 2017)	Mobile app for promoting cultural heritage: geostatistics and textual analysis.	Developed a mobile application for visiting Cultural heritage sites.	
07	(B. C. Lee, 2019)	Sustainability. The Effect of Gamification on Psychological and Behavioral Outcomes: Implications for Cruise Tourism Destinations.	Literature review.	
08	(Aydin & Schnabel, 2016)	The Museum of Gamers: Unmediated Cultural Heritage Through Gaming.	This is a chapter which discusses gamification and technologies.	
09	(Chortaras et al., 2018)	WITH: Human-Computer Collaboration for Data Annotation	This study uses the WITH Aggregation method	

		and Enrichment.	which can enhance digital services and human-computer collaboration for data observations and enrichment.	
10	(Fakhour M., Azough A., Kaghat FZ., 2020)	A Cultural Scavenger Hunt Serious Game Based on Audio Augmented Reality.	This study uses audio augmented reality methodology through profound game concepts.	
11	(Robles-Bykbaev, López-Nores, Ochoa-Zambrano, García-Duque, & Pazos-Arias, 2015)	Game-like Application for Dance Learning using a Natural Human-Computer Interface Alexandros.	This study offers a component for game designing. These components help to make way for transmission of Intangible Cultural Heritage education and, mainly, education for traditional cultural dances.	
12	(Grammatikopoulou et al., 2019)	An adaptive framework for the creation of exergames for intangible cultural heritage (ICH) education.	This study uses a method in which it offers a framework for cultural training through a gamification approach.	
13	(Olivieri et al., 2016)	Cityzen: A social platform for cultural heritage focused tourism.	This study adapted a social media approach for cultural heritage dissemination.	
14	(Basaraba, 2018)	Co-constructing Cultural Heritage Through a Web-Based Interactive Digital Narrative.	This study uses a co-constructing methodology through a web-based interactive narrative for cultural heritage understanding.	
15	(J. Lee et al., 2020)	Cultural Heritage Design Element Labeling System with Gamification.	This study uses the labelling technique for gamification in the context of cultural heritage.	
16	(López-Martínez et al., 2020)	Empowering museum experiences applying gamification techniques based on linked data and smart objects.	This study uses a crowdsourcing approach for a hybrid mobile application which can be used to collect data within the cultural heritage area.	
17	(Hao He, Ziyang Li, Xiandong Cheng & Design, 2019)	Gamified Participatory Museum Experience for Future Museums	This study proposed an application named SPORTSWEAR EXHIBITION for enhancement of museum participation and educational experience for visitors using gamified participatory experience.	
18	(Prandi et al., 2019)	Gamifying cultural experiences across the urban environment.	This offers a prototype application for urban gamification for cultural heritage exploration.	
19	(López-gonzalez, 2016)	Gaming as a Gateway Ensuring	This study offers a	

		Quality Control for Crowdsourced Data.	crowdsourcing setting approach to improve the task assignments and performance of users during the exploration of cultural heritage sites.	
20	(Ioannides et al., 2016)	Imaging Novecento. A Mobile App for Automatic Recognition of Artworks and Transfer of Artistic Styles.	This study is developed an application called Imaging Novecento.	
21	(Quattrini et al., 2019)	The European research night: new ways of communicating science with ICT and video mapping.	This study adapted a photo survey approach for cultural heritage understanding.	
22	(Papathanasiou-Zuhrt et al., 2017)	The gamification of heritage in the UNESCO enlisted medieval town of Rhodes.	This study is based on the Model of heritage game that enhances the user experience while visiting historical places.	
23	(Moreno Sánchez & Navarro Newball, 2015)	La ciudad escondida. Toledo, laboratorio de comunicación transmedia.	This study designed and developed a model for analysing the hidden or lost cultural heritage sites and objects.	
24	(Bujari et al., 2017)	Using gamification to discover cultural heritage locations from geo-tagged photos.	This study offers an approach that can exploit social networks gamification and crowdsourcing that enhance the user experience in the context of cultural heritage exploration.	

Discussion and conclusion

Overall assessment of quality across the studies reviewed, the design and methods were explained clearly and, in most cases, would be replicable. In all reviewed studies, convenient nonrandomized approaches and procedures were employed for the development of a gamification atmosphere or to understand the gamification impact on cultural heritage.

In this systematic review, a comprehensive understanding of gamification for the dissemination of cultural heritage applications and consideration on open issues was achieved. In this literature, the study uses Scopus data platforms for exploration query on 72 papers that were published from 2016 to 2020. Finally, the study reviewed 45 papers that emphasized gamification and cultural heritage. For gamification, AR and VR approaches have the highest percentage of the application approaches by 46.66% (21 out of 45 studies) that enhance the dissemination of cultural heritage knowledge. The high percentage of AR and VR shows that this technology has significant influence in the tourism sector and this influence pushes the researchers to develop AR and VR

applications in which tourists can explore the cultural heritage through augmented reality and virtual reality.

Furthermore, in a systematic review, 53.33 % studies (24 out of 45 studies) are based on different technological methods that develop a gamification environment for the promotion of cultural heritage among tourists. The percentage of different methods is very high as compared to VR and AR technology, which indicated that researchers are not only relying on Augmented reality and Virtual reality, they are also using diverse and new innovative techniques to develop a gamification application for Cultural heritage dissemination.

The aim of all the selected studies in the review is offering or discussing gamification environments that help to enhance cultural heritage education, offers news ways of exploration of cultural heritage sites and motivate the users to use gamification applications for cultural heritage dissemination.

The systematic review reveals that the last five years researchers and producers are using a gamification approach as a comprehensive tool to develop novel systems and applications for promotion of cultural heritage. Moreover, gamification tools can motivate tourists to visit cultural heritage and explore historical sites by playing serious games.

Furthermore, the systematic review highlights the importance of the gamification method and how we can develop gamification not only with AR and VR tools but through various approaches. The review studies described that gamification does not only offer entertainment platforms but also offers tourists the means to enhance their knowledge level by planning serious games.

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