Tourism Technology Platforms Based On Virtual Reality

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Abstract

The development of Tourism Technology Platforms based on virtual reality in recent years, offers great potential for the widespread consumption of tourism content, for this reason, this paper presents a systematic review of literature on the subject, in the last five years. This review identified that e-tourism, smart tourism, and cultural tourism are those that have most frequently used this type of development. The advantages that they imply for both the tourism industry and the users were also evidenced, but the low level of publication in this regard was also evidenced.

Keywords: Tourist technological platforms; technologies in tourism, types of tourism, virtual reality.

I. Introduction

Tourism is one of the most relevant economic sectors in the international sphere, it represents 30% of the global service market exportations, creating one of every twelve jobs and 10% of the global gross domestic product (GDP), according to the World Tourism Organization (UNWTO) (UNWTO, 2016). According to UNWTO: “in 2019 1.500 million international tourist arrivals to different destinations worldwide have been registered, this shows a 4% increase in the tourist business, in comparison to 2018” (UNWTO, 2020). Tourism is one of the

economic activities with better growth prospects and that in post-pandemic times can become the strongest economic support in many regions of our planet. As an important source of global economic reactivation, tourism is in a good position to stir up strategies that provide income to different population centers through job generation (PNUD, 2015).

On the other hand, the adoption of Tourism Technology Platforms (TTP), has been taken as a strategic action aimed at the relevant use of Information and Communications Technologies (ICT), which seeks to influence the business models in a positive way, using emerging technologies such as Virtual Reality (VR) (UDIMA, 2020).

The development of ICT has influenced many business sectors, particularly, the tourism industry (Beck et al., 2019). The emerging technologies contribute to the reengineering of the systems and processes in the tourism sector, upon impacting its operational, structural, and strategic levels (Buhalis y Egger, 2006), they alter the ways in which the tourism production and products, and services are managed, advertised, and marketed. The above implies a change in the way in which travelers identify, plan, book, and experience their travels (Buhalis and Law, 2008; Neuhofer et al., 2014). Among the technologies that in recent times have been at the forefront in the tourism sector are Augmented Reality (AR), Mixed Reality (MR) (Ali, 2016), and Virtual Reality (VR) (Guttentag, 2010).

Given the above, it is very clear that the use of VR in the tourism field presents enormous advantages both for the tourism industry and for potential users, therefore, its dissemination is transcendental in both directions, herein lies the importance of knowledge of the existence of publications on the matter.

Among the main contributions of this document within the framework of the field of study, the following can be highlighted:

1) The identification of the most recognized technology platforms by the academic community on tourism based on VR.
2) A characterization and analysis of the emerging technologies mostly used in the tourism sector, which includes VR, with its different applications and developments.
3) A variety of reflections and suggestions in relation to VR in the field of TTP.

The work is organized according to the following structure: in section II the related studies are described, in section III the methodology used for the systematic literature review (SLR) is presented, in section IV the scientometric analysis is presented, in section V the technical analysis, in section VI the analysis of the results is presented, section VII contains the discussions that have arisen from this study and sections VIII and IX outline the conclusions and future work respectively.

II. Related Studies

When researching the studies related to the topic of this work, the SLR could be carried out (Moro et al., 2019; Shafiee et al., 2019; Loureiro et al., 2020; Kontogianni and Alepis, 2020); as well as applications of VR and AR in tourism in (Beck et al., 2019; Yung and Khoo-Lattimore, 2017); the incidence of Information and Communication Technologies (ICT) in tourism (Ukpabi and Karjaluoto, 2016); mobile technology in hospitality and tourism (Law et al., 2018); the design of an immersive tourism technology platform (Candido et al., 2020), and the experience of using VR in tourist destinations (Tussyadiah et al., 2018). A specific list of the works previously mentioned is provided below.

In (Moro et al., 2019), AR and VR developments are framed in a 15-year time frame (until 2019) from a scientific perspective. The methodology used for the analysis of the 1.455 articles consulted was based on the implementation of text mining and topic modeling techniques, thanks to which 1.049 articles that dealt with VR and 406 AR topics were processed.

In (Shafiee et al., 2019), a model of smart tourist destinations is presented, based on grounded theory as an

analytical framework. They carried out a systematic review of articles in a time frame of 17 years (until 2017).

In (Loureiro et al., 2020), in the first place, they carry out a review of the literature on VR and AR in the tourism field in a time frame of 25 years (until 2019). Second, they perform a citation network analysis of top journal articles and their discovered references in the literature, to find the most influential articles. Third, they use a text mining technique to find correlated patterns between discussions of the use of VR and AR in tourism research in both journal articles and conferences.

In (Kontogianni and Alepis, 2020), they present an SLR of works in a six-year time frame (until 2020), related to smart tourism. The most used basic concepts in smart tourism include privacy preservation, context awareness, cultural heritage, recommender systems, social media, the internet of things, user experience, VR, AR, and Big Data.

In (Beck et al., 2019), the existing literature on VR in tourism is reviewed and analyzed in a 25-year time frame (until 2018). In this study, they present a classification of the different VR systems according to the level of immersion and describe their respective technological capabilities.

In (Yung and Khoo-Lattimore, 2017), the state of research on VR and AR in tourism is mapped in a time frame of 10 years (until 2017), through a systematic quantitative review of articles published in the journals of Tourism and Hotelery.

In (Ukpabi and Karjaluoto, 2016), review the studies on the acceptance or adoption of electronic tourism (e-tourism) by consumers in the tourism sector. They analyze a total of 71 studies in a 12-year time frame (until 2016), from both tourism and non-tourism magazines, classifying them into three different groups, according to their context, similarity, and relevance.

In (Law et al., 2018); 92 articles published in hotel and tourism magazines were collected and analyzed. The review shows that a high percentage of the works are focused in the context of the tourist experience and the hotel industry.

In (Candido et al., 2020), a participatory technology platform for visual immersion designed and implemented with the aim of promoting dialogue between locals and tourists in the city of Funchal, Portugal, is presented.

In (Tussyadiah et al., 2018), based on two studies, one conducted in Hong Kong with 202 participants and the other one in the United Kingdom with 724 participants, several positive consequences of the sense of presence in VR experiences in the tourism field were identified. This study provides empirical evidence from the field of tourism to support previous research suggesting the positive consequences of the presence of immersive virtual environments (Choi et al., 2001; Klein, 2003; Li et al., 2001; Li et al., 2002; Lombard and Snyder-Duch, 2013).

II. Methodology

A systematic literature review (SLR) was carried out, in the field of ICT applied to tourism based on VR, of articles published in the period 2016 - 2020. A total of 136 articles were retrieved and carefully analyzed. In this work, the SLR methodology used in (De-La-Hoz-Franco, 2018), in (Barrios-Ulloa, et al. 2022), and in (Mendoza, M.A.D., et al. 2023) was taken as a reference, which implies the execution of three phases: definition of the search criteria (DSC), compilation and purification of the information (CPI) from the scientific articles consulted and presentation of results (PR) product of the SLR. This methodology (M) is presented by the following equation:

M = DSC + CPI + PR

The first phase, consisted of determining the objectives of the study, which are reflected in the following research questions: What technological platforms based on Immersive Virtual Environments (IVE) are mostly used to promote tourism? What development tools are used for the creation of IVE based on tourism?

Afterward, a preliminary review of the literature was made to identify key terms from the review articles. Then the search strings were built, and exclusion criteria were defined that complemented these strings, which were built from the integration of the keywords starting from generality to specificity. Once the search strings were built, they were validated by applying them to the different specialized databases related to this study (Web of Science, Science Direct, Scopus, IEEExplore).

Two types of search strings were built using the keywords represented in Fig.1 and Fig 2, their structure is as follows: String No. 1 ((TP or DP or DT) and “tourism”) and (''e -tourism '' or '' m-tourism '' or ''nature'') and no(''cultural'' or ''community'')) and string No. 2 ((IVE or VR or AR) and “ tourism”) and (''e-tourism'' or ''m-tourism'' or ''nature'' not(''cultural'' or ''community'')). Where TP is the tourism platform, DP is the digital platform, DT is the digital transformation; e-tourism is electronic tourism, m-tourism tourism is based on mobile devices, and IVE is immersive virtual environments.

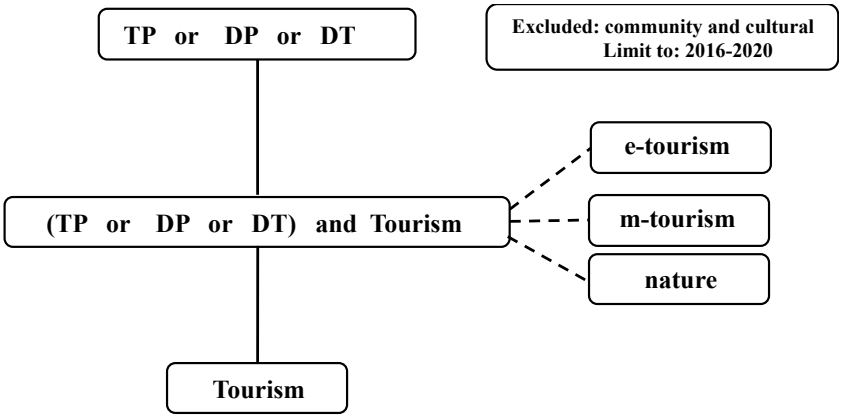

Figure 1. Search string conformation model No. 1

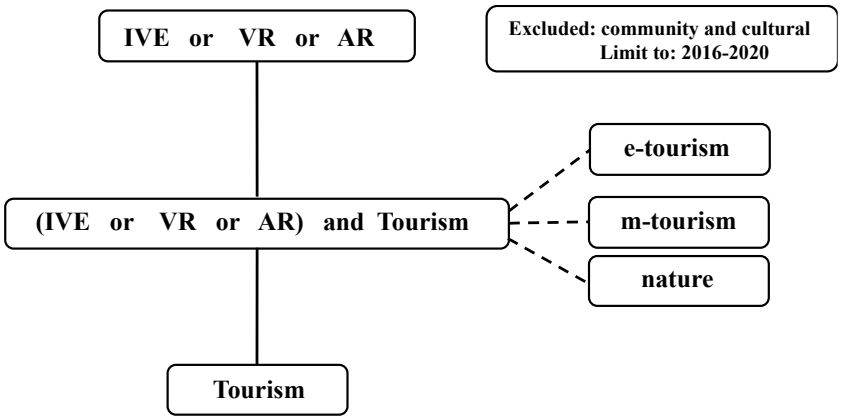

Figure 2. Search string conformation model No. 2

In the models of the search chains No. 1 and No. 2, the terms "community" and "cultural" have been excluded, to delimit the scope of the publications to be analyzed.

From the second phase called compilation and purification of the information, a total of 104 articles were identified. Considering that they correspond to non-duplicate articles and because of manual verification, it was found that they effectively obeyed the purposes of this investigation. Then, a data acquisition matrix was constructed in which a series of scientometric and technical variables were documented for each of the articles identified during the SLR. The final phase corresponding to the analysis and presentation of the information was carried out based on the documented variables.

IV. Scientometric Analysis

To carry out the bibliometric study of the 136 articles consulted, scientometric indicators were used that allowed the analysis and evaluation of the information not only qualitatively, but also quantitatively. The variables studied in the analysis of ICT-related literature were: the number of publications on ICT per year in the period between 2016 and 2020, the number of articles published in the area per database (identifying those that were referenced in several databases), publications according to their typology in the same period; In addition, the relative importance of the publications with respect to all the journals published in the area, quantified by means of the classification by quartiles, was studied. The countries that

receive a greater flow of products and those that give rise to a greater flow of work, the journals, and universities that have more development in this specific field of research were also identified. The following figures and tables illustrate this more precisely.

Figure 3 shows the number of ICT publications per year, in the period between 2016 and 2020, where a growth of more than 50% can clearly be observed from 2018 to 2019, a growth that followed its increase in the year 2020, this reveals that this type of publication has been gaining considerable importance in recent years.

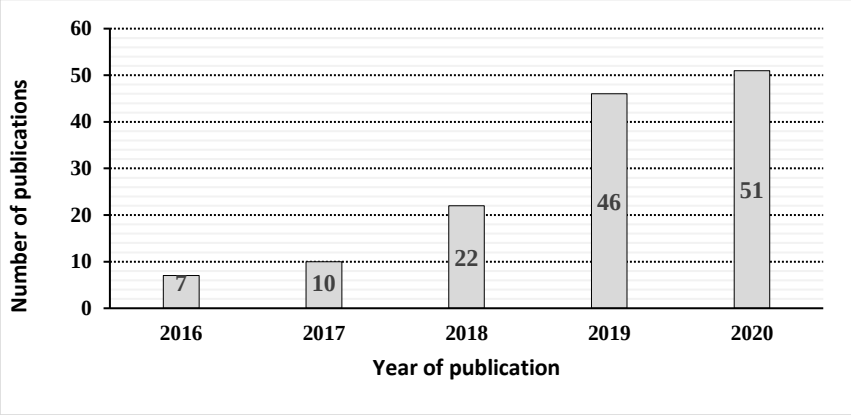

Figure 3: Number of publications per year

On the other hand, Figure 4 shows for each of the scientific databases studied, the number of ICT publications in the period between 2016 and 2020. As evidenced in this graph, in the period studied, the The scientific database with the most research and products registered in ICT (journals, proceedings and book chapters, among others), is Web of Science (WoS), while Scopus and Science Direct follow with less than 50% of the number of publications in the area. These results show the high attention concentration of the area in WoS, one of the most important databases in the world.

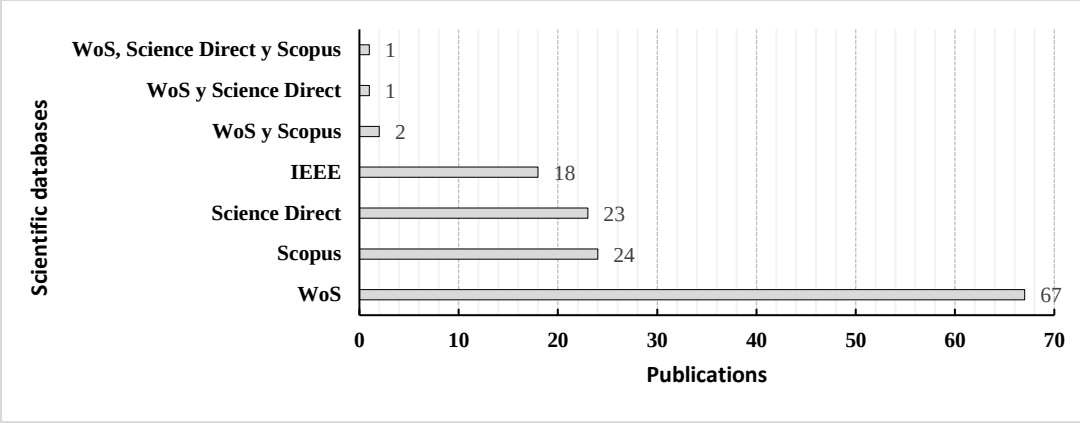

Figure 4. Number of ICT publications by scientific databases

On the other hand, 81% of the products generated in this field of knowledge (corresponding to 110 of the articles studied), have been published in specialized magazines (journals), 15% (corresponding to 20 of the publications analyzed), has been presented at specialized events and published in the respective proceedings, which can be accessed from the IEEExplore specialized database and the remaining 4% (corresponding to 6 of the publications studied), were published as book chapters, (see figure 5). These results show an evident trend in the publication of these topics in specialized magazines, which are normally consulted mainly by ICT experts. The graph shows in Figure 5 explicitly shows these results.

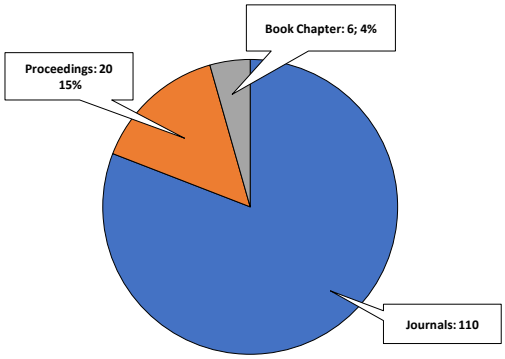

Figure 5. Number of ICT publications by type of publication.

Based on the 110 publications in journals that are related to ICT, but now analyzing the relative importance of each journal within the total number of journals in the area in the medium (analyzed according to their classification by Q quartiles), it was found that 56, 3%, that is, 62 of these articles,

were published in journals indexed in SJR in Q1, which shows the level of quality of the publications in this area of knowledge in high-impact journals; 10.9% (12 publications) were published in journals with Q2 impact, 8.2% (9 publications) were accepted in journals with Q3 impact; 6.4% (7 publications) were accepted in journals with Q4 impact, while 18.2% (the remaining 20) were published in journals that are not within any quartile categorization. Figure 6 summarizes these results.

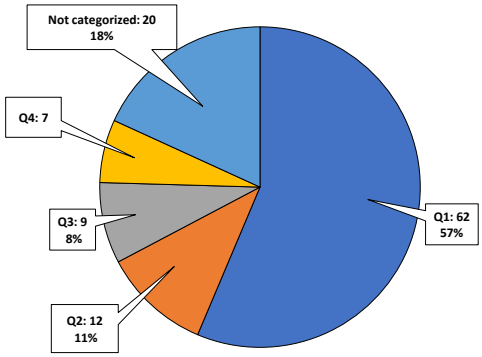

Figure 6. Number of ICT publications according to the relative importance of the journals in the medium (by quartile).

Figures 7 and 8 show the number of ICT publications received and generated by country, respectively, between 2016 and 2020. The first value was calculated by counting the country of publication of the journal, proceedings, or book chapter. From this, it has been identified that the countries with the highest number of publications received and that are related to the field of research are: the United Kingdom (UK), United States (USA), Switzerland, Holland, Spain, and Indonesia, among others.

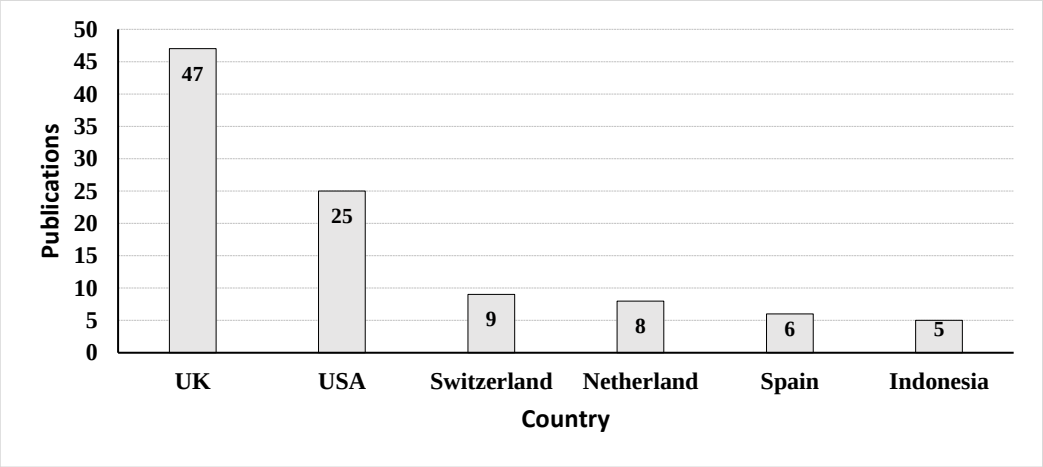

Figure 7. Number of ICT publications received by country.

To account for the publications by their country of generation, the place of origin of the university, research center or organization with which the authors of said publication identified themselves were considered.

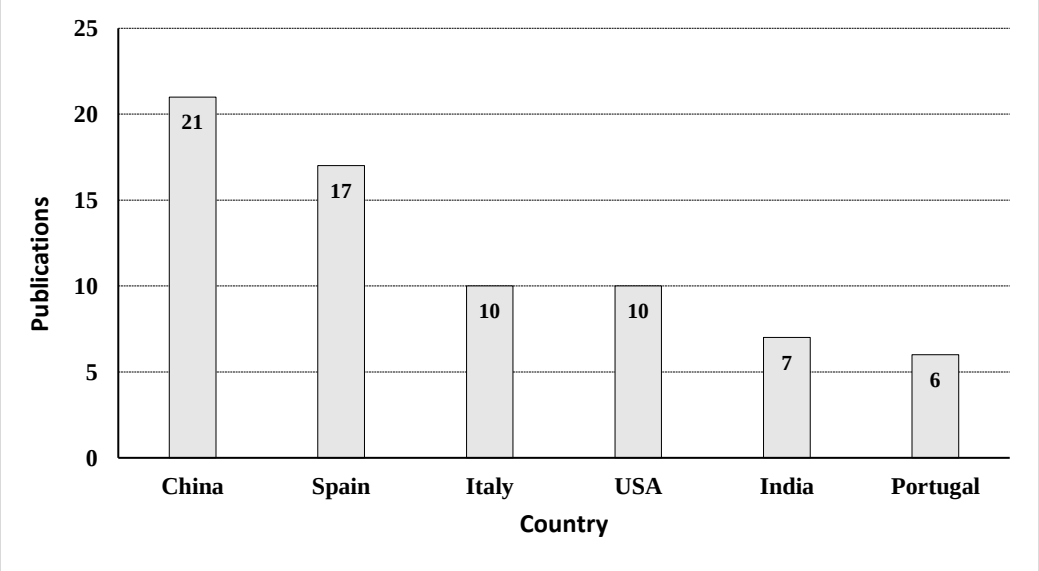

Figure 8. Number of publications in ICT generated per country.

On the other hand, when analyzing the journals with the most published works related to VR-based on TTP, it is noteworthy that most of them are categorized in the highest quartiles, as can be seen in Table I.

Table I. Journals with more published papers related to Virtual Reality-based Tourism Technological Platforms.

Title	Publications	Country	SJR	JCR	ISSN
Tourism management	8	United Kingdom	Q1	Q1	02615177
Tourism management perspective	5	United States	Q1	Q1	22119736
Journal of heritage tourism	3	United Kingdom	Q1	Q2	17476631
Journal of hospitality and tourism technology	3	United Kingdom	Q1	Q2	17579880
Tourism review	4	United Kingdom	Q1	Q1	16605373
Sustainability	3	Switzerland	Q2	Q2	20711050
Journal of tourism futures	2	United Kingdom	Q1	Q2	20555911
Tourism	2	Croatia	Q2	Q3	13327461
Journal of china tourism research	2	United Kingdom	Q1	Q3	19388160
Journal of Hospitality and Tourism Management	2	United Kingdom	Q1	Q1	14476770
Microprocessors and Microsystems	2	Netherlands	Q3	Q3	01419331
RISTI	2	Portugal	Q4	N.C.	16469895
Journal of Destination Marketing & Management	2	United Kingdom	Q1	Q1	2212571X
Current issues in tourism	2	United Kingdom	Q1	Q1	13683500

When analyzing the number of publications generated in the field of ICT in terms of the universities and research centers that generate them, parity is seen among many of them. Figure 9 shows the distribution found.

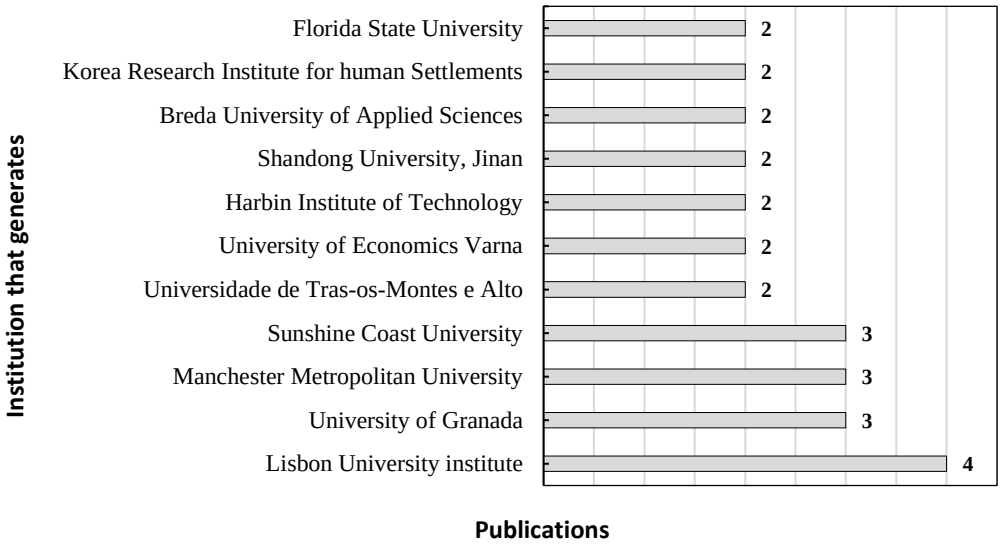

Figure 9. Publications generated in ICT by universities and research centers.

Figure 9 shows that the Instituto Universitario de Lisbon is the one that has generated the greatest number of publications in this specific field of research, highlighting two of them as related to the purpose of this research, both have been SLR, related to VR and AR in the tourism sector (Moro et al., 2019; Loureiro et al., 2020).

V. Technical Analysis

Regarding the technical analysis, different variables were documented to characterize the typology and other elements of the technological platforms and tools used in the different research works consulted, such variables are: 1) technological platform, 2) emerging technology, 3) typology of tourism, and 4) technological development tool.

Table II shows the TTP used and identified in the articles analyzed in the SLR process.

Table II. TTP used and identified in the articles analyzed in the SLR process.

Platform emphasis	Tourism technological platform	Frequency	Percentage
Online bookings	TripAdvisor	7	14 %

Low cost accommodation	AirBnB	6	12 %
Online reviews	Booking	2	4 %
Social media	Facebook, Instagram, Twitter	2	4 %

The TripAdvisor platform appears in seven articles, being the most referenced in the analyzed studies, followed by the AirBnB platform with six articles. To calculate the percentages, 50 articles out of a total of 136 were taken into consideration, where the tourist technological platforms used are mentioned.

In Table II, the platforms that were cited in only one article were not referenced, but rather those with the highest citation frequency.

Table III presents information on the technologies or technological tools used in the studies analyzed in the SLR. In this information, VR (26.3%), VR and AR (12%), and AR (11%) stand out. The percentages were calculated based on 110 identified technologies.

Table III. Technologies most used in tourism identified in the SLR.

Technology	**Quantity**	**Porcentage**
Virtual Reality	29	26.3 %
Augmented Reality	12	11 %
Virtual Reality and Augmented Reality	13	12 %
Big Data	9	8.1 %
IoT	6	5.4 %
Online Bookings	3	2.7 %
360° videos	3	2.7 %
eWOM	2	1.8 %
Machine learning	2	1.8 %
5G	2	1.8 %
Cloud Computing	2	1.8 %
Social Media	2	1.8 %
Mobile Applications	3	2.7 %
Digital Marketing	2	1.8 %
Big data e IA	2	1.8 %

On the other hand, the type of tourism addressed in the different reviewed publications was analyzed, such as e-tourism (electronic tourism carried out through ICT), intelligent tourism (tourism with technological characteristics, accessible and safe for the tourist and the tourist territory), cultural tourism, etc.

Table IV shows the data on the types of tourism addressed in each of the articles analyzed in the SLR. The percentages were calculated on 133 types of tourism identified.

Table IV. Types of tourism mostly implemented in the articles.

Type of tourism	Amount	Percentage
e-tourism	43	32.3 %
Intelligent tourism	30	22.5 %
Cultural tourism	23	17.2 %
enoturismo	9	6.7 %
m-tourism	7	5.2 %
Collaborative tourism	3	3%
e-tourism and cultural tourism	3	3%
Community tourism	2	2%

Based on the table above, it is very clear that e-tourism is ahead of all others.

Each VR system, VR-based technologies and their operating systems or development tools were also analyzed, in terms of the frequency of their use.

Table V shows the VR-based technologies used in the studies carried out. Within the non-immersive and semi-immersive systems, the use of Smartphones and Tablets stands out (whose frequency of use is difficult to calculate), while in immersive technologies, the Unity Software together with the HTC Vive device stands out with 34.2% and the Oculus rift device with 13.2%.

Table V. VR-based technologies currently used detected in the SLR carried out.

VR system	VR set	Operating Systems	Development tools	Equipment (Commercial references)	Percentage
Non-immersive technologies	Smartphone Tablet Desktop PC	Android iOS Windows Linux		Apple Samsung Xiaomi Microsoft	
Semi-immersive technologies	Smartphone Tablets	Android iOS iPAD		Apple Samsung Xiaomi Huawei Lenovo	
Immersive technologies	High performance computer equipment HMD		Unity Unreal Engine Twin motion	HTC Vive Oculus rift Visor Samsung Gear VR Google cardboard	13(34.2%) 5 (13.2%) 2 (5.3 %) 2 (5.3%)

Regarding all these types of non-immersive, semi-immersive, and immersive technologies, it was found that the development tool most used in the studies was "Unity", (Daineko et al., 2018).

VI. Analysis of the results

Table II summarizes the TTPs identified in the SLR performed. Some articles are not referenced in the data set of this table, because there is no evidence of the use of PTTs in their studies. From the data presented, it is clear that, except for the TripAdvisor platform (which appears with the highest frequency: 14%), and the AirBnB platform (which appears at 12%), no general trend of predominance can be observed in the TTPs that are used.

On the other hand, from the results of Table III where the technologies used in the reviewed works in the developed SLR are summarized, it should be noted that VR presents the highest percentage in the investigations (26.3%), in fact, the TTPs of interest of this research focus on this technological tool. In the third line of the technologies used appears the combination of VR and AR technologies (12%) with 13 studies

of the total of 110 analyzed. In the next line is AR with 11%, that is, 12 studies of the total (110). From the above, VR, alone or with AR, is the most widely used technology (42 publications out of 110 reviewed, which is equivalent to 38%), which, as mentioned, are the publications of greatest interest in this work.

Table IV shows that the predominant types of tourism in the analyzed works correspond to e-tourism (32.3%) and smart tourism (22.5%), followed by cultural tourism (17.2%). According to these results, the current trend in tourism points towards a greater application of technology, the digitization of processes, and the strengthening of value chains in the tourism industry, travel, hospitality, and gastronomy.

Finally, from the results of Table V where the development tools, software, and/or devices used in the studies are summarized, as already mentioned, it is evident that the "Unity" software and the HTC Vive device are the most used with 21.2% and 13% respectively, in the total of the 38 articles identified, revealing a very clear tendency to use, due to its efficiency and outstanding digital characteristics compared to the others. Regarding the use of operating systems with greater application, a more in-depth study of their frequency of use should be carried out, since the versions that work under Linux, although they are mostly free to use, are the most used in large companies in contrast to small companies.

VII. Discussions

After carefully reviewing the large number of articles reviewed so far, it is possible to show that within VR-based TTPs, up to now, an exhaustive review of their literature has not been presented, this is evidenced by the very low percentages of publications found. in this field in the sample studied and its low frequency of citations, as well as very little diverse activity is observed: online reviews, low-cost accommodation and tourism, social networks, transportation, weather (this can be seen in table II); On the other hand, the most referenced types of tourism are e-tourism, smart tourism, cultural tourism, wine tourism, m-tourism, collaborative tourism, and community tourism (see table IV).

According to the review carried out, at a global level the tourist platform that is at the forefront in this economic sector is TripAdvisor since around 463 million travelers use it per month; Tourists from all over the world access this platform and application to consult more than 859 million opinions and comments on 8.6 million accommodations, restaurants, experiences, airlines, and cruises (Bastidas, 2020).

The initial analysis of the results shows that there are still not many articles published in top-level journals that address the topic of TTP and VR in tourism (Loureiro et al., 2020). This is how the first two articles that were published in top-level tourism magazines date back to 1995. They are short articles (about 5 pages) that discuss the initial definitions of VR and related issues in the context of tourism (Loureiro et al.., 2020).

In this sense, some precursor authors of the use of VR in tourism, such as Hobson and Williams (1995), presented this immersive technology as a new tool in which consumers can choose and adapt their experiences to a degree that was not possible in the 20th century. On the other hand, (Gutierrez et al., 2008) highlighted the benefits of using virtual environments in the travel industry because they can reduce the impacts of tourism and can also operate as a marketing tool, where tourists could experience advances. of destinations and their respective attractions and facilities.

The first study to offer an overview of the conceptualization of VR and its application in the tourism sector was that of (Guttentag, 2010). This author defines VR as using a "computer-generated 3D environment, called a 'virtual environment' (VE), in which one can navigate and possibly interact, resulting in a real-time simulation of one or more of the user's five senses".

In this sense, VR is composed of two important aspects, mainly its ability to provide physical immersion (participants are isolated from the rest of the world) and physical presence (when participants behave in a similar situation in real life) (Bonetti et al., 2018).

(Candido et al., 2020) validated the VR-based Technology Platforms, in their study they identified three positive aspects. First, the feeling of being in the virtual environment increases the enjoyment of immersive experiences. Second, the increased feeling of being their results in stronger liking and preference for the destination, and third, a positive attitude change leads to a higher level of visit intent.

VIII.Conclusions

The development of TTPs and VR devices in recent years offers great potential for the widespread consumption of VR tourism content (Law et al, 2018). It is evident that the reproduction or creation of tourist experiences through immersive technologies will greatly impact the tourism industry.

From the point of view of tourists, the main benefits of VR include the improvement of tourist experiences (Moorhouse et al., 2018; Castro et al., 2017); and the facilitation of immersive, engaging, social and entertaining experiences (Guttentag, 2010; Jung et al, 2018; Gibson and O'Rawe, 2018), as well as the potential to provide accessible tourism for all.

From the perspective of businesses and destinations adopting immersive virtual environments, factors such as marketing and promotions, sales and distribution (Huang et al., 2016; Moorhouse et al., 2018; Hobson and Williams, 1995), additional income generation, and wealth preservation and sustainability were identified as the greatest benefits of VR.

Guttentag (2010) outlines six areas of tourism where immersive virtual environments can be valuable: travel planning and management, marketing, entertainment, education, accessibility, and preservation of cultural heritage.

The development of VR presents research challenges to better understand the effectiveness of VR in providing alternative or substitute tourism experiences and shaping consumer attitudes towards tourism destinations. In addition, destination managers also face challenges in making strategic investment decisions in order to leverage this technology to influence consumer travel decisions (UNWTO, 2020c).

In the field of TTPs, the work carried out by (Candido et al, 2020) can be highlighted, where they designed an immersive participatory platform to promote dialogue between visitors and the inhabitants of a city in Portugal. The platform allows tourists to have a better understanding of the cities they visit through interaction with residents; Also, it allows hosts to present their city and daily activities to travelers from a very personal point of view.

This study contributes to a better understanding of TTPs and to help recognize the benefits and limitations of the use of immersive technologies in tourism. It also contributes to the development of the definition of TTPs, as well as the most representative authors and magazines in the literature that addresses this topic and likewise contributes to increasing the documentary collection of works specifically interested in inquiring about TTPs and RV.

IX. Future Work.

In future work, taking into account the theoretical component of this work, it is planned to develop a TTP in the context of the department of Sucre, Colombia, based on VR technologies and some Artificial Intelligence techniques, to develop a personalization model of the virtual tourist experience that allows the identification of tastes and behaviors, thus obtaining a greater knowledge of the profile of clients or potential visitors, which allows positioning the tourist attractions and products of the municipalities that are part of the tourist corridor Golfo de Morrosquillo and Sabanas of the department of Sucre, in the field of cultural and natural tourism in Colombia.

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