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Evaluation of the online communication of the museums. An empirical application to the Valladolid Science Museum

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Abstract: Nowadays, the museum institutions are aware of the help the new communication technology can provide, as well as the presence on the social networks to manage and spread their heritage. This paper analyses, in particular the use of the new communication technologies within the Valladolid Science Museum. Follow-up and analysis will be conducted of data taken from the Twitter, Facebook and Google Analytics monitoring systems on communication in social networks and the museum's webpage. The method applied will focus on a descriptive study of the data as well as certain statistical procedures such as factorial analysis and multiple regression in order to evaluate the state of the museum's online communication. Currently, the percentage of museums with a website and a presence in the social networks is not very high in this region. The majority use these tools with an informative and low-participatory approach in general. The results of this study allow assessing the efficiency of the online communication of the Science Museum within a twofold: the webpage and the use and manage of the social networks with the added value that the information obtained can be integrated into the widest set of measurements. Thus it allows assessing the performance and efficiency of such institution. All of this is intended to give some guidelines for managers of the museum so that they carry out improvements within its communication with the public, and then offer a better service.

Keywords: Cultural Economy, Social Networks, Key Performance Indicators.

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1. Introduction

New information and communication technologies (ICT) have become essential tools in museums' attempts to enhance their visibility, show off their collections and improve their facilities, but particularly vis-à-vis making a qualitative leap in communication and interaction with a global audience. A look back shows how the leading museums first used Internet around 1994. Since then, there have been various stages in Internet use. Initially, the webpage was exploited for merely informative purposes and provided only general information concerning opening times, admission cost and location. However, after 1998, museum websites began to change and to offer new material and content. Websites ceased to be just calling cards and became tools for leisure, learning and research, and even for purchasing via the online shop (Río, 2012). Museums got closer to their audiences, and increased both the number and loyalty thereof (Gómez, 2008).

In the early 21st century, the concept of the online museum altered radically. They no longer sought to resemble their brick-and-mortar counterparts, but aimed to also to provide independent content and facilities on the Net that would enrich the museum's overall offer (Forteza, 2012). Nowadays, there are two differing types of user: the off-line audience, who go to the actual physical museum and achieve an in situ cultural experience, and the online audience who seek knowledge, documentation, leisure and interaction with the museum without leaving home, and indeed at any time and from anywhere. Many online visitors simply do not have the chance to pay an on-site visit, although a large part of those who visit the museum's webpage do so to complement and enhance a subsequent physical visit.

Museums are interested in both types of audience. As a result, in addition to recording data and drawing up statistics of onsite visits, it is important to try to monitor museums' websites and social networks so as to obtain data on the volume of online audience, how users access the site, how long visits last, and which aspects of the website prove most appealing, etc.

To date, many studies have been conducted into the applications and use of new technologies in museums. The publications of Robles *et al*. (2012) and Padilla and del Águila (2013) focus on how the presence of these tools has evolved in museums, and Gómez (2012) or Martínez-Sanz (2012) explore the scope and possibilities social networks offer for making these places more open and participative. In one work, Capriotti (2010) addresses the issue of how museums and art centres communicate with their local environment in a study carried out in the city of Tarragona, surveying museum managers and local visitors.

Other studies have focused more on exploring social networks in museums. Losada and Capriotti (2015) evaluated the presence and activity of the leading Spanish museums in Facebook,

Kidd (2011) examined the increased use of social networks in museums in the UK, Viñarás and Cabezuelo (2012) explored the issue of content generation and participation in Facebook through a two-week study in the Prado Museum and, adopting an eminently practical approach, prominent is the project undertaken by Villaespesa (2014) to regularly gauge the performance of the Tate Gallery in London's Twitter or Facebook account.

Online site owners, whether they be webs or social networks, have free monitoring tools available which allow for an analysis of the extent and reach of their contents, the interaction achieved with the public and the amount of data on user behaviour. Ever-increasing use is being made of these tools and this is also being reflected in the literature. Fang (2007) explored the use of Google Analytics for improving the webpage content and design of the Rutgers-Newark Law Library. The study led to an improved website, increased traffic, greater engagement with users and enhanced visitor navigation. Other works have studied the depth of the visit to the web using data from Google Analytics classified in terms of traffic source using regression procedures (Plaza, 2009) and time series analyses (Plaza, 2011). Pakkalaa, Presser and Christensen (2012) focused their analysis on visitor statistics for food websites. These studies underscore the usefulness of tools that monitor online sites.

In the field of museums, there are some examples of applications, such as the article by Claes and Detell (2004) which analyse the profiles of the main museums in San Francisco, London and Madrid in Facebook and Twitter, providing overall follow-up figures for 2013 with the aim of examining communication strategies. In 2013, the SocialWin tool, which analyses and monitors social networks, conducted a study into which museums were using social networks and which generated most engagement. Some studies, such as Padilla and del Águila (2013) have focused on museums' online communication strategies and their sources of value using performance measures in Internet.

In general, all of the works highlight the importance of social networks in museum communication management. However, social webs are yet to be implanted in full. In his study into the use of social networks in Danish museums, Holdgaard (2011) points out that even though half of them have a Facebook account, most make little interactive use of it with their users and only employ it to attract more visitors to the physical museum. In a similar vein, Oliveira and Capriotti (2013) claim that these institutions are still at the embryonic stage when it comes to adopting new models for managing their audiences. This is very often due to the lack of time and staff coupled with the lack of know-how required to select the metrics (Villaespesa, 2014).

The current work seeks to provide useful analytical tools aimed at improving museums' communication strategies, using free website and social network monitoring systems. After this

introduction, the article describes in further detail the case study and the method used. The results of the statistical analysis are then provided and, finally, the most salient conclusions are summed up.

The main contributions the work makes are: first, to offer a comprehensive case study, Valladolid Science Museum, in a field in which there are few publications addressing the two topics, online communication in museums and website monitoring; second, to highlight the usefulness of various simple statistical analyses, which are capable of extracting valuable information for improving communication processes, and finally to gauge said museum's online trends.

2. Case study and methodology

Valladolid Science Museum was opened in 2003. The building has several rooms which house both permanent as well as temporary exhibitions, a planetarium boasting a modern digital projection system, a conference room, and the House on the River, an area which is home to aquariums, terrariums and interactive modules for understanding the main ecological processes occurring in rivers. The Science Museum is a municipally owned Foundation, whose Board of Trustees is made up of Valladolid City Council, Valladolid Provincial Council, the University of Valladolid and the Regional Government of Castilla y León, and which is chaired by the mayor of Valladolid.

As with most science museums, a large part of the audience is made up of children and families, such that educational workshops and activities play a leading role[1]. Since it was opened, the museum has been committed to embracing the communication tools provided by the new technologies, first through its website, which it has updated several times over the years, and later through its presence on social networks: Facebook since 2009 and Twitter since 2011.

The present empirical application analyses Valladolid Science Museum's online communication. For this, monitoring data from its webpages, as well as Twitter and Facebook social networks, are used. We feel that one of the main advantages of monitoring tools is the immediacy they offer, and the chance to analyse trends and particular events as they happen, and to be able to make comparisons with the previous week or month as well as being able to conduct a longer-term analysis every so often.

Broadly speaking, the volume of data provided by monitoring tools is huge and the difficulty lies in summing up the information efficiently. Short-term evaluation of online communication is straightforward and involves designing appropriate panels for each museum which may be updated rapidly and without too much trouble (Villaespesa, 2014). As for long-term studies, simple statistical techniques such as descriptive analyses, correlations and regressions can be used in an effort to

[1] Foremost amongst these are the Summer School, Bird Day or Researchers' Night. Other leading programmes include the Night and Day of the Museums, the short story competition "Science and You" or Science Week.

relate certain metrics to others, or factorial analysis to determine the main factors that explain the site's online activity.

3. Description of the science museum's online communication.

The monitoring sources used in this study were Twitter Analytics, the analytics of Facebook and Google Analytics for the museum's website. The Twitter digital analysis tool, which provides monthly metrics and metrics for each tweet, is one of the most recent and, for the moment, less developed in terms of the amount of information and ease of download. The two other tools, however, offer a great amount of data every day, from the previous week or month and, in particular, Google Analytics, allows information to be classified in many ways (by source means of access, keyword, language, etc.). The aspects of online site communication which metrics usually measure are volume, quality and traffic behaviour. We do not aim to make an exact comparison of networks and websites since these have very different audiences and because the metrics measure concepts which are hard to compare.

In Twitter, they basically measure communication in said social network, focusing particular interest on the number of total impressions so as gauge audience size, and interaction rate in order to measure the intensity thereof (Table 1). In Facebook, there are countless metrics, although the ones we consider to be fundamental count both the number of communication actions and how many users make said communications (Table 2). Finally, the basic metrics of Google Analytics provide a study of the quality of traffic on the page in terms of user behaviour and audience size via the number of visits to the page, which would be closest to the number of impressions on social networks (Table 3).

Table 1. Main metrics in Twitter Analytics

Metric	Definition
Tweets	Number of publications or messages using a maximum of 140 characters
Impressions	Number of times users saw the tweet
Profile visits	Clicks on the user profile with the name of the user or profile photo of the author of the tweet
Total interactions	Total number of clicks, retweets, responses, follows, favourites, etc.
Interaction rate	Rate = Number of impressions/Number of total interactions x 100

Table 2. Main metrics in Facebook

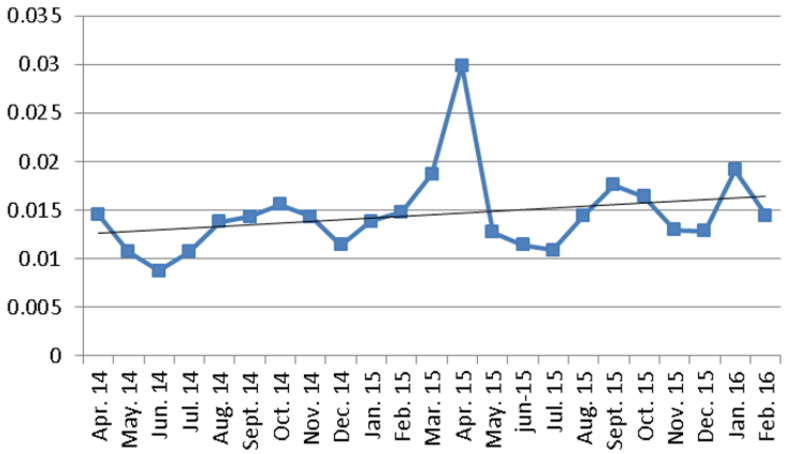
Metric	Definition
Lifetime Total Likes	The total number of people who have liked your Page. (Unique Users)
New Likes	The number of new people who have liked your Page (Unique Users)
Unlikes	Daily: The number of Unlikes of your Page (Unique Users)
Page Engaged Users	The number of people who engaged with your Page. Engagement includes any click or story created. (Unique Users)
Total Reach	The number of people who have seen any content associated with your Page. (Unique Users)
Interaction rate	Rate = Number of users interacting/Total Reach x100
Total Impressions	The number of impressions seen of any content associated with your Page. (Total Count)
Reach of page posts	The number of people who saw any of your Page posts. (Unique Users)
Total Consumers	The number of people who clicked on any of your content. Stories that are created without clicking on Page content (ex, liking the Page from timeline) are not included. (Unique Users)
Page consumptions	The number of clicks on any of your content. Stories generated without clicks on page content (e.g., liking the page in Timeline) are not included. (Total Count)
Total Impressions of your posts	The number of impressions that came from all of your posts. (Total Count)
People Talking About This	The number of people sharing stories about your page. These stories include liking your Page, posting to your Page's timeline, liking, commenting on or sharing one of your Page posts, answering a question you posted, responding to one of your events, mentioning your Page, tagging your Page in a photo or checking in at your location. (Unique Users)

Table 3. Main metrics in Google Analytics

Metric	Definition
Sessions	Number of visits to the webpage
Bounce rate	Percentage of visitors who immediately abandon the site
No. of pages seen	Number of pages seen (Total)
Duration of visit	Time visitors spent at the site (sec.)
Return rate	Percentage of people who have visited more than once

The descriptive analyses portraying the evolution of the metrics between April 2014 and February 2016 are shown in Table 4. It can be seen that the total number of impressions in Facebook (80,414.5) is higher than Twitter (56,578.7) and that the social networks have a greater reach than the web if we compare impressions in networks with pages seen on the museum's web (17,969.7). Nevertheless, an increase is evident in the case of Twitter, whereas there is a clear drop in Facebook (Graph 1 and Graph 2) in the evolution graphics in the interaction rates that can be calculated in the social networks and that is also reflected in the number of "likes", which in Twitter seem to have outstripped those of Facebook since 2015 (Graph 3). Specifically, the interaction rate in Twitter shows a very notable peak in April 2015, coinciding with the VII Science Race organised by this museum in conjunction with the Valladolid City Council and two events organised in conjunction with el Norte de Castilla newspaper: the short story competition "Science and You. Light and You" and the show "Mathematics + Chemistry = ¡¡¡magic!!! The Magic of the Periodic Table".

Graph 1. Monthly interaction rate in Twitter (Apr-14 – Feb-16)



Graph 2. Monthly interaction rate in Facebook (Apr-14 – Feb-16)

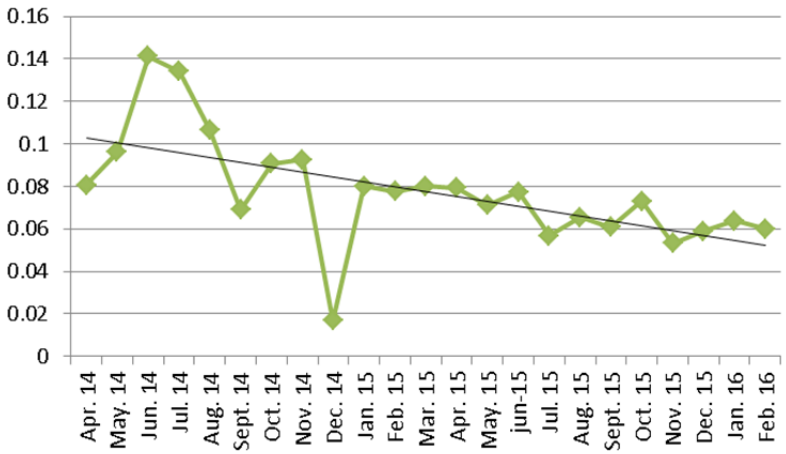


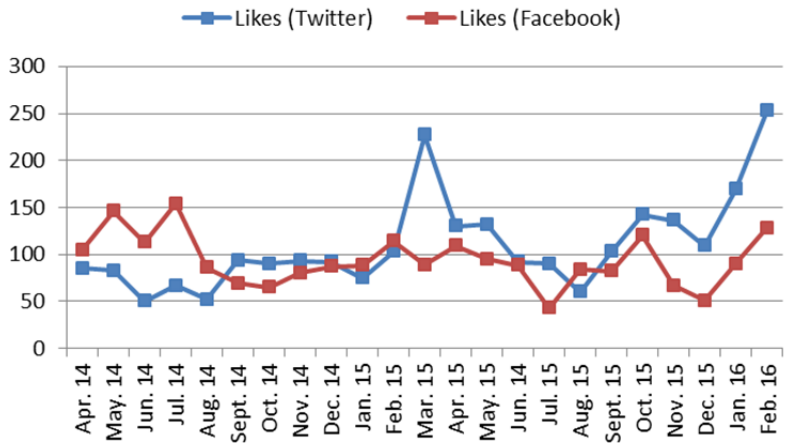
Table 4. Mean values of the monthly metrics of the Science Museum's three online sites (April-14 to February-16)

Twitter (23 months)	Means
Tweets	92.7391
Impressions	56578.7
Interactions	850.217
Interaction rate	0.01451
Retweets	134.826
Responses	11.3043
Likes (Action)	109.87
User profile clicks	128.957
URL clicks	89.0435
Tag clicks	6.26087
Further details	216
Clicks on permanent links	2.26087
Follows	5.3913
Multimedia views	145.826
Others	13.913

Facebook (23 months)	Means
Lifetime Total Likes	2424.39
New Likes	93.6087
Unlikes	9.52174
Page Engaged Users	2669.78
Total Reach	39055
Total Impressions	80414.5
Logged-in Page Views	490.913
Reach of Page Posts	21691.3
Total Impressions of your posts	43582.2
Total Consumers	2216.74
Count of Fans Online	51607.3
People Talking About This	660.13
Page consumptions	4502.3
Negative Feedback from Use	13.7826

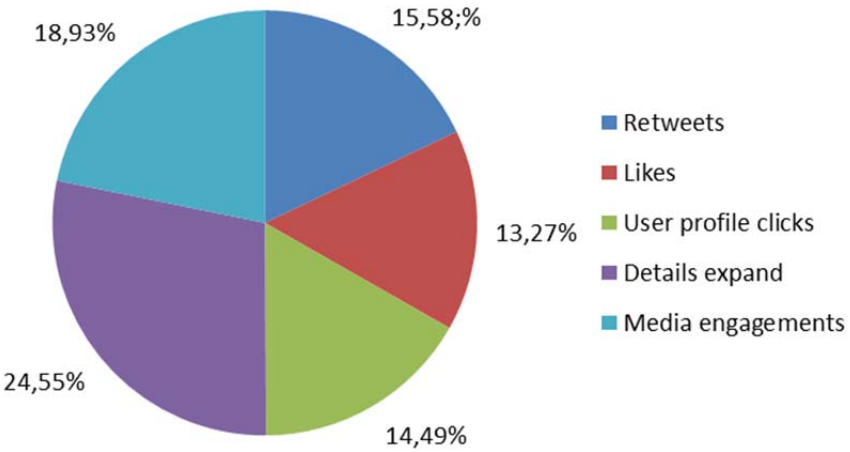
Web (23 months)	Medias
Total sessions to be added	4489.04
Users	3375.52
Number of pages seen	17969.7
Pages/session	4.01666
Mean duration of session	176.138
Bounce rate	0.4508
Return rate	0.325461

Graph 3. "Like" Evolution in Facebook and Twitter (Apr-14 – Feb-16)



As regards the various ways of interacting in Twitter, Graph 4 shows that foremost are further details (24.55%), multimedia views (18.93%), retweets (15.58%), clicks on the user profile (14.49%) and likes (13.27%). Qualitative analysis of the data evidencing the highest interaction rate reveals that certain tweets made a lot of noise in April 2014, despite this not exactly being the best month of the period studied. Specifically, these were the ones which referred to the robotics and planetarium activity, BabyPlanet. The series of lectures "Amazing but false" is one of the museum's star activities and was also highly active in April 2015.

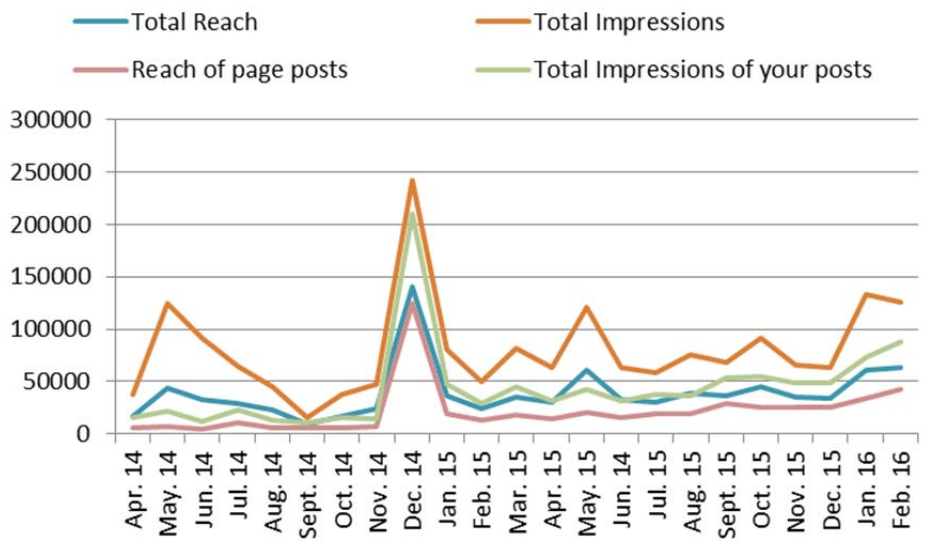
Graph 4. Types of interaction in Twitter



The audience metrics in Facebook (Graph 5) display an upward trend, especially after 2015, one particular highlight being December 2014, when there is a major increase in this social network with regard to scope and impressions. This coincided with the first Wikimaraton of Spanish scientists that took place simultaneously at five Spanish science museums. May 2014 and 2015 are also months of major activity in Facebook, due to the museum's own

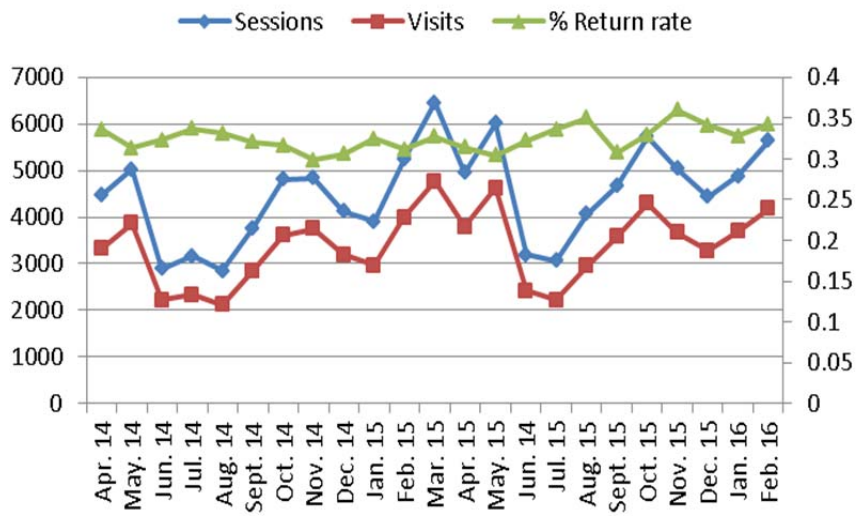
activity with the Science Race and the Night and Day programme organised by museums to celebrate the International Museum Day with numerous activities.

Graph 5. Evolution of audience metrics in Facebook (Apr-14 – Feb-16)

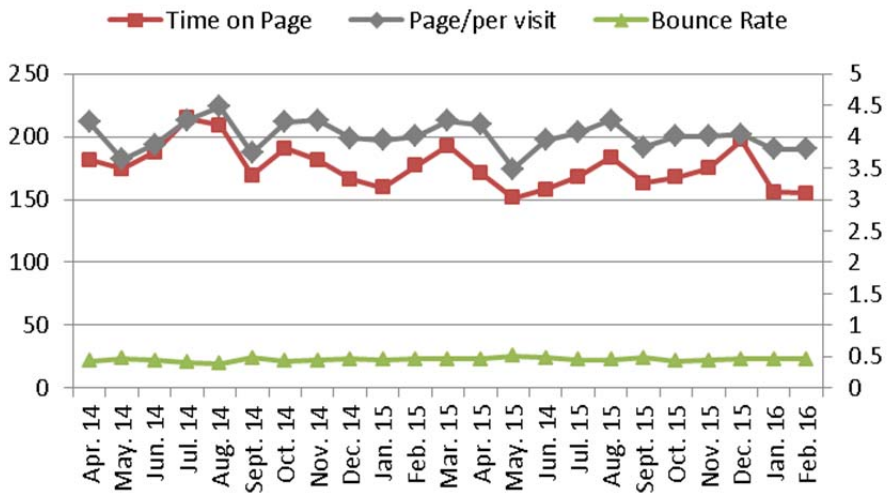


The monthly means of the metrics in Google Analytics reflect 4,489 sessions, with 3,375 users who see around four pages per session, with a mean duration of 176 seconds. The mean monthly values of return rate and bounce rates are 32.5% and 45%, respectively. The evolution of reach, measured through the number of sessions, users and return rate, is positive (Graph 6), whereas the metrics related to the quality of visit reflect a high degree of stability in the bounce rate and a reduction in duration and number of pages seen (Graph 7).

Graph 6. Evolution of the webpage's audience metrics



Graph 7. Evolution of visit quality on the webpage



This concludes a general description of the data on the Science Museum's networks and webpage and leads us on to two specific studies with which to gain deeper insights in our understanding of digital communication.

4. Determinant factors of the activity in Facebook in the Science Museum

Facebook metrics provide a great deal of information, although it is usually quite difficult to ascertain which metrics prove key to understanding visitor behaviour, since there are many measures that refer both to actions and users, and which thus give rise to numerous variables that correlate with one another.

The amount of data available daily to carry out a long-term analysis is enough to be able to summarise and improve the interpretation of all these metrics using a multivariate technique: factorial analysis. The variables chosen address reach, visibility and this social network's interaction in the Science Museum and is as follows:

- Variables of reach: Total Reach, Reach of page posts
- Variables of visibility: Total Impressions and Total Impressions of your posts.
- Variables of interaction: Page Engaged Users, Total Consumers, Page consumptions, New Likes and People Talking about This.

The Kaiser-Meyer-Olkin measure of sampling adequacy for the results obtained is 0.633, the Bartlett sphericity test is significant, and there is only a 5% discrepancy between the observed correlations matrix and the reproduced matrix. Table 5 shows the three factors extracted with Varimax rotation that explain 92.602% of common variance.

Table 5. Rotated Component Matrix[a].

	Component		
	1	2	3
Total Consumers	.975	.131	.129
Page Consumptions	.967	.056	.071
Page Engaged Users	.962	.162	.188
Reach of Page Posts	-.005	.990	.065
Total Impressions of your Posts	.004	.988	.100
Total Reach	.437	.877	.096
Total Impressions	.639	.738	.101
New Likes	.048	-.019	.928
People talking about this	.352	.358	.633

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization

a. Rotation converged in 4 iterations

We now interpret these factors and give the percentage of explained variance:

F1: Interaction (39.292%), since it correlates highly with the number of users who interact and with the number of interactions. Through this factor, user commitment is gauged.

F2: Content reach and visibility (38.282%), related to the total number of people who access one of the museum's publications, either directly or indirectly.

F3: Active followers and fans (15.029%) basically represents the number of people who like the page and who talk about it on the social network, which proves crucial to the museum since it helps to spread content.

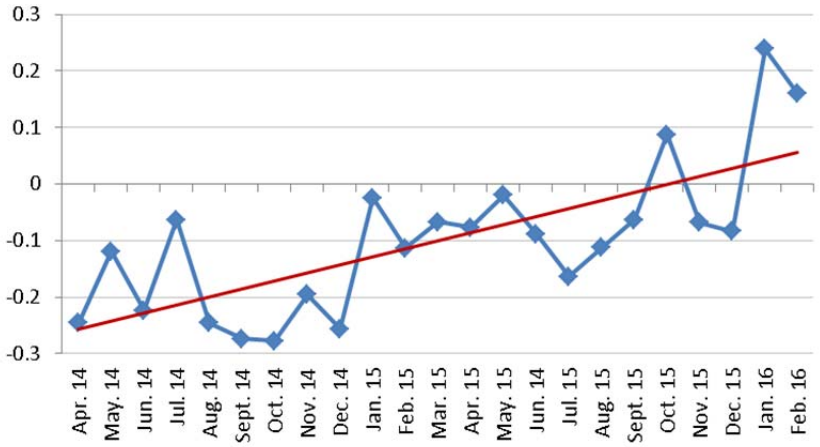
In order to adequately sum up this information, we constructed a Facebook activity indicator based on all of these variables, using daily data with the factorial scores weighted by the percentage of variance explained by each factor: $I = w_1F_1 + w_2F_2 + w_3F_3$, where the weights w_i = % of the variance explained by F_i / % of total explained variance.

The unusually high values of said indicator were evaluated, corresponding both to 2014 and 2015 to the Science Race, Night of the Museums, the Renovation of the Planetarium in 2014, the 2014 Christmas workshops and the 2014 Wikimaraton. Finally, in order to achieve greater visibility of the indicator's evolution over time, Graph 8 to Graph 11 show the mean monthly values for both the index and contributions to the index of the three factors excluding the extreme points. All the trends are seen to be positive except F3, although the greatest

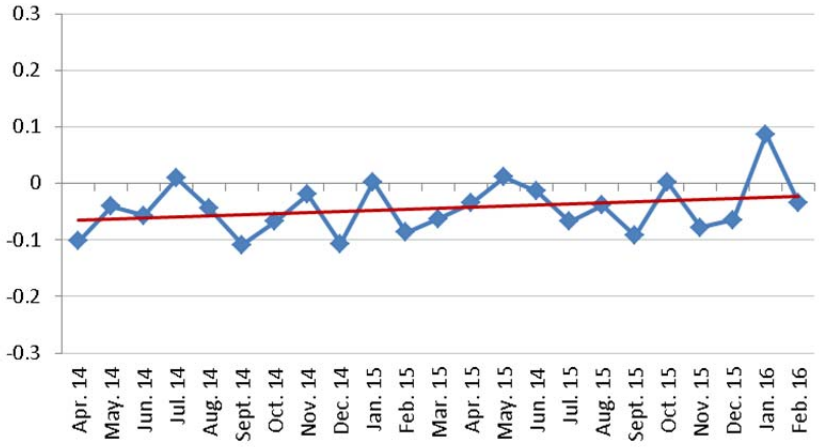
increase is in the second factor. As a result, there is a major improvement in the component representing content reach and visibility.

To sum up, this museum in Facebook has managed to reach a wider audience over this period, although if it wishes to enhance this form of communication, it must focus its efforts on securing greater user interaction.

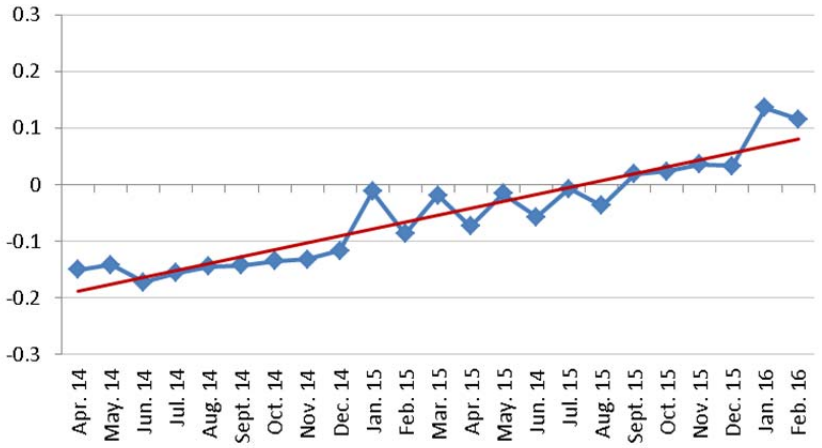
Graph 8. Activity indicator in Facebook (Apr-14 – Feb-16). Mean monthly values



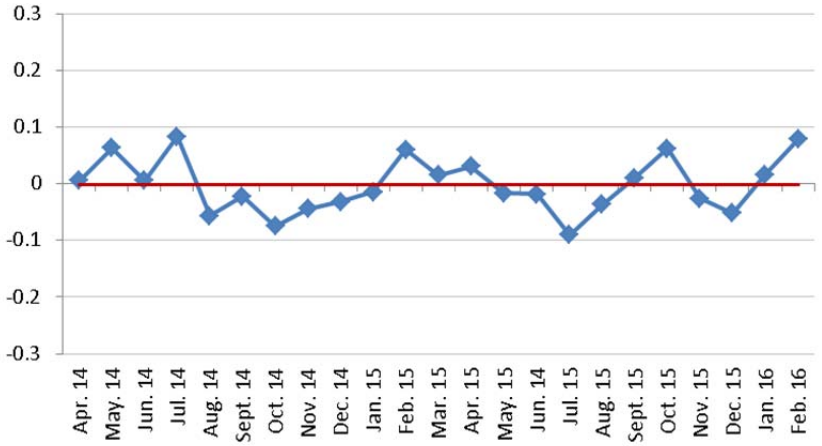
Graph 9. Contribution of F1 to the activity indicator in Facebook (Apr-14 – Feb-16). Mean monthly values



Graph 10. Contribution of F2 to the activity indicator in Facebook (Apr-14 – Feb-16). Mean monthly values



Graph 11. Contribution of F3 to the activity indicator in Facebook (Apr-14 – Feb-16). Mean monthly values



5. Keywords and quality of traffic on the science museum webpage.

The data recorded at the Science Museum between 4 March 2010 and 15 March 2016 indicate that 68.76% of visits are through direct traffic, and 25.21% are organic searches, 4.25% is reference traffic and 1.77% stem from social networks. The specific study of the keywords with which users reach the web might help web owners to improve their position in search engines. In the case of this museum, the organic keywords which attract most sessions are mainly those including three words “museo”, “ciencia” and “valladolid”, although a high number of visits are also the result of those which refer to the planetarium and the House on the River. Table 9 shows the best performing keywords arranged in order of visit duration, pages per session, bounce rate and return rate.

We feel that the underlying relations between the metrics of Google Analytics are reflected in the behaviour of the organic keywords, as a result of which in this study we use the data corresponding to the 110 keywords that have had at least 25 visits to the museum website[2]. The number of pages per session variable, which gives us an idea of the depth of the visit, displays a positive correlation with duration and bounce rate. The duration variable, which also proves relevant for measuring the quality of the visit, shows a positive dependence with regard to the number of pages per session and return rate and a negative dependence with regard to the bounce rate. The return rate does not seem to have any relation either with the number of pages per session or with the bounce rate (Table 6).

Table 6. Correlations

	Pages/session	Duration	% bounce	% return
Pages/session		0.6218* 0.0000	-0.7161* 0.0000	0.0051 0.9578
Duration	0.6218* 0.0000		-0.5505* 0.0000	0.3135* 0.0009
% bounce	-0.7161* 0.0000	-0.5505* 0.0000		-0.0040 0.9671
% return	0.0051 0.9578	0.3135* 0.0009	-0.0040 0.9671	

We therefore posit two regression models which reflect these relations. The first explains the number of pages per session in terms of the duration and bounce rate (Table 7 and Graph 12). The keyword "museo de la ciencia de valladolid hoy guían mis abuelos" produces an important unusual residual in the regression. It is an unusual access word, since it generated 87 sessions, with a high number of pages seen (14.43), with a long visit duration (609.48) and a low bounce rate (24.14%). When it is included in the model through a dummy variable, we see that all the coefficients are significant, the adjusted R^2 is 75.57% and that there is no serial correlation of the residuals.

The study of the significantly influential points in this analysis reveals that users who access by typing "http://www.museocienciavalladolid.es/opencms/mcva/" and. "site:www.museocienciavalladolid.es" pay long visits to the web.

[2] Plaza (2009) conducts a similar analysis in which some of these relations are confirmed.

Table 7. Regression Pages/session

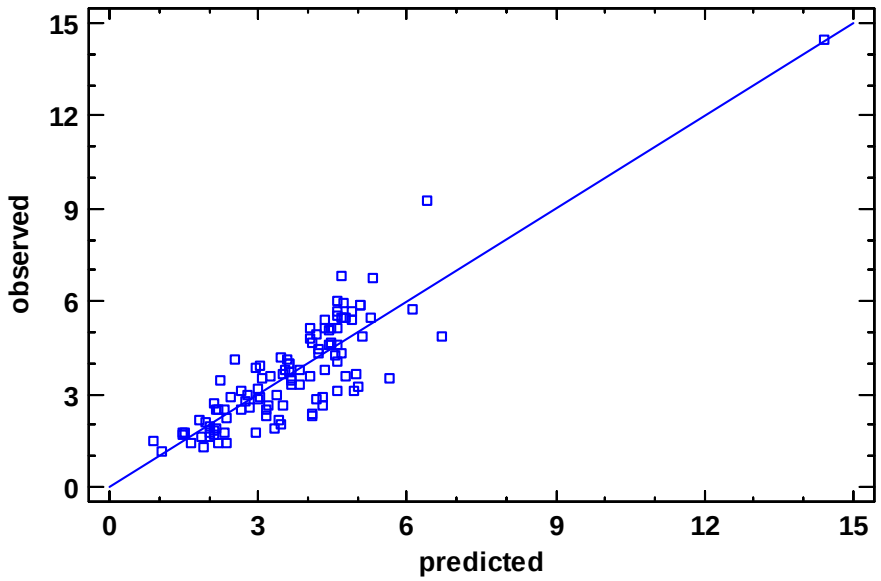
Parameter	*Estimation*	*Error Standard*	*Statistic T*	*P-Value*
CONSTANT	5.98904	0.408437	14.6633	0.0000
Mean duration of the session	0.002578	0.000719	3.58309	0.0005
Bounce rate	-5.85134	0.616936	-9.48451	0.0000
grandparents	8.289	0.936965	8.84665	0.0000

Variance analysis

Source	*Sum of squares*	*G.l.*	*Mean square*	*F-reason*	*P-value*
Model	274.553	3	91.5176	113.40	0.0000
Residual	85.542	106	0.807		
Total (Corr.)	360.095	109			

R-squared = 76.2446 percent
R-squared (adjusted for g.l.) = 75.5723 percent
Standard error of the est. = 0.898332
Mean absolute error = 0.679138
Durbin-Watson statistic = 1.99746 (P=0.4947)
Autocorrelation of lagged residuals 1 = -0.000509827

Graph 12. Regression Pages/session. Observed vs. predicted



Likewise, an estimation is made of the regression that explains the duration of the visit in terms of the number of pages per session, the return rate and the bounce rate. Table 8 and Graph 13 show the results, and it can be seen that all the coefficients are significant, the adjusted R^2 is 82.08%, and that there is no serial correlation of the residuals. In this case, the only influential point is the word “museo de la ciencia de valladolid hoy guían mis abuelos”, commented on previously.

Table 8. Regression Mean duration of the session

Parameter	*Estimation*	*Error Standard*	*Statistic T*	*P-Value*
Pages/session	43.4597	4.21315	10.3153	0.0000
Bounce rate	-123.367	37.2315	-3.3135	0.0013
Return rate	173.568	34.6414	5.01041	0.0000

Variance analysis

Source	*Sum of squares*	*G.l.*	*Mean squared*	*F-reason*	*P-Value*
Model	5.50566E6	3	1.83522E6	167.09	0.0000
Residual	1.17525E6	107	10983.7		
Total	6.68091E6	110			

R-squared = 82.4088 percent
R-squared (adjusted for g.l.) = 82.08 percent
Standard error of the est. = 104.803
Mean absolute error = 66.0744
Durbin-Watson Statistic = 2.04872
Autocorrelation of lagged residuals 1 = -0.026437

Graph 13. Regression Mean duration of the session. Observed vs. predicted

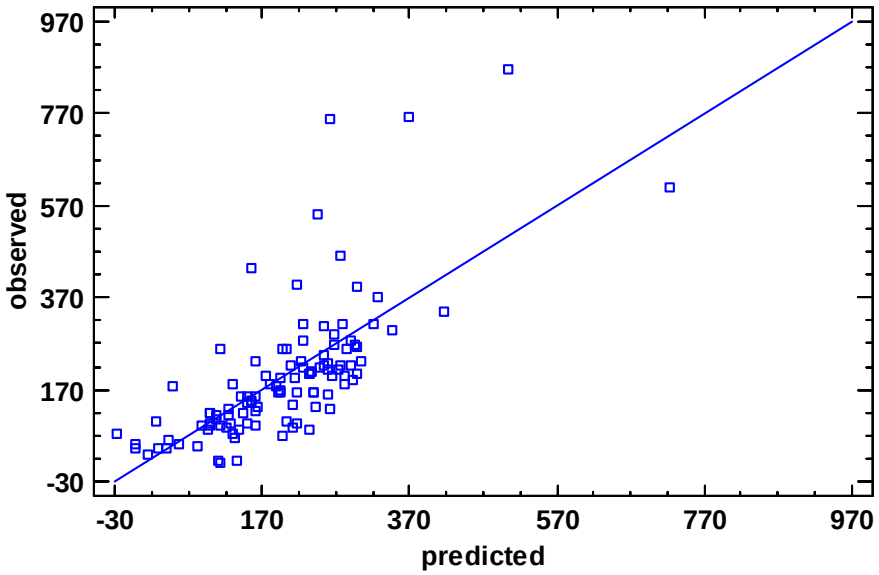


Table 9. Top 5 Keywords ordered by: page/session, bounce, mean duration of the session and return

Ordered by page/session	Sessions	% bounce	Pages/session	Mean duration of the session	% return
museocienciavalladolid.es Wikipedia	21	0.19	17.62	2065.00	1
site:www.museocienciavalladolid.es/opencms/mcva/queofrecemos/	11	0.09	16.73	2096.91	1
museo de la ciencia de valladolid hoy guían mis abuelos (Valladolid Science Museum. Today my grandparents are taking me)	87	0.24	14.44	609.48	1
museo ciencia valladolid tarifas (Valladolid Science Museum admission prices)	10	0.30	10.60	386.10	1
museo ciencia valladolid taller de pan (Valladolid Science Museum bread workshop)	12	0.17	9.42	411.17	1
Ordered by bounce					
casa mapa Valladolid (house map Valladolid)	10	0.90	1.80	26.30	0.3
concursos de inventos 2012 (invention contest 2012)	10	0.90	1.10	2.90	0
museo de la tecnologiavalladolid precio (Valladolid Technology Museum admission price)	29	0.90	1.14	120.07	1
actividades museo de la ciencia (Science Museums activities)	25	0.88	1.48	10.12	1
horarios museo ciencia Valladolid (Valladolid Science Museum opening hours)	15	0.87	1.53	35.00	0.47
Ordered by mean duration of the session					
site:www.museocienciavalladolid.es/opencms/mcva/queofrecemos/	11	0.09	16.73	2096.91	1
museocienciavalladolid.es wikipedia	21	0.19	17.62	2065.00	1
site:http://www.museocienciavalladolid.es	11	0.27	4.27	923.36	1
site:www.museocienciavalladolid.es	83	0.31	9.25	864.99	0.93
conferencias hablando de química y museo ciencia Valladolid (lectures on chemistry and Valladolid Science Museum)	10	0.20	4.50	830.40	1
Ordered by return					
canal youtube museo ciencia	223	0.43	2.91	306.51	1
linkdomain:www.museocienciavalladolid.es	192	0.48	3.80	458.83	1
grupo museo de la ciencia (Science Museum group)	149	0.42	4.08	394.25	1
el juez de la luna museo ciencia Valladolid (The judge of the moon Valladolid Science Museum)	140	0.21	4.86	764.72	1
casa del río pisuerga (House on the River Pisuerga)	123	0.13	5.76	338.92	1

6. Conclusions.

Today, it is essential for museums to have reliable data on their online activity, since this provides a useful, fast and far-reaching form of communication that can also be used as a marketing tool. Gaining an insight into which kinds of message work best, when there is most traffic, and in which situations it improves the quality of the visits, in addition to which devices, navigators, operating systems or keywords are most often being used for access, are data that help to enhance communication efficiency and to achieve more productive management.

Short-term analyses are critical in the day-to-day running vis-à-vis adapting and communicating scheduled activities better, with the subsequent optimisation of resources, whilst long-term studies can provide for a greater understanding of how online visitors communicate, whether the museum is where it should be or whether its position can be improved through some paid campaign, evaluating the usefulness of the content and the activities offered, etc.

In the specific case of the Valladolid Science Museum, we have seen that the three platforms studied improve the scope and help reach a wider audience during the period examined albeit with slight differences. Facebook is the most visited form of online communication followed by Twitter and the webpage in absolute terms of reach, although the interaction with users has decreased in the case of Facebook and has risen in the case of Twitter, particularly since 2015. The metrics of the depth of the visit to the webpage have also declined. The bounce rate has remained stable and the likelihood of returning to the page has increased. This might indicate that webpage users find the information they are looking for easily and use it several times, as a result of which they are perhaps familiar with it and thus require less time and pages per session to get to the content they are interested in.

Analysing communication in Facebook proved more difficult due to the sheer volume of metrics available. The factorial analysis conducted clearly defines the three key factors for interpreting the results: interaction, reach and visibility of content as well as follower commitment. In the case of the Science Museum, it can be seen how, although the reach has evolved favourably over the period studied, greater user interaction in this social network is desirable.

On the webpage, the regressions carried out using the data from the keyword searches recorded with Google Analytics confirm the link between the number of pages per session, the mean duration of the visit as well as the bounce and return rates. In this analysis, “grandparents” is a word which displays unusual behaviour that did not generate many onsite

visits. However, there are two fairly influential keywords that generate long visits: "http://www.museocienciavalladolid.es/opencms/mcva/" and "site:www.museocienciavalladolid.es".

Finally, the dates on which there was most activity and interaction were related to key events in the museum's schedule, evidencing the fact that the area of communication has proven enormously effective, and has achieved good dissemination and publicity, taking into consideration its limited resources in terms of staffing and finance.

In sum, social networks are this museum's main vehicle of communication and interaction, whilst the webpage has proved to be more informative. The statistical tools used in this work are replicable, easy to use and provide valuable information for museum managers vis-à-vis enabling them to determine whether the pre-established goals are being achieved. We feel that evaluating webpage and social network performance demands some reflection and systematic work, but that it does prove to be a profitable investment bearing in mind how it can enhance communication and improve the running of the museum.

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